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박사학위 청구논문

A phylogenomic study of Magnoliaceae and its evolutionary implications

2020

성신여자대학교 대학원

생물학과

박 수 현

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김 상 태 교수 지도

이 논문을 박사학위논문으로 제출함

2020년 4월

성신여자대학교 대학원

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ABSTRACT

Reconstruction of the phylogeny of a taxonomic group provided a deep understanding of its evolution and diversification history. Phylogenetic studies in Magnoliaceae have been mainly done using a few chloroplast or nuclear DNA regions. The recent molecular phylogenetic study in Magnoliaceae analyzed ten chloroplast DNA regions from 48 taxa representing all subgroups of Magnoliaceae and identified major eleven clades within Magnolioideae. However, relationships among them were unclear with low supporting values. The Hyb-Seq technique, which is a method combining hybridization-based target enrichment and genome skimming, can generate data for hundreds of single-copy (or low-copy) nuclear genes and organellar genomes from hundreds of individuals, even if from non-model organisms. In this study, chloroplast genomes and 400 nuclear genes for 124 taxa (125 samples) that cover all major subgroups in Magnoliaceae were sequenced and assembled based on the Hyb-Seq to clarify phylogenetic relationships and to understand the evolutionary history of Magnoliaceae. The chloroplast genome of Magnoliaceae has a typical structure consisted of a pair of IRs separated by LSC and SSC in length ranging from 159,269 bp to 160,186 bp, containing 79 protein-coding genes, 30 tRNA genes, and four rRNA genes. The comparative and phylogenetic analyses were carried out on the aligned matrix of 136,930 bp in length except for an IR, and the dataset included 8,962 variable sites (6.54%) and 5,697 parsimonious

informative sites (4.16%). The genome structure, gene organization, and IR border structure are well conserved within the family. The chloroplast phylogenetic tree confirms the eleven major clades in the subfamily Mangolioideae identified from the previous studies and provides their relationships with high supporting values. At the base of the tree (hereafter, capital-lettered words indicate clade names), TALAUMA and GWILLIMIA are placed. MACROPHYLLA and FRASERI are the second basal group. After these four groups, two groups are recognized consisting of one including MICHELIA, YULANIA, GYNOPODIUM, and KMERIA and the other containing MANGLIETIA, RYTIDOSPERMUM, and THEORHODON. The regions containing the best phylogenetic information (five intergenic spacers: *atpH-atpI*, *petA-psbJ*, *ndhF-rpl32*, *rpl32-trnL*, and *rps15-ycf1*; four protein coding genes: *matK*, *ndhF*, *psaC*, and *ycf1*) were suggested for the future phylogenetic analysis of additional samples based on the sequence analyses of completed chloroplast whole genomes. In nuclear genome analyses, specific probes for capturing 504 single-copy nuclear genes were designed, and assembly results showed that the probes worked well by recovering an average of 87% for the total target transcripts (443,988 bp) used for probe design per sample across Magnoliaceae. Phylogenetic analyses were performed with 400 loci using two different approaches: the concatenation approach and the coalescent approach. The concatenated matrix is 765,376 bp in alignmened length and includes 321,537 variable sites (42.01%) and 186,094 parsimony-informative sites (24.31%). The nuclear tree is slightly different from the chloroplast tree. It shows 13 major

clades in Magnolioideae and some conflicts are identified in topologies between trees inferred under the two different approaches. However, most of the clades in the coalescent ASTRAL tree conflicting with the concatenated ML tree have low LPP values and show considerable discordance among individual gene trees. The source of the gene tree discordance at those nodes was detected mainly as low-frequency alternative bipartitions. Although the result of the coalescent analysis reflects different evolutionary histories for different loci, the phylogenetic noise is maximized due to insufficient phylogenetic signals in each locus. The concatenated ML tree shows two primary clades in the subfamily Magnolioideae. One contains MANGLIETIA, RYTIDOSPERMUM, OYAMA, FRASERI, and SPLENDENTES (clade A, BS= 98), and the other contains MICHELIA, YULANIA, KMERIA, GYNOPODIUM, THEORHODON, MACROPHYLLA, GWILLIMIA, and TALAUMA (clade B, BS= 88). In clade A, the SPLENDENTES is placed at the base of this tree and FRASERI, OYAMA, RYTIDOSPERMUM, and MANGLIETIA are followed. The clade B consists of clade C and clade D. The clade C (BS = 96) contains GWILLIMIA and TALAUMA, and the clade D (BS= 99) contains MICHELIA, YULANIA, KMERIA, GYNOPODIUM THEORHODON, and MACROPHYLLA. In clade D, THEORHODON and MACROPHYLLA forms an independent clade (clade E, BS= 100), which is sister to a clade consisting of MICHELIA, YULANIA, KMERIA, and GYNOPODIUM (clade F, BS= 100). In clade F, GYNOPODIUM is branched first, and KMERIA, YULANIA, and MICHELIA are followed. Counting the number of quartets shared with the concatenated ML tree in each gene tree provides the phylogenetically best loci in 400 nuclear genes

included in this study. The subset of the best 20 loci recovers 94.1% of quartets in the concatenated ML tree, suggesting the proper DNA regions for the future phylogenetic studies of additional samples in Magnoliaceae based on nuclear genome regions. Conflict topologies between highly supported two trees that from chloroplast genome and nuclear genome suggests the ancient hybridizations of 1) MICHELIA+YULANIA and 2) RYTIDOSPERMUM. It is suggested that they are originated from ancestors between GYNOPODIUM (female) and KMERIA (male) and between ancestors of OYAMA (female) and MANGLIETIA (male), respectively. Results of molecular dating and biogeographic analyses showed that 1) Magnolioideae is originated in a large ancestral region including Asia and the Americas in the late Eocene (37.84 mya) and 2) the intercontinental disjunctions of Magnoliaceae from the ancestral region into Asia or the Americas is occurred during the late Eocene and early Oligocene (32-35 mya), which is correlated with the global cooling event in the late Eocene, following global warming in the early Eocene. The independent temperate disjunctions in *Liriodendron* (between *L. tulipifera* and *L. chinense*; 17.54 mya), RYTIDOSPERMUM (between *M. tripetala* and *M. obovata*/*M. officinalis*; 13.00 mya), and YULANIA (between *M. acuminata* and the other taxa in the clade; 25 mya; one of calibration points) may have occurred during the global climate fluctuating period in early Oligocene and mid-Miocene. Since the climate during the Mid-Miocene Climatic Optimum (MMCO, 15 mya) was as warm as in the late Eocene (34 mya), the hypothesis is supported. The current classification system of Magnoliaceae recognized three subgenera (*Magnolia*, *Yulania*, and

Gynopodium) and 12 sections within Magnolioideae by reflecting a piece of findings of previous molecular phylogenetic studies of Magnoliaceae. The massive molecular data and highly supported phylogenetic trees from both bi-parental lineage (nuclear) and uni-parental lineage (chloroplast) provided in this study will be a direct evidence for supporting future new classification system and will be resources to understanding the evolution and diversification history in Magnoliaceae.

CONTENTS

Abstract ····· i

Contents ····· vi

List of figures ····· x

List of tables ····· xii

Chapter 1. Introduction

1.1 Magnoliaceae ····· 1

1.1.1 Family Magnoliaceae ····· 1

1.1.2 Classification history of the Magnoliaceae ····· 4

1.1.3 Previous molecular phylogenetic studies on the Magnoliaceae ····· 9

1.1.4 Report of misidentified Magnoliaceae chloroplast genomes deposited in the GenBank ····· 10

1.2 Hyb-Seq ····· 18

1.2.1 Hybridization-based target enrichment ····· 18

1.2.2 Application of Hyb-Seq ····· 20

1.2.3 Probe design ····· 21

1.2.4 Experimental workflow in Hyb-Seq ····· 24

1.2.5 Data analysis workflow in Hyb-Seq ····· 25

1.2.6 Assemblers for Hyb-Seq data ····· 26

1.2.7 Hyb-Seq as an ultimate phylogenomic tool ····· 28

Chapter 2. Comparative and phylogenetic analyses of *Manglietia* (Magnoliaceae) based on complete chloroplast genomes

2.1 Introduction ····· 35

2.2 Materials and Methods ····· 37

2.3 Results ····39
2.3.1 Structure of chloroplast genomes in *Manglietia* ····39
2.3.2 Variation of IR borders ····42
2.3.3 Small repeated sequences ····46
2.3.4 Sequence divergence and hot spots ····48
2.3.5 Phylogenetic analyses in *Manglietia* ····52
2.4 Discussion ····53
2.4.1 Structure of chloroplast genomes in *Manglietia* ····53
2.4.2 Diversity of repeated sequences and SSRs ····54
2.4.3 Genome variation and hotspots ····55
2.4.4 Phylogenetic relationship within *Manglietia* ····56

Chapter 3. Comparative and phylogenetic analyses of chloroplast genomes in Magnoliaceae
3.1 Introduction ····61
3.2 Materials and Methods ····62
3.2.1 Taxon sampling, DNA extraction, and sequencing ····62
3.2.2 Genome assembly and annotation ····64
3.2.3 Repeat structure and sequence divergence analyses ····66
3.2.4 Phylogenetic analyses ····67
3.3 Results ····68
3.3.1 Structure of chloroplast genomes in Magnoliaceae ····68
3.3.2 Variation of IR borders ····71
3.3.3 Repeat sequences ····73
3.3.4 Sequence divergence and hot spots ····77
3.3.5 Phylogenetic analyses in Magnoliaceae ····78
3.4 Discussion ····84

3.4.1 Structure of chloroplast genomes in Magnoliaceae ·····85
3.4.2 Diversity of repeated sequences and SSRs ·····86
3.4.3 Genome variation and hotspots ·····87
3.4.4 Phylogeny of Magnoliaceae based on chloroplast genomes ·····88

Chapter 4. Phylogeny of Magnoliaceae based on 400 nuclear DNA regions using target-enrichment NGS
4.1 Introduction ·····91
4.2 Materials and Methods ·····91
4.2.1 Probe design ·····91
4.2.2 Taxon sampling, DNA extraction and sequencing ·····94
4.2.3 Assembly and alignment ·····95
4.2.4 Phylogenetic analyses ·····96
4.2.5 Molecular dating ·····98
4.2.6 Biogeographical analysis ·····100
4.3 Results ·····101
4.3.1 Sequencing, assembly, and alignment ·····101
4.3.2 Phylogenetic analyses results ·····104
4.3.3 Comparison between phylogenies based on nuclear and chloroplast dataset ·····113
4.3.4 Molecular divergence time estimation ·····118
4.3.5 Biogeography ·····119
4.4 Discussion ·····122
4.4.1 Alignment of Hyb-Seq data ·····123
4.4.2 Comparison of phylogeny-reconstruction methods ·····124
4.4.3 Ancient hybridization history in the evolution of Magnoliaceae ·····125
4.4.4 Molecular date and biogeography of Magnoliaceae ·····129
4.4.5 Further studies ·····132

Literature cited ·····134
Abstract in Korean ·····146
Appendix for Chapter 2 ·····151
Appendix for Chapter 3 ·····159
Appendix for Chapter 4 ·····199

LIST OF FIGURES

Fig. 1. Position of Magnoliaceae in the phylogenetic tree of angiosperms ·····2

Fig. 2. The number of species in Magnoliaceae and their percentage in each plant geographic area ·····4

Fig. 3. The maximum likelihood tree using 44 sequences containing sequences of 43 Magnoliaceae chloroplast genomes and a sequence for six chloroplast regions of *Michelia alba* (*trnK* intron including *matK*, *trnH–psbA*, *atpB–rbcL*, and *ndhF*) ·····16

Fig. 4. Experimental overview of Hyb-Seq ·····32

Fig. 5. Workflow of the Hyb-Seq data processing ·····34

Fig. 6. A typical gene map from chloroplast genomes in *Manglietia* ·····40

Fig. 7. Comparison of inverted repeat (IR) borders in chloroplast genomes of the 40 *Manglietia* and seven outgroup taxa ·····44

Fig. 8. The type and frequency of repeated sequences and simple sequence repeats (SSRs) in chloroplast genomes in *Manglietia* ·····47

Fig. 9. MAUVE alignment of 40 *Manglietia* chloroplast genomes ·····50

Fig. 10. Comparative analysis of the nucleotide diversity (Pi) values within *Manglietia* and in *Manglietia* and outgroups ·····51

Fig. 11. A result of phylogenetic analyses in *Manglietia* based on chloroplast genomes ·····59

Fig. 12. A typical gene map from chloroplast genomes in Magnoliaceae ·····70

Fig. 13. A result of phylogenetic analyses in Mangliaceae based on chloroplast

genomes ·····82

Fig. 14. A heat map showing the percentage of the recovered region in 504 genes in each taxon analyzed using HybPiper ·····103

Fig. 15. Maximum likelihood tree of Magnoliaceae reconstructed by IQ-TREE based on the concatenated matrix from 400 loci obtained by HybPiper ·····105

Fig. 16. Plotting of the percentage of shared quartets between each gene tree with the concatenated ML tree in decreasing order ·····112

Fig. 17. A tanglegram of phylogenetic trees based on the concatenated nuclear data and chloroplast genome data ·····115

Fig. 18. Summarized comparison between nuclear phylogeny and chloroplast phylogeny ·····117

Fig. 19. Reconstruction of the ancestral geographic region in each clade using BioGeoBEARS ·····121

Fig. 20. Three interpretations for the evolutionary history for addressing ancient hybridization based on observations of reconstructed nuclear and chloroplast trees with the analyses of extent taxa ·····128

LIST OF TABLES

Table 1. Classification history of Magnoliaceae ·····7

Table 2. Identification of 43 cp genomes reported from Magnoliaceae and their accession numbers ·····14

Table 3 Summary of Hyb-Seq studies on diverse plant taxa at various ranks ···30

Table 4. Voucher information of this study and their sequencing information ····38

Table 5. Summary of features of *Manglietia* chloroplast genomes ·····41

Table 6. List of genes contained in the *Manglietia* chloroplast genomes ·····43

Table 7. List of genes in chloroplast genomes from Magnoliaceae ·····71

Table 8. Statistics of sequencing and assembly results analyzed using HybPiper ····· 102

Table 9 Statistical summary of a concatenated matrix which is based on 400 nuclear loci used in phylogenetic analyses ·····104

Chapter 1. Introduction

1.1 Magnoliaceae

1.1.1 Family Magnoliaceae

As a candidate for basal angiosperm, Magnoliaceae Juss. is a family which has received a lot of attention from botanists who have been curious about the origin of flowering plants. Magnoliaceae has an evolutionary history of over 100 million years, and it is supported by the fossil record of *Archaeanthus* Dilcher & Crane (1984) from the Dakota Formation of Kansas, USA. The *Archaeanthus* has been suggested to be a direct ancestor of Magnoliaceae based on shared morphological features of extant Magnoliaceae (Dilcher and Crane, 1984; Doyle and Endress, 2010; Massoni et al., 2015). Although *Amborella* has been recognized as a basal-most angiosperm in the recent molecular phylogenomic studies, Magnoliaceae is placed in Magnoliales of Magnoliids clade, which is the second-leveled basal group after the ANA grade in the tree (Moore et al., 2007; Zhang et al., 2012) (Fig. 1). Magnoliaceae still maintains an important phylogenetic position in the history of angiosperm evolution (Kim and Suh, 2013). In addition, some species of Magnoliaceae have economic value by producing timber, providing materials for medicines and perfumes, and being used as ornamental trees (Liu, 2004). More than 1,000 accessions of cultivated magnolias were registered in the Magnolia Society, International (https://www.magnoliasociety.org/CultivarChecklist). Therefore, Magnoliaceae

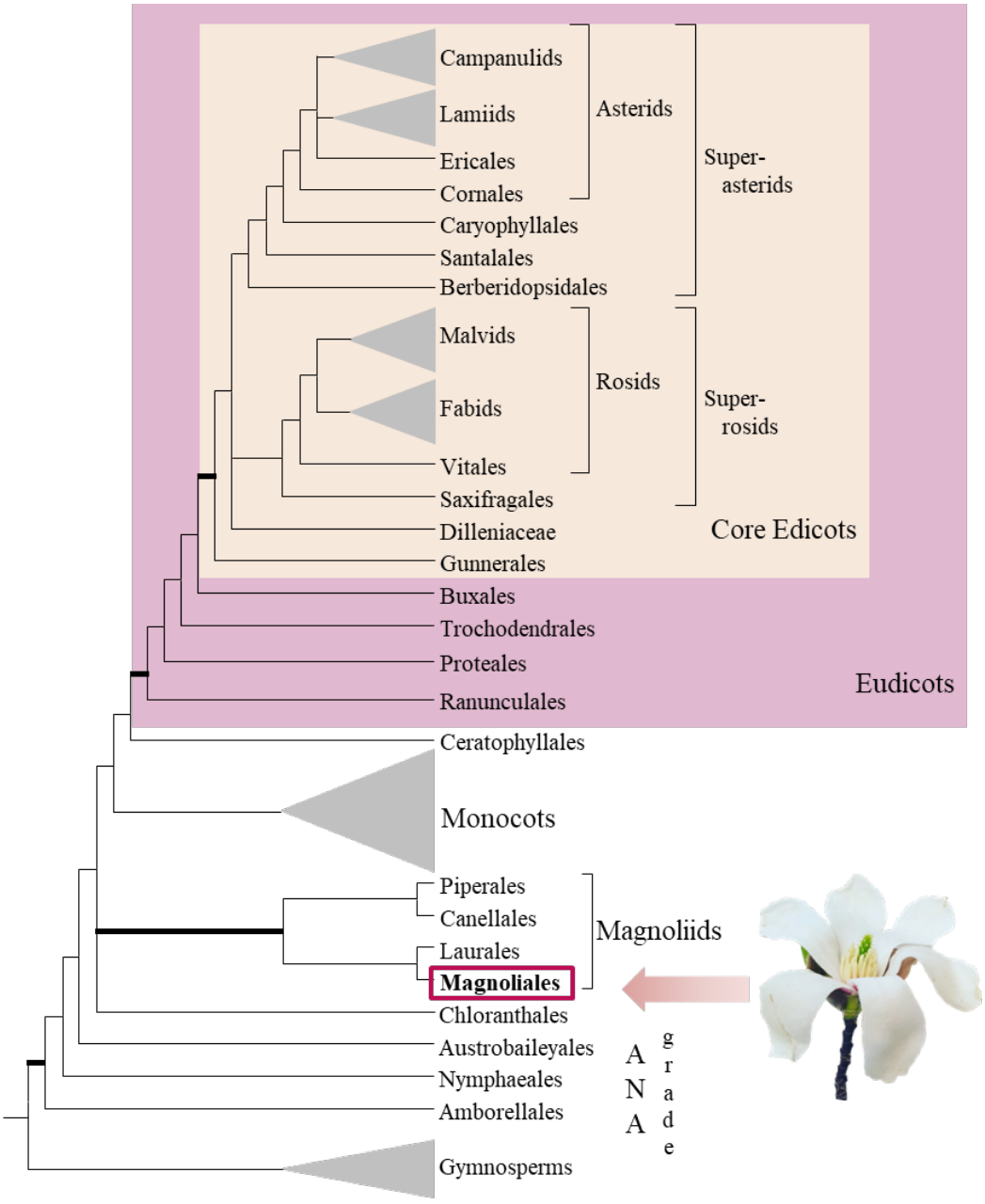


Fig. 1. Position of Magnoliaceae in the phylogenetic tree of angiosperms.

received keen attention not only from botanists but also from the people who use magnolia trees practically.

Magnoliaceae has characterized by a stipular scar around the node, undifferentiated perianth (except some species of section *Yulania*), and numerous stamens and carpels arranged spirally on an elongated receptacle (Nooteboom, 1985; Frodin and Govaerts, 1996; Kim et al., 2001). Fruit type of Magnoliaceae is an aggregate of follicles (Magnolioideae) or samaras (Liriodendroideae) (Judd et al., 2016). Recently updated the Checklist of Magnoliaceae includes 322 species (320 species in Magnolioideae and two species in Liriodendroideae) distributing from eastern Canada to Brazil, the Caribbean, from India to Kuril Island, and New Guinea (Govaerts et al., 2020). The number of species of Magnoliaceae in each country based on the third level of the Taxonomic Database Working Group (TDWG) geographical codes in the World Checklist of Magnoliaceae shows that China (112 spp.) holds the largest number of species, followed by Vietnam (50 spp.), Colombia (37 spp.), and Mexico (34 spp.) (Fig. 2). However, the number of *Magnolia* species in Neotropical countries is continuously increasing based on recently updated monographic works such as Vázquez-García et al. (2012), Arroyo et al. (2013), Arroyo and Pérez (2013), Vázquez-García et al. (2017), and Vázquez-García et al. (2018).

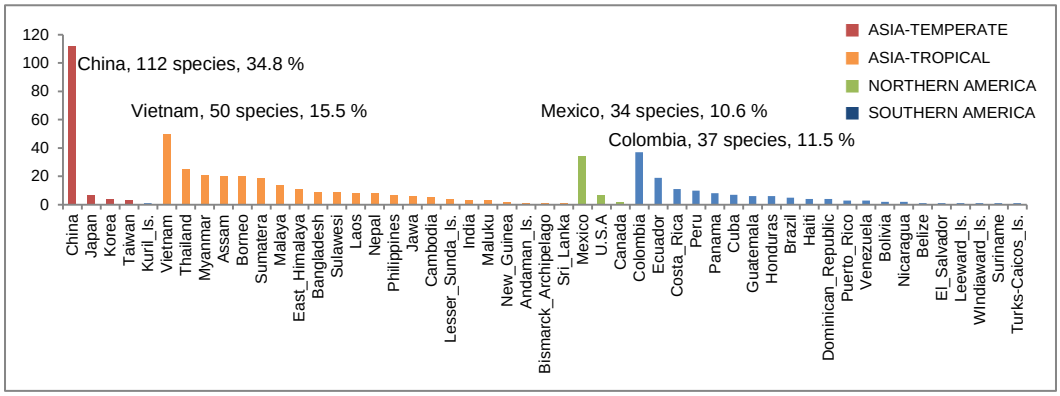


Fig. 2. The number of species in Magnoliaceae and their percentage in each plant geographic area. The x-axis indicates the third-level TDWG geographical codes (Brummitt, 2001) and the y-axis indicates the number of species. The top four geographic areas that matched with independent countries were highlighted with species numbers and their percentage to the reported total number of species in the Magnoliaceae.

1.1.2 Classification history of the Magnoliaceae

There is no disagreement in the classification history of Magnoliaceae for the recognition of two subfamilies, Liriodendroideae and Magnolioideae (Table 1). These two subfamilies are morphologically well distinguished by characters from flowers (extrorsely dehiscing anthers vs. introrsely or latrorsely dehiscing anthers), fruits (aggregate of samaras vs. aggregate of follicles), and even vegetative organs (lobed leaf margin vs. entire leaf margin). However, taxonomic treatment in Magnolioideae have long been discussed and changed at the level of tribe,

genus, and section (Dandy, 1927; Law, 1984; Nooteboom, 1985; Chen and Nooteboom, 1993; Law, 1996; Nooteboom, 2000; Figlar and Nooteboom, 2004) (Table 1). Especially, the delimitation of the genus *Magnolia* has been continuously changed, and eventually, the taxonomic boundary of *Magnolia* is extended to the entire subfamily in the recent classification system (Figlar and Nooteboom, 2004).

In addition to the delimitation of the genus *Magnolia*, the taxonomic position of genus *Dugandiodendron* Lozano-Contreras (1975) and section *Splendentes* Dandy ex A. Vázquez (1994) has been controversial in the classification system of Magnoliaceae (Table 1). Lozano-Contreras (1975) first recognized *Dugandiodendron* as an independent genus, based on differences in the position of the flower and the prefoliation of the vegetative buds. However, *Dugandiodendron* was included in the section *Talauma* in *Magnolia* in Nooteboom's system (Nooteboom, 1985) since he thought that those differences were hardly visible. Subsequently, the *Dugandiodendron* belonged to section *Theorhodon* as a subsection by Nooteboom (2000) and then was transferred to section *Talauma* as a subsection by Figlar and Nooteboom (2004). Section *Splendentes* that consisted of the Caribbean species was separated from section *Theorhodon* based on the following morphological character: stamens with a long curved setiform appendage, which becomes embedded in the gynoecium and holds the stamen when it detaches at the base during dehiscence of the anther (Vázquez-G, 1994). The section *Splendentes* was maintained a section of subgenus *Magnolia* in Nooteboom (2000) but transferred to section *Talauma* as a

subsection in Figlar and Nooteboom (2004). Evaluation of the taxonomic identity of *Dugandiodendron* and *Splendentes* is necessary based on their phylogenetic relationship.

Figlar and Nooteboom (2004) suggested that Magnolioideae contains one genus, *Magnolia*, which consists of three subgenera based on phylogenetic studies by Kim et al. (2001), and Azuma et al. (1999, 2000, 2001), and morphological considerations by Figlar (2000, 2003a, b) and Nooteboom (1985, 1998, 2000). However, the recent phylogenetic studies using three nuclear regions or ten chloroplast (cp) regions didn't support the three subgenera system (Nie et al., 2008; Kim and Suh, 2013) representing the need of an updated classification system. Therefore, this study follows the classification system of Nooteboom (1985), which was widely used one before the system of Figlar and Nooteboom (2004). Nooteboom (2000) pointed out that the confusion on the classification system in Magnolioideae was due to the parallel development of morphological characters considered important in Magnolioideae. Therefore, morphological character evolution in Magnoliaceae based on phylogenomic data including chloroplast whole-genome and massive nuclear single-copy genes is reconsidered..

Table 1. Classification history of Magnoliaceae. The order of taxa in each system is rearranged based on the recent classification system (Figlar and Nooteboom, 2004). Subgroups based on a type in each system were placed at the same horizontal line. Arrows indicate combined, divided, or translocated subgroups.

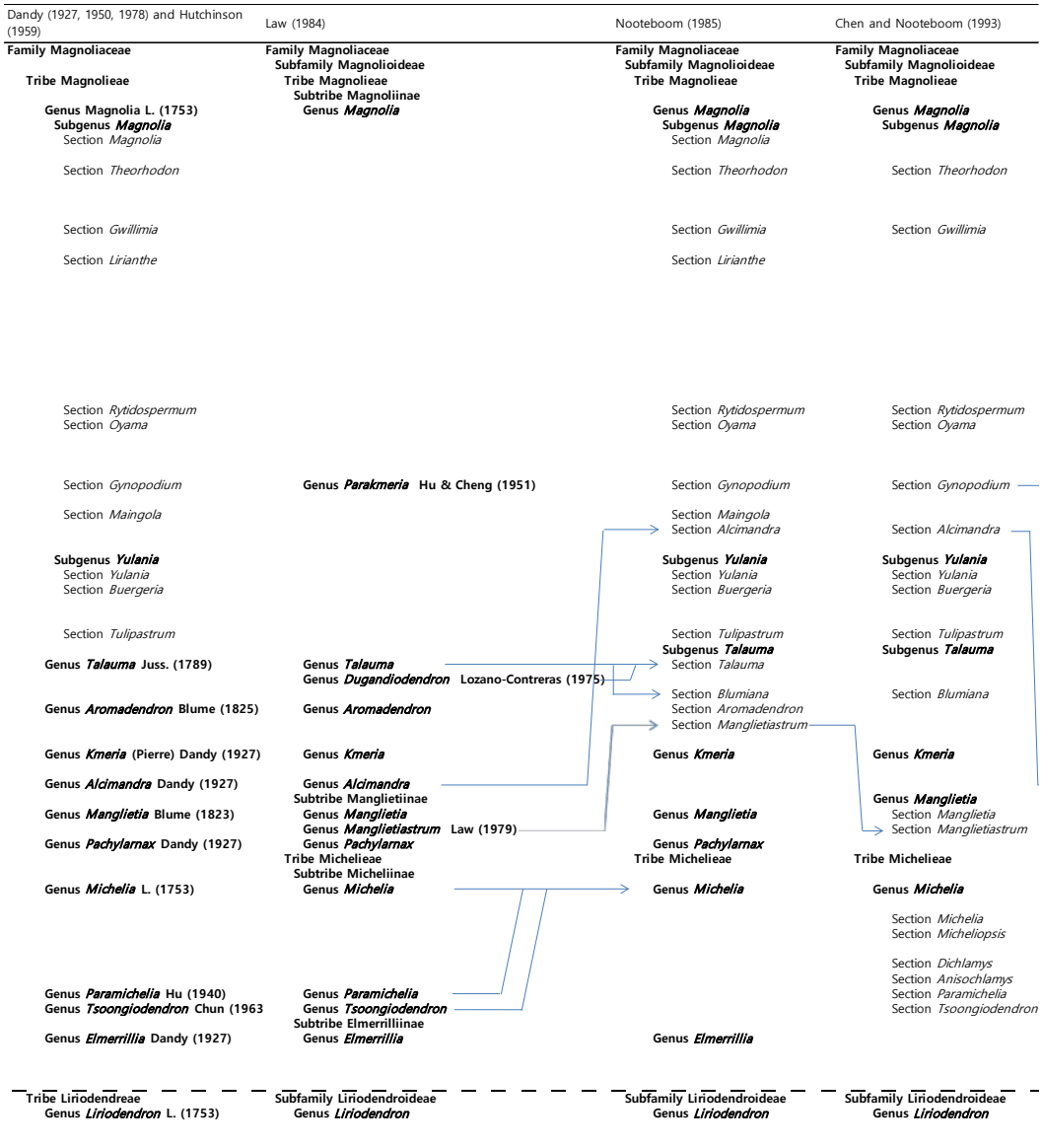
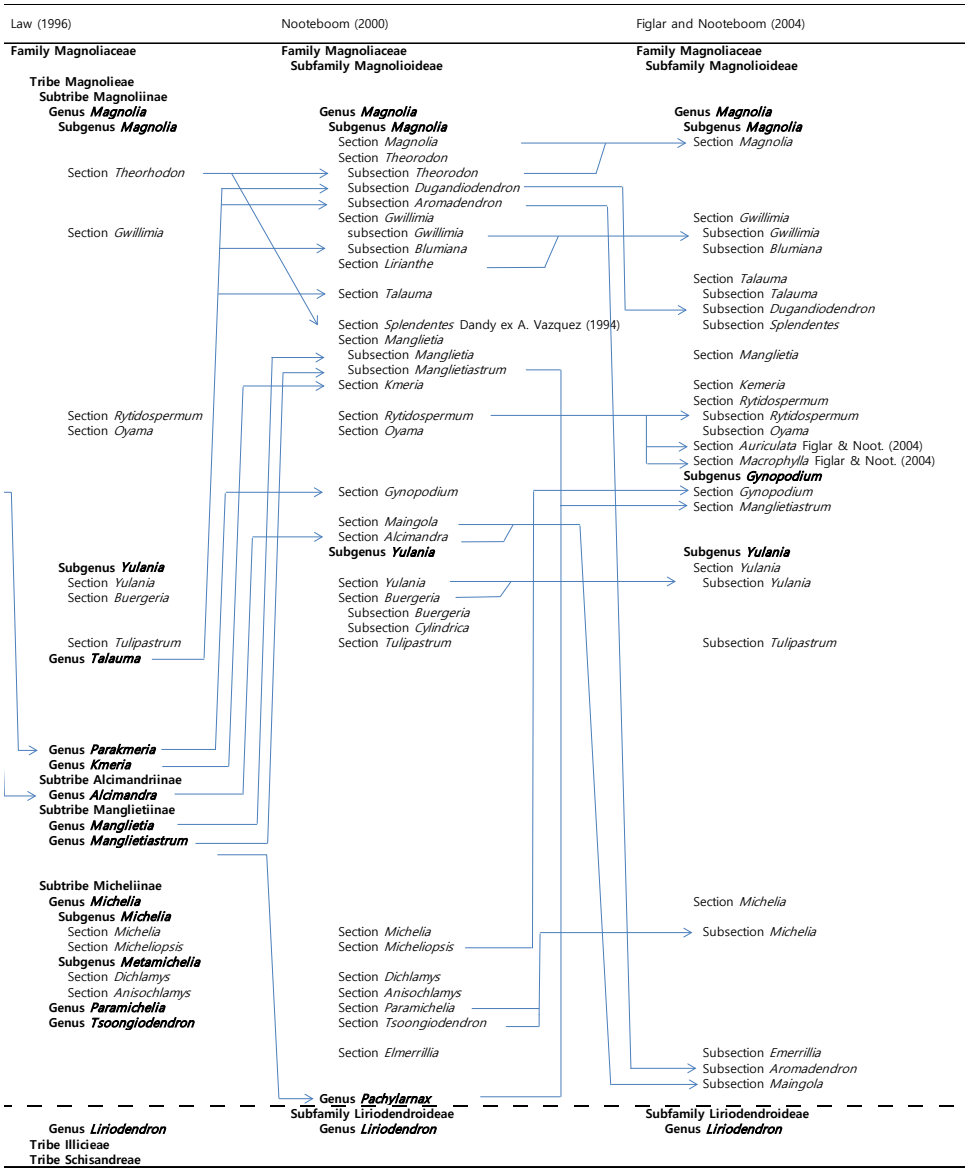


Table 1. (Continued)



1.1.3 Previous molecular phylogenetic studies on the Magnoliaceae

The previous molecular phylogenetic studies of Magnoliaceae mainly used a few chloroplast genome regions obtained by polymerase chain reaction (PCR) and Sanger sequencing (Azuma et al., 1999; 2001; Kim et al., 2001; Azuma et al., 2011; Kim and Suh, 2013). Azuma et al. (1999, 2001) analyzed five chloroplast regions (*trnK* 5' intron, *matK*, *trnK* 3' intron, *psbA-trnH*, and *aptB-rbcL* intergenic regions; total ca. 3.7 kbp) for 47 taxa except for *Pachylarnax* and section *Aromadendron* in the subgroups of the Nooteboom's (Nooteboom, 1985) of the classification system. Kim et al. (2001) analyzed *ndhF* for 99 taxa representing all genera and sections classified by Nooteboom (1985). Nie et al. (2008) analyzed three nuclear genes (*PHYA, LFY*, and *GAL1*) for 86 taxa except for *Dugandiodendron,* section *Splendentes*, and section *Maingola*. Azuma et al. (2011) analyzed six chloroplast regions (*trnK* 5' intron, *matK*, *trnK* 3' intron, *psbA-trnH*, *atpB-rbcL*, and *ndhF*; total ca. 5.8 kbp) for 85 taxa except for *Dugandiodendron*. Kim and Suh (2013) analyzed ten chloroplast DNA regions (*ndhF*, *rbcL*, *matK*, ORF350, *trnL* intron, *trnL-trnF*, *trnH-psbA*, *rbcL-atpB*, *trnK* 5' intron, and *trnK* 3' intron; total ca. 8.7 kbp) for 48 taxa, representing all sections and genera recognized by Nooteboom (1985). Kim and Suh (2013) confirmed the eleven major clades within Magnolioideae, but the relationships among them were unclear. Shen et al. (2018) analyzed chloroplast genomes of 26 taxa using data from the GenBank, which was insufficient to identify the relationships within Magnolioideae. Veltjen et al. (In press) focused on Caribbean Magnolias and analyzed five nuclear regions (*AGT1*, *GAI1*, *LEAFY*, *PHYA*, and *SQD1*; ca. 3.9

kbp) and six chloroplast regions (*ndhF*, *rbcL*, *trnK*, *atpB-rbcL*, *ndhF-rpl32*, and *psbA-trnH*; ca. 8.35 kbp) for 15 taxa representing section *Splendentes*, section *Talauma*, and section *Magnolia*. Therefore, the additional intensive phylogenomic study for covering the entire family is required for resolving phylogenetic relationships among major clades using taxa covering all subgroups of Magnoliaceae.

1.1.4 Report of misidentified Magnoliaceae chloroplast genomes deposited in the GenBank

Today, researchers have improved the accessibility and economics of next-generation sequencing (NGS), making it easier to determine the entire chloroplast genome than the Sanger sequencing era. It is because of the enablement of relatively deep sequencing of the chloroplast genome from shallow whole-genome sequencing caused by high-copy of the chloroplast genome (Straub et al., 2012). Therefore, it has become common to determine the entire chloroplast genome of a plant in an individual laboratory. Many of short publications for a report of the chloroplast genome in Magnoliaceae (e.g., Mitochondrial DNA part B) routinely show a phylogenetic tree using a selected member of the published genome in the family for showing the placement of the new genome. By 2018 Dec., 43 chloroplast genomes of Magnoliaceae (32 taxa; 30 species including two *Liriodendron* species) have deposited in the GenBank (Table 2).

However, there are questionable magnolia cp genomes reported in the GenBank, and these make a potential mistake to interpret the phylogenetic position of a target cp genome. Three cases involving two types of errors have been found in ten recent papers associated with genome announcements and the comparative genome studies. One is a misspelling of the taxon name for the GenBank accession including RefSeq ID, and the other is what appears to be a misidentification of the taxon name (or sequences) showing in each accession of the GenBank and RefSeq ID.

The former was related to *Magnolia liliiflora* Desr. with the accession number of JX280397 (RefSeq: NC_023238). The sequence of JX280397 was originally reported in the previous study as the sequence from *Magnolia liliiflora*, a member of YULANIA clade in Magnoliaceae (Kim and Suh, 2013). However, the scientific name of the taxon was incorrectly reported during the sequence submission as *Magnolia liliifera* Baill., which is a member of GWILLIMIA clade (Kim and Suh, 2013). Although the name was corrected by the update of authors in October 2017, this sequence was confirmed by the NCBI immediately and received the RefSeq ID (NC_023238) before the name correction. As a result, the taxon name of NC_023238 was *Magnolia liliifera* and this name was not matched with that of JX280397 for a while. Currently, the taxon name of RefSeq NC_023238 was revised to *Magnolia liliiflora*. However, this has made many errors in the papers involving this genome. In seven papers, the phylogenetic analysis has performed using JX280397 with the name of *Magnolia liliifera* (Hinsinger and Strijk, 2017; Cui et al., 2018; Gao et al, 2018; Shen et al., 2018; Wang et al., 2018; Yao et al.,

2018; Zheng and Xu, 2018).

The latter type involves potential taxonomic misidentification of *Manglietia insignis* Blume (KY921716; RefSeq ID: NC_035657) and *Michelia alba* DC. (MF990568; RefSeq ID: NC_037005). According to previous molecular phylogenetic studies covering samples from entire Magnoliaceae, *Manglietia insignis* was included in the MANGLIETIA clade, which is a completely different lineage from the MICHELIA clade. (Nie et al., 2008; Azuma et al., 2011; Kim and Suh, 2013). However, this genome was nested in the MICHELIA clade instead of the MANGLIETIA clade in the phylogenetic tree of many other short studies for cp genome report (Cui et al., 2018; Shen et al., 2018; Song et al., 2018; Xu et al., 2018; Yao et al., 2018; Zheng and Xu, 2018).

As a similar case to *Manglietia insignis*, *Michelia alba* was included in the MICHELIA clade, and clades of MICHELIA and YULANIA were clearly resolved with high supporting values in the recent phylogenetic studies with intensive sample collections (Kim et al., 2001; Nie et al., 2008; Azuma et al., 2011; Kim and Suh, 2013). However, a genome sequence from *Michelia alba* (MF990568) was contained in the YULANIA clade rather than the MICHELIA clade in the studies of short report for a cp genome (Shen et al., 2018; Wang et al., 2018; Yao et al., 2018; Song et al., 2019a). Furthermore, this genome formed a clade with a cp genome from *Magnolia liliiflora* with a bootstrap value 100. Therefore, to confirm these errant cases, phylogenetic analysis was performed in this study using 43 Magnoliaceae cp genomes deposited on the GenBank and a sequence including

six chloroplast regions of the identified *Michelia alba* (Azuma et al, 2011; *trnK* 5' intron, *matK*, *trnK* 3' intron, *psbA-trnH*, *atpB-rbcL*, and *ndhF*; total ca. 5.8 kbp) (Table 2). In this analysis, the total 44 sequences were aligned by MAFFT (Katoh and Standley, 2013), an alignment module in Geneious 11.1.3 (Kearse et al., 2012), with "auto" option and then, revised manually. The maximum likelihood analysis was performed with GTRGAMMAI model and bootstrap 500 replications using raxmlGUI v. 1.5 (Silvestro and Michalak, 2012).

The maximum likelihood tree shows that *Manglietia insignis* of KY921716 (RefSeq ID NC_035657) forms a clade with *Magnolia cathcartii* (JX280392) in MICHELIA clade with a high bootstrap value (96%), not with *Manglietia insignis* (MF990566) (Fig. 3). *Michelia alba* of MF990568 (RefSeq ID NC_037005) forms a clade with *Magnolia liliiflora* (JN867576 and JX280397) in YULANIA clade, not with *Michelia alba* (AB23297, AB623271, AB623323, AB23349, and KY204085) (Fig. 3). The result indicates that taxon names for the accession numbers of both KY921716 (RefSeq ID NC_035657) and MF990568 (RefSeq ID NC_037005) are incorrect (Fig. 3). This report will help to reduce the confusion in using the Magnoliaceae chloroplast genome database and to prevent the possibility of these errors being repeatedly. It also will be essential to improve the accuracy for the future studies on the chloroplast genomes in Magnoliaceae.

Table 2. Identification of 43 cp genomes reported from Magnoliaceae and their accession numbers

Taxon name registered on the GenBank	Taxon name following Nooteboom (1985)	Original GenBank accession number	RefSeq ID	Note	Size(bp)	Author (year)
Liriodendron chinense	*Liriodendron chinense*	KU170538	NC_030504		159,429	Li et al. (2016)
Liriodendron tulipifera	*Liriodendron tulipifera*	DQ899947	NC_008326		159,886	Cai et al. (2006)
Magnolia kwangsiensis	*Kmeria septentrionalis*	HM775382	NC_015892		159,667	Kuang et al. (2011)
Magnolia dealbata	*Magnolia dealbata*	JX280393	NC_023235		160,002	Song et al. (2019b)
Magnolia grandiflora	*Magnolia grandiflora*	JN867584	NC_020318		159,623	Li et al. (2013)
Magnolia kobus	*Magnolia kobus*	JX280396	NC_023237		159,443	Song et al. (2018)
Magnolia liliiflora	*Magnolia liliiflora*	JX280397	NC_023238	misspelled name corrected	158,177	Song et al. (2019b)
Magnolia pyramidata	*Magnolia pyramidata*	JX280395	NC_023236		160,025	Song et al. (2019b)
Magnolia sieboldii	*Magnolia sieboldii*	MG800828			160,274	Cui et al. (2018)
Magnolia sinica	*Magnolia sinica*	JX280400	NC_023241		160,044	Song et al. (2018)
Magnolia sinostellata	*Magnolia sinostellata*	MH105018	NC_039941		160,076	Yao et al. (2018)
Magnolia tripetala	*Magnolia tripetala*	KJ408574	NC_024027		160,037	Zhu et al. (2016)
Magnolia yunnanensis	*Magnolia yunnanensis*	KF753638	NC_024545		160,085	Yang et al. (2014)
Magnolia aromatica	*Manglietia aromatica*	MF990561	NC_037000		160,062	Wang et al. (2018)
Magnolia conifera	*Manglietia conifera*	MF990563	NC_037001		159,973	Wang et al. (2018)
Magnolia dandyi	*Manglietia dandyi*	MF990567	NC_037004		160,077	Wang et al. (2018)
Magnolia duclouxii	*Manglietia duclouxii*	MF990564	NC_037002		160,055	Wang et al. (2018)
Magnolia fordiana	*Manglietia fordiana*	MH394396		UNVERIFIED	160,113	Zeng et al. (2018)
Magnolia fordiana	*Manglietia fordiana*	MH394398		UNVERIFIED	160,113	Zeng et al. (2018)
Magnolia fordiana var. *calcarea*	*Manglietia fordiana* var. *calcarea*	MF990562			160,027	Wang et al. (2018)
Magnolia glaucifolia	*Manglietia glaucifolia*	MF990565	NC_037003		160,059	Wang et al. (2018)
Magnolia insignis	*Manglietia insignis*	KY921716	NC_035657	potentially misidentified sample	160,117	Zheng and Xu. (2018)
Magnolia insignis	*Manglietia insignis*	MF990566			160,051	Wang et al. (2018)
Magnolia alba	*Michelia alba*	MF990568	NC_037005	potentially misidentified sample	160,106	Wang et al. (2018)
Magnolia alba	*Michelia alba*	KY204085		UNVERIFIED	159,789	Hinsinger and Strijk (2017)
Magnolia alba	*Michelia alba*	*AB623297, *AB623271, *AB623323, *AB623349			5,800	Azuma et al. (2011)
Magnolia laevifolia	*Michelia laevifolia*	MF583748	NC_035956		160,120	Xu et al. (2018)
Magnolia odora	*Michelia odora*	JX280398	NC_023239		160,070	Song et al. (2019b)
Magnolia acuminata var. *acuminata*	*Magnolia acuminata* var. *acuminata*	JX280391			159,812	Unpublished
Magnolia biondii	*Magnolia biondii*	KY085894	NC_034687		160,002	Unpublished
Magnolia cathcartii	*Magnolia cathcartii*	JX280392	NC_023234		159,950	Unpublished
Magnolia denudata	*Magnolia denudata*	JX280394			160,082	Unpublished
Magnolia denudata	*Magnolia denudata*	JN867577			160,090	Unpublished
Magnolia denudata	*Magnolia denudata*	JN227740	NC_018357		160,053	Unpublished
Magnolia denudata	*Magnolia denudata*	KY085917			160,089	Unpublished
Magnolia grandiflora	*Magnolia grandiflora*	JN867587			159,671	Unpublished
Magnolia liliiflora	*Magnolia liliiflora*	JN867576		UNVERIFIED	160,033	Unpublished

Magnolia officinalis	*Magnolia officinalis*	JN867579	NC_020316	160,183	Unpublished
Magnolia officinalis	*Magnolia officinalis*	KY085916		160,136	Unpublished
Magnolia officinalis subsp. *Biloba*	*Magnolia officinalis* subsp. *Biloba*	JN867582		160,097	Unpublished
Magnolia officinalis subsp. *Biloba*	*Magnolia officinalis* subsp. *Biloba*	JN867580	NC_020317	160,105	Unpublished
Magnolia officinalis subsp. *Biloba*	*Magnolia officinalis* subsp. *Biloba*	JN867581		160,099	Unpublished
Magnolia salicifolia	*Magnolia salicifolia*	JX280399	NC_023240	160,093	Unpublished
Magnolia sprengeri	*Magnolia sprengeri*	JX280401	NC_023242	160,033	Unpublished

*partial cp sequences

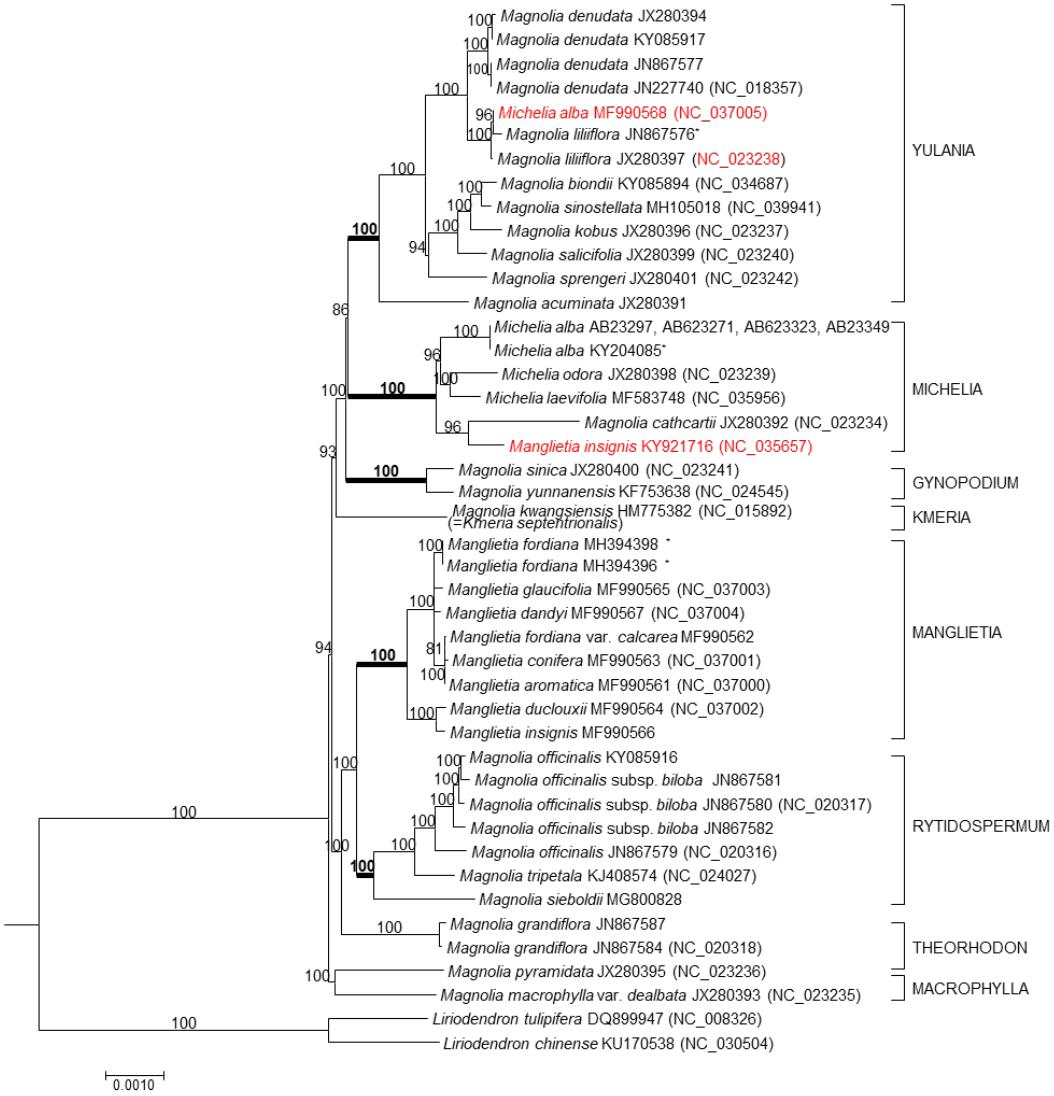


Fig. 3. The maximum likelihood tree using 44 sequences containing sequences of 43 Magnoliaceae chloroplast genomes and sequences of six chloroplast regions from *Michelia alba* (*trnK* intron including *matK*, *trnH–psbA*, *atpB–rbcL*, and *ndhF*). The GenBank accession numbers and their RefSeq IDs are indicated after the taxon name next to each of the taxon names at the tip. The accessions with problems are displayed in red. The accession numbers with * mark have a

comment for unverified sequence and/or annotation from the GenBank. Major clade names defined by Kim and Suh (2013) are indicated at the right side of the tree.

1.2 Hyb-Seq

1.2.1 Hybridization-based target enrichment

Plant systematists have used DNA sequences to understand plant phylogenetic relationships and diversification patterns since Sanger sequencing was developed (Straub et al., 2012). Currently, employing multiple regions to infer phylogenetic relationships has become the baseline in phylogenetics (McCormack et al., 2013a). The advent of NGS technologies have made whole-genome sequencing accessible, it is not yet feasible to assemble and compare large numbers of complete genomes for nonmodel plants because the cost and time taken are still overmuch (Mamanova et al., 2010; Cronn et al., 2012; Grover et al., 2012; McCormack et al., 2013a; Dodsworth et al., 2019). As a simple approach, genome skimming, shallow whole genome sequencing, with a multiplexing approach provides deep sequencing results of high copy portion of the genome (organellar genomes and repetitive elements) for a lot of taxa at once, but recovery of low copy nuclear regions for phylogenetic analysis is limited (Straub et al., 2012; Dodsworth, 2015; Dodsworth et al., 2019). Therefore, methods for genomic reduction to reduce the genome to overlapping interest subsets before sequencing are required based on the advantages of more cost-effective and less complicated analysis than whole-genome sequencing (Mamanova et al., 2010; Cronn et al., 2012; Grover et al., 2012; McCormack et al., 2013a; Dodsworth et al., 2019).

As an approach to reduce genomic complexity in a sample, the hybridization-

based targeted enrichment approach is characterized to capture specific sequences with RNA or DNA probes (baits), which are complementary to the target and are designed from pre-existing closely related genomic resources (i.e., genome data or transcriptome data) (Cronn et al., 2012; Grover et al., 2012; McCormack et al., 2013a; Dodsworth et al., 2019). The hybridization-based targeted enrichment approach has the advantage of being rapid, less laborious, and relatively inexpensive than PCR-based target enrichment to collect hundreds of loci (Grover et al., 2012). Also, the approach has broader applicability from the population level to deep-level phylogenomics, whether model plants or not (Grover et al., 2012; McCormack et al., 2013a). The approach is classified as hybridizing either on an array or in solution (Grover et al., 2012; McCormack et al., 2013a). Sequence capture in-solution has been evaluated to have a slightly higher performance in uniformity and specificity of data obtained, and to be more efficient in cost, sequencing time, and amount of DNA required, than on array (Mamanova et al., 2010).

The approach of hybridization-based target enrichment using probes (baits) in solution is referred variously to as bait hybridization, target enrichment, sequence/target/hybrid capture, anchored (hybrid) enrichment, Hyb-Seq, or other combinations of such terms (Dodsworth et al., 2019). This approach has been applied earlier and more commonly to animals, including fishes (Faircloth et al., 2013), birds (McCormack et al., 2013b; Prum et al., 2015), and Insecta (Faircloth et al., 2015, Breinholt et al., 2017) than to plants. Currently, the approach is widely applied not only to flowering plants (Table 3) but also to moss (Liu et al.,

2019; Medina et al., 2019) and fern (Wolf et al., 2018). This approach has been evaluated as a cost-efficient and rapid method of obtaining data from hundreds of loci for hundreds of samples for deep and shallow phylogenetic studies (Lemmon et al., 2012). With this approach, many clades with different taxonomic depths for diverse taxa across the Tree of Life have been reconstructed with a considerable resolution (Buddenhagen et al., 2016). In this section, the generalized workflow of this strategy, especially Hyb-Seq, which would be expected to become a typical method for phylogenetic studies in angiosperms is described.

1.2.2 Application of Hyb-Seq

The Hyb-Seq is a method combining hybridization-based target enrichment and genome skimming to generate data for both on-target (low-copy nuclear genome) and off-target (high-copy elements), and the term was suggested initially by Weitemier et al. (2014). Recently, the term Hyb-Seq seems to be changed to include slightly different meanings as well, such as mixing the enriched and unenriched libraries (Villaverde et al., 2018) or sequencing both the libraries separately to recover off-targeted high-copy elements (Dodsworth et al., 2019). Hyb-Seq has been applied to diverse taxa at various scales from the genus to the angiosperm-wide, and the contents of these studies are summarized in Table 3. Although the counting unit of the recovered region is different by each author, such as loci or genes, the number of recovered regions ranges from hundreds to thousands.

Hyb-Seq can generate both the low-copy nuclear genome and high-copy elements with a small investment producing prior genomic resources to design probes, even if in non-model organisms (Weitemier et al., 2014). Hyb-Seq data can resolve phylogenetic relationships from populations to species and above, and data produced from old herbarium materials can have missing data by low capture efficiency but did not bias estimation of phylogenetic relationship (Villaverde et al., 2018). The Hyb-Seq would be a promising method to understand the evolutionary history of angiosperm until whole-genome sequencing for every species of interest becomes practical (Weitemier et al., 2014).

1.2.3 Probe design

Molecular phylogenetics frequently has been faced with difficulty between the availability and suitability of genetic markers for the specific systematic study (Johnson et al. 2018), and researchers have invested considerable time to develop and screen genetic markers appropriate to the evolutionary timescale of interest (McCormack et al., 2013a). Previously, genetic markers have been used mainly from chloroplast (cpDNA) and ribosomal DNA (rDNA), since these markers have universal applicability across plants and their usefulness in sequencing by high copy numbers in the plant genome (Duarte et al., 2010; Zimmer and Wen, 2013; Johnson et al., 2018; Villarverde et al., 2018). However, these markers limit the number of genes used to analyze phylogeny, and the

chloroplast DNA markers that represent maternal lineage might be insufficient to reconstruct phylogenetic relationships of plant lineages (i.e., hybridization and allopolyploidization) (Duarte et al. 2010; Zimmer and Wen, 2013; Johnson et al., 2018). Identifying conserved orthologous genes across plant lineage to use as markers also has been difficult because of gene and genome duplication events in the plant (Weitemier et al., 2014; Johnson et al., 2018). Nevertheless, the limitations of cp DNA and rDNA have required the development of markers in other regions of the nuclear genome (Zimmer and Wen, 2013). These limitations can be resolved by enriching for single or low copy nuclear genes using DNA or RNA probes (baits) that hybridize to library inserts.

The selection of target loci for probe design requires a careful balance in which genomic regions are variable enough to infer phylogenies while they are conserved sufficient to ensure sequence recovery by increasing capture efficiency (Johnson et al., 2018). In the case of animals, ultraconserved elements (UCEs) and their variable flanking regions are often utilized (Faircloth et al., 2012; McCormack et al., 2012). UCEs, which are defined as DNA sequences that are identical and located in syntenic positions in at least two genomes, have been found as many as hundreds in animal genomes, however, little is known in plant genome by undergone far more dynamic genomic evolution such as polyploidy events and chromosomal changes (Reneker et al., 2012). Thus, for plant phylogenetics, low-copy nuclear genes (ideally single copy genes) are typically targeted to minimize orthology issues (Schmickl et al., 2016; Dodsworth et al., 2019).

Duarte et al. (2010) published a set of 959 nuclear single-copy genes shared in *Arabidopsis*, *Populus*, *Vitis*, and *Oryza*. The single-copy nuclear genes can increase the robustness of phylogenetic tree reconstruction by providing more phylogenetically informative data that complement organellar and ribosomal data (Duarte et al., 2010; Zimmer and Wen, 2013). Analyses that combine and compare all of these data would allow us to understand the evolutionary history of angiosperms better (Duarte et al., 2010).

Researchers can identify single or low- copy genes by blasting reciprocally between pre-existing genomic resources or by blasting newly sequenced genome itself, and select target loci based on target length and GC contents. Also, researchers can use user-friendly bioinformatic pipelines, MarkerMiner (Chamala et al., 2015) and Sondovač (Schmickl et al., 2016), to find single-copy genes. The MarkerMiner (Chamala et al., 2015) compares user-provided transcriptome data against reference databases for single-copy nuclear genes that were identified in 17 genomes (five monocots and 12 eudicots) by De Smet et al. (2013) and provides output for putative single-copy nuclear loci using reciprocal BLAST queries. The Sondovač (Schmickl et al., 2016) uses user-provided transcriptome and genome skimming data and finds low-copy nuclear loci by matching genome skimming data excluding organellar origin sequences against unique transcripts that removed transcripts sharing ≥90% sequence similarity, using BLAT (Kent, 2002). MarkerMiner and Sondovač have been applied respectively in finding single or low copy genes for probe design of Hyb-Seq, and MarkerMiner seems to be used more frequently (Table 3). The previous

studies show the probes designed based on genes selected through each pipeline generate well the Hyb-Seq data needed to infer phylogeny (Table 3).

Sequence capture probes (baits) in length 120 bp used in previous studies were synthesized into MyBaits custom probes (Arbor Biosciences, Ann Arbor, Michigan, USA) or SureSelect target enrichment kit (Agilent Technologies, Santa Clara, California, USA). The probes can set from 1X to 4X or above tiling by overlapping neighboring probes (Table 3). Recently, probe kits applicable to the entire angiosperms have been developed (Buddenhagen et al., 2016; Johnson et al., 2018). The universal probe kit has the future potential to be useful for collecting and integrating the findings of each phylogenetic study in understanding history of angiosperm diversification (Buddenhagen et al., 2016).

1.2.4 Experimental workflow in Hyb-Seq

We present the generalized workflow of Hyb-Seq (Fig. 4). First, probes are designed based on identified as single-copy genes (Fig. 4 a). Genomic DNAs extracted from materials are turned into libraries of genomic fragments (Fig. 4 b). Biotinylated probes (baits) are hybridized to target loci (Fig. 4 c). Probe-attached DNA fragments are bound to streptavidin-coated magnetic beads and separated from the mixture with a magnet (Fig. 4 d). DNA fragments without target loci are discarded by not binding to probes in washing steps, and target enriched libraries are sequenced on the NGS platform. Off-target reads from organellar genomes and ribosomal DNA and the flanking regions of targeted loci (the splash zone)

can be sequenced (Weitemier et al., 2014). Hyb-Seq has verified to works well with old collections over 100 years old ago (Hart et al., 2016), although there could be a correlation between the age of specimen and capture success (Villaverde et al., 2018). Fragmentary DNA results in incomplete genes that could produce long branches but might not be necessarily misleading in a phylogenomic study (Villaverde et al., 2018).

1.2.5 Data analysis workflow in Hyb-Seq

We briefly describe a generalized Hyb-Seq data analysis workflow (Fig. 5). Researchers usually receive demultiplexed, and adapter-trimmed reads from a company that performed sequencing. The analysis workflow is started with a quality check and control of sequencing reads. Raw data is checked whether the raw data has any problems through statistics generated by a program such as FastQC (www.bioinformatics.babraham.ac.uk/projects/fastqc/) and MultiQC (Ewels et al., 2016), and be trimmed adapter sequences and low-quality bases using a program such as Trimmomatic (Bolger et al., 2014), SeqyClean (Zhbannikov et al., 2017), and Trim Galore! (www.bioinformatics.babraham.ac.uk/projects/trim_galore/). For each locus, cleaned reads could be assembled using user-selected assembly programs, or assembly pipelines suitable for target enrichment data like HybPiper (Johnson et al., 2016) and PHYLUCE (Faircloth, 2015). Except for loci that are detected as paralogs or contain a lot of missing data, the assembled contigs of each locus

are aligned using alignment programs like MAFFT (Katoh and Standley, 2013), MUSCLE (Edgar, 2004), and PASTA (Mirarab et al., 2015). Each alignment is trimmed with tools like trimAl (Capella-Gutiérrez et al., 2009) and Gblocks (Castresana, 2000) by eliminating sites where data are missing below the threshold and are aligned poorly. Phylogenetic analyses can be performed based on the concatenation approach (which concatenate all of the aligned matrices into a supermatrix and estimate phylogenetic relationships) and the coalescent approach (which infer a species tree from gene trees) using the trimmed alignment dataset (Mirarab et al., 2014).

1.2.6 Assemblers for Hyb-Seq data

HybPiper (Johnson et al., 2016) is a pipeline designed specifically to assemble Hyb-Seq data. HybPiper (Johnson et al., 2016) implements parallel execution of sequence assembly in three phases that consist of mapping and sorting reads by target gene, contigs assembly, and extraction of the target sequence. In read mapping phase, HybPiper uses BLASTX (Camacho et al., 2009) if peptide sequences are used as a reference and use BWA (Li and Durbin, 2009) if nucleotide sequences are used as a reference. HybPiper uses SPAdes (Bankevich et al., 2012) to conduct a de novo assembly for each gene separately. HybPiper detects intron-exon junctions and extracts coding sequences, flanking non-coding sequences, and supercontig containing all assembled contigs (exon and intron), using Exonerate (Slater and Birney, 2005) and intronerate.py in the

HybPiper. HybPiper pipeline has been commonly applied in the assembly of Hyb-Seq data in plants. (Crowl et al., 2017; Johnson et al., 2018; Morales-Briones et al., 2018; Villaverde et al., 2018; Carter et al., 2019; Couvreur et al., 2019; Murphy et al., 2019; Soto Gomez et al., 2019; Zerega and Gardner 2019).

PHYLUCE (Faircloth, 2015) was the first pipeline released for dealing with data generated from the target enrichment of ultra-conserved elements (Faircloth et al., 2012), and mainly applied to animal groups (Branstetter et al., 2017; Hedin et al., 2018; Platt et al., 2017; Bossert et al., 2019). PHYLUCE offers three assemblers for assembly: Velvet (Zerbino and Birney, 2008), ABySS (Simpson et al., 2009), and Trinity (Grabherr et al., 2011). The main difference between HybPiper and PHYLUCE is whether the read mapping is done before or after de novo assembly (Faircloth, 2015; Johnson et al., 2016; Herrando-Moraira et al., 2018). PHYLUCE performs de novo assembly of reads into contigs, followed by mapping step that aligns the contigs back to the reference sequences (Faircloth, 2015; Herrando-Moraira et al., 2018). HybPiper maps the reads against each target separately, performs de novo assembly of reads into contigs, and the contigs are aligned to targets again (Johnson et al., 2016; Herrando-Moraira et al., 2018). The number of loci recovered by PHYLUCE was less than HybPiper, but the length of the matrix recovered by PHYLUCE was longer than HybPiper, which is due to PHYLUCE's procedure of assembling reads before mapping (Herrando-Moraira et al., 2018). Herrando-Moraira et al. (2018) compared two pipelines and evaluated the PHYLUCE method seems to show more limitations and to produce more phylogenetic noise than the HybPiper.

As other new tools, aTRAM (Allen et al., 2015; 2017), HybPhyloMaker (Fér and Schmickl, 2018), and SECAPR (Andermann et al., 2018) are developed and published, but HybPiper and PHYLUCE seem to be commonly used in plant groups (Table 3).

1.2.7 Hyb-Seq as an ultimate phylogenomic tool

Phylogenetics rely on an analysis of hundreds of individuals or taxa in many cases (McCormack et al., 2013a). Phylogenetic data make researchers confront a constant trade-off between the depth (characters as DNA base pairs) and breadth (number of taxa) of data collected (Dodsworth et al., 2019). The Hyb-Seq method permits more samples to be sequenced at the same cost by reducing the sequencing space per sample and becoming multiplexing of samples feasible and allows the complexity of analysis to reduce by targeting only the parts of interest in the genome (Grover et al., 2012). Hyb-Seq also generates data for hundreds or thousands of low-copy nuclear loci appropriate for phylogenetic analyses as well as high-copy repeats and organellar data as a byproduct (Weitemier et al., 2014). Hyb-Seq has been applied successfully to various groups in angiosperm (Table 3) and also resolved relationships at varying levels of phylogenetic depth from population to species and above (Villaverde et al., 2018). Although probes have been designed for each specific taxon, an angiosperm-wide universal target enrichment probe set has been under development (Buddenhagen et al., 2016; Johnson et al., 2018). Recently,

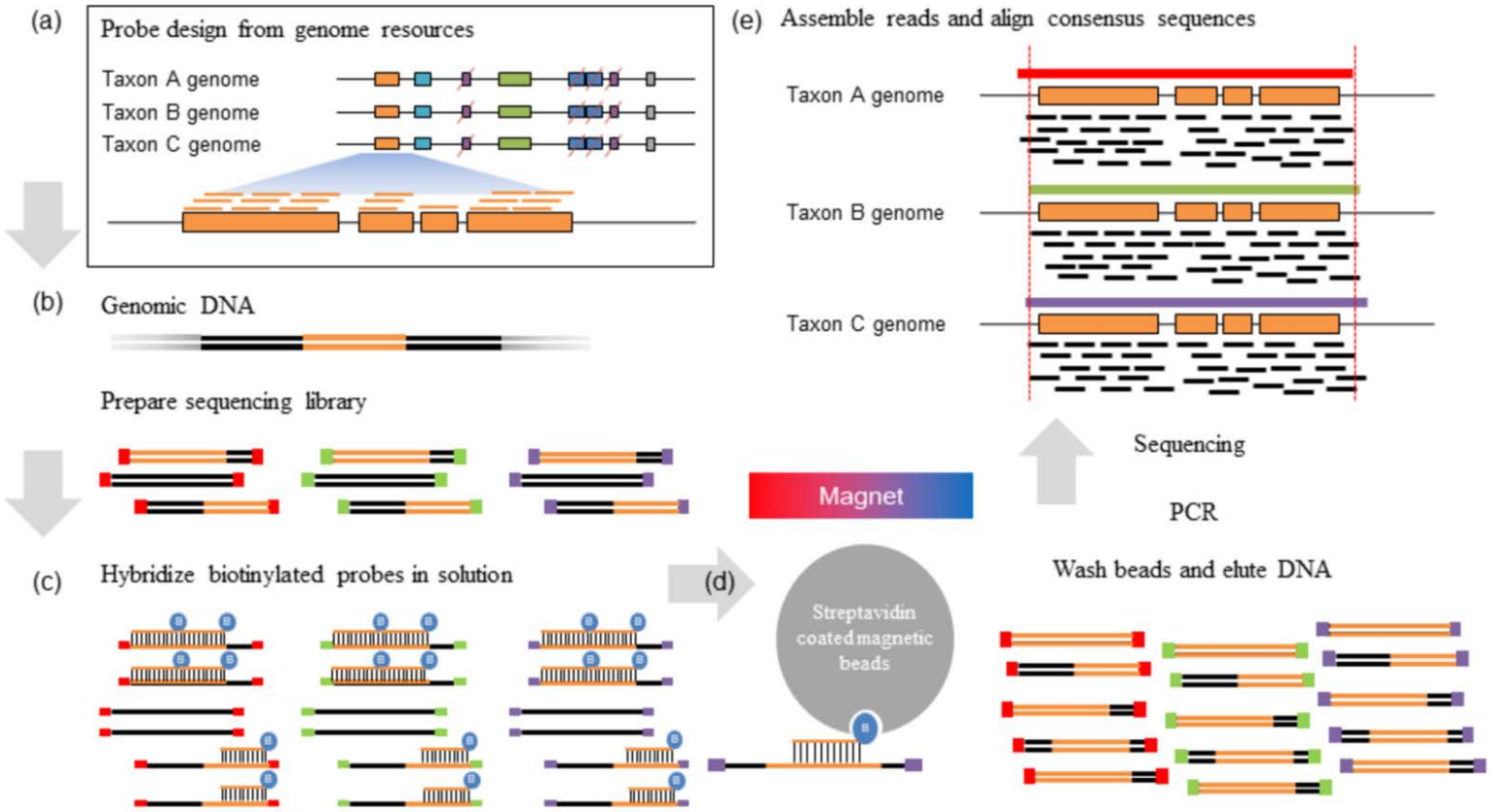
Johnson et al. (2018) have published a probe set targeting for 353 low-copy nuclear genes and tested for 42 species across the angiosperms. The universal probe set could enable systematists to unify data by reconciling differences in their work and provide better insight into understanding the history of angiosperm diversification (Buddenhagen et al., 2016). By building a database of hundreds of genes shared among samples, the core set of genes may be used as a flowering plant DNA barcode (Dodsworth et al., 2019). Until the sequencing and assembly of whole genomes for every species of interest become practical and affordable, Hyb-Seq would be an ultimate method to quickly and efficiently generate genome-scale data sets in improving our understanding of the evolutionary history of plants (Weitemier et al., 2014).

Table 3. Summary of Hyb-Seq studies on diverse plant taxa at various ranks

Authors	Taxon	Taxon scale	# of recovered loci or genes	assembly program	# of samples	Bioinformatic pipeline or programs employed to design probes	Probe (kit, company)	Probe coverage	length of concatenated all loci
Weitemier et al. (2014)	*Asclepias* (Apocynaceae)	Genus	768 nuclear genes	YASRA[g], BLAT[b], Alignreads v. 2.25[i]	12 samples	BLAT[b], CD-HIT-EST[cl], custom scripts	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	-	average 2.2 Mbp
Mandel et al. (2014)	Asteraceae	Family	763 nuclear loci	Velvet[e], PHYLUCE[k]	15 species	BLAST	MyBaits COS 1Kv1, Arbor Biosciences (Ann Arbor, Michigan, USA)	1.5X	269,585 bp
De Sousa et al. (2014)	*Medicago* (Fabaceae)	Genus	50 nulcear loci	CLC Genomics software (CLC Bio, Aarhus, Denmark)	6 species	BLAST	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	122,450 bp
Mandel et al. (2015)	Asteraceae	Family	795 nulcear loci	Velvet[e], PHYLUCE[k]	23 samples	-	MyBaits COS 1Kv1, Arbor Biosciences (Ann Arbor, Michigan, USA)	1.5X	274,242 bp
Nicholls et al. (2015)	*Inga* (Fabaceae)	Genus	194 nuclear loci	Bowtie2 v. 2.0.2[m], bcftools from SAMtools v. 0.1.18[f]	24 samples representing 22 species	BLAST (blastn)	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	259,313 bp
Stephens et al. (2015a)	*Sarracenia* (Sarraceniaceae)	Genus	199 nuclear genes	Velvet v. 1.2.08[e], Trinity v. 20130225[h]	75 samples	BLAST (blastn)	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	128,110 bp
Stephens et al. (2015b)	*Helianthus* (Asteraceae)	Genus	170 nuclear genes	Velvet v. 1.2.08[e], Trinity v. 20140717 [h]	103 samples representing 37 species/subspecies	RepeatMasker, CD-HIT-EST v. 4.6.1[cl], BLAST	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	106,862 bp
Buddenhagen et al. (2016)	Angiosperms	Angiosperms	517 nuclear loci	Custom scripts	53 samples	Of single-copy genes identified by Duarte et al. (2010), exons with ≥ 55 % sequence similarity between Arabidopsis and Oryza.	Angiosperm v. 1 kit, Agilent Technologies (Santa Clara, California, USA)	2.8X	average 233,993 bp (107,918 to 365,941)
Johnson et al. (2016)	*Artocarpus* (Moraceae)	Genus	333 nuclear loci	HybPiper[p]	22 species	BLAST (blastn), AUGUSTUS[d]	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	594,149 bp
Fisher et al. (2016)	Chloridoideae (Poaceae)	Subfamily	122 nuclear loci	Geneious mapper	47 species	BLAST, Geneious v. 6.1.6, RepeatMasker[a]	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	4X	105,486 bp
Schmickl et al. 2016	*Oxalis* (Oxalidaceae)	Genus	727 nuclear loci	Alignreads v. 2.25 [i]	23 species	Sondovač[q]	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	2X	
Crowl et al. (2017)	*Campanula* (Campanulaceae)	Genus	130 nuclear loci	HybPiper[p]	109 samples	MarkerMiner[o]	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	2X	207,991 bp
Fragoso-Martínez et al. (2017)	subgenus *Calosphace* in *Salvia* (Lamiaceae)	Subgenus	448 nuclear loci	Custom scripts used in Prum et al. (2015) and Buddenhagen et al. (2016)	12 species	-	Angiosperm v. 1 kit, Agilent Technologies (Santa Clara, California, USA)	2.8X	316,701 bp
Garcia et al. (2017)	Hippoeastreae (Amaryllidaceae)	Tribe	18 nuclear loci	Velvet[e], aTRAM[n]	40 samples	MarkerMiner[o], single-copy genes identified by Duarte et al. (2010)	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	2X	about 20,000 bp
Kamneva et al. (2017)	*Fragaria* (Rosaceae)	Genus	257 nuclear loci	HapCompass v0.6.2[j]	54 samples representing 20 species	Identifying putative single-copy genes by single reciprocal hits using BLAT[b] between pre-existing genomic resources and designing in considering target length (exons ≥ 80 bp) and GC content between 30 and 70%	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	1.5X	576,013 to 1,136,434 bp
Carlsen et al. (2018)	Zingiberales	Order	378 nuclear genes	HybPhyloMaker[r]	44 samples representing 31 genera across 8 families	Sondovač[q]	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	2X	228,304 bp
Herrando-Moraira et al. (2018)	Cardueae (Asteraceae)	Tribe	627 and 1,051 nuclear loci	PHYLUCE[k], HybPiper[p]	85 samples	-	MyBaits COS 1Kv1, Arbor Biosciences (Ann Arbor, Michigan, USA)	1.5X	515,875 bp by PHYLUCE method and 333,614 bp by HybPiper
Morales-Briones et al. (2018)	*Lachemilla* (Rosaceae)	Genus	396 nuclear loci	HybPiper[p]	27 species	Probes used in Kamneva et al. (2017)	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	1.5X	265,028 bp
Villaverde et al. (2018)	*Euphorbia* (Euphorbiaceae)	From population to genus	296 nuclear genes	HybPiper[p]	121 samples	MarkerMiner 1.0[o]	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	2X	486 878 bp
Carter et al. (2019)	*Rubus* (Rosaceae)	Genus	approximately 1,000 nuclear	HybPiper[p]	94 species and 3 cultivars	Identifying putative single-copy genes by single reciprocal hits using BLAST between pre-existing	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	1X	average 2.7 Mbp

			gene			genomic resources and designing in considering target length (exons ≥ 80 bp) and GC content between 30 and 70%			
Couvreur et al. (2019)	Annonaceae	Family	317 nuclear loci	HybPiper[p]	83 samples	CD-HIT-EST v. 4.6.6[cl], BLASTp	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	533,322 bp
Herrando-Moraira et al. (2019)	Cardueae (Asteraceae)	Tribe	776 and 1,055 nuclear loci	PHYLUCE[k], HybPiper[p]	76 samples	-	MyBaits COS 1Kv1, Arbor Biosciences (Ann Arbor, Michigan, USA)	1.5X	429,549 bp by PHYLUCE method and 332,260 bp by HybPiper median length
Johnson et al. (2018)	Angiosperms	Angiosperms	353 nuclear genes	HybPiper[p]	42 species	-	Angiosperms 353 v 1 target capture kit (Johnson et al., 2018), Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	137,046 bp and 216,816 bp in coding sequences and noncoding sequences, respectively
Murphy et al. (2019)	*Nepenthes* (Nepenthaceae)	Genus	266 nuclear loci	HybPiper[p]	197 samples, 151 species	-	Angiosperms 353 v 1 target capture kit (Johnson et al., 2018), Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	160.320 bp
Nikolov et al. (2019)	Brassicaceae	Family	1,827 nuclear loci	YASRA[g], BLAT[b], Alignreads v. 2.25[i]	63 species	Identifying putative single-copy genes by single reciprocal hits using BLAT[b] between pre-existing genomic resources and designing by considering target length (exons > 180 bp) and GC content between 30 and 70%	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	2X	about 940,000 bp
Soto Gomez et al. (2019)	*Dioscorea* (Dioscoreaceae)	Genus	264 nuclear genes	HybPiper[p]	25 samples	MarkerMiner 1.0[o]	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	319,788 bp
White et al. (2019)	Section *Archerythroxylum* in *Erythroxylum* (Erythroxylaceae)	Section	427 nuclear genes	aTRAM[n]	68 taxa	BLAT[b], CD-HIT-EST[cl], custom scripts used in Weitemier et al. (2014)	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	1.2 Mbp
Zerega and Gardner (2019)	Moraceae	Family	333 nuclear genes	HybPiper[p]	25 species	BLAST (blastn), AUGUSTUS[d]	MyBaits custom probes, Arbor Biosciences (Ann Arbor, Michigan, USA)	3X	385,454 bp

[a]Smit et al. (1996), [b]Kent (2002), [c]Li and Godzik (2006), [d]Stanke et al. (2008), [e]Zerbino and Birney (2008), [f]Li et al. (2009), [g]Ratan (2009), [h]Grabherr et al. (2011), [i]Straub et al. (2011), [j]Aguiar and Istrail (2012), [k]Faircloth et al. (2015), [l]Fu et al. (2012), [m]Langmead and Salzberg, (2012), [n]Allen et al. (2015), [o]Chamala et al. (2015), [p]Johnson et al. (2016), [q]Schmickl et al. (2016), [r]Fér and Schmickl (2018)


(a)
Probe design from genome resources
Taxon A genome
Taxon B genome
Taxon C genome
(b)
Genomic DNA
Prepare sequencing library
(c)
Hybridize biotinylated probes in solution
(d)
Streptavidin coated magnetic beads
Magnet
Wash beads and elute DNA
PCR
Sequencing
(e)
Assemble reads and align consensus sequences
Taxon A genome
Taxon B genome
Taxon C genome

(Previous page) Fig. 4. Experimental overview of Hyb-Seq. (a) Probes are designed based on genes identified as single-copy genes in the reference genome. (b) Sequencing libraries are prepared from genomic DNA fragments in each sample. (c) Libraries are denatured, and biotinylated probes are hybridized to target loci (d) Probe-attached DNA fragments are mixed with streptavidin-coated magnetic beads and separated by a magnet. The target enriched libraries are amplified and sequenced on the NGS platform after untargeted fragments are washed off. Orange line indicates target DNA sequences, and black line indicates non-target sequences in (b), (c), and (d). Red, green, and purple boxes of both sides of DNA fragments are index sequences that distinguish individual samples. (e) NGS reads are assembled into consensus sequences, and the consensus sequences are aligned. Orange boxes are target sites where probes designed, and bold red, green, and purple lines are consensus sequences assembled from each sample.

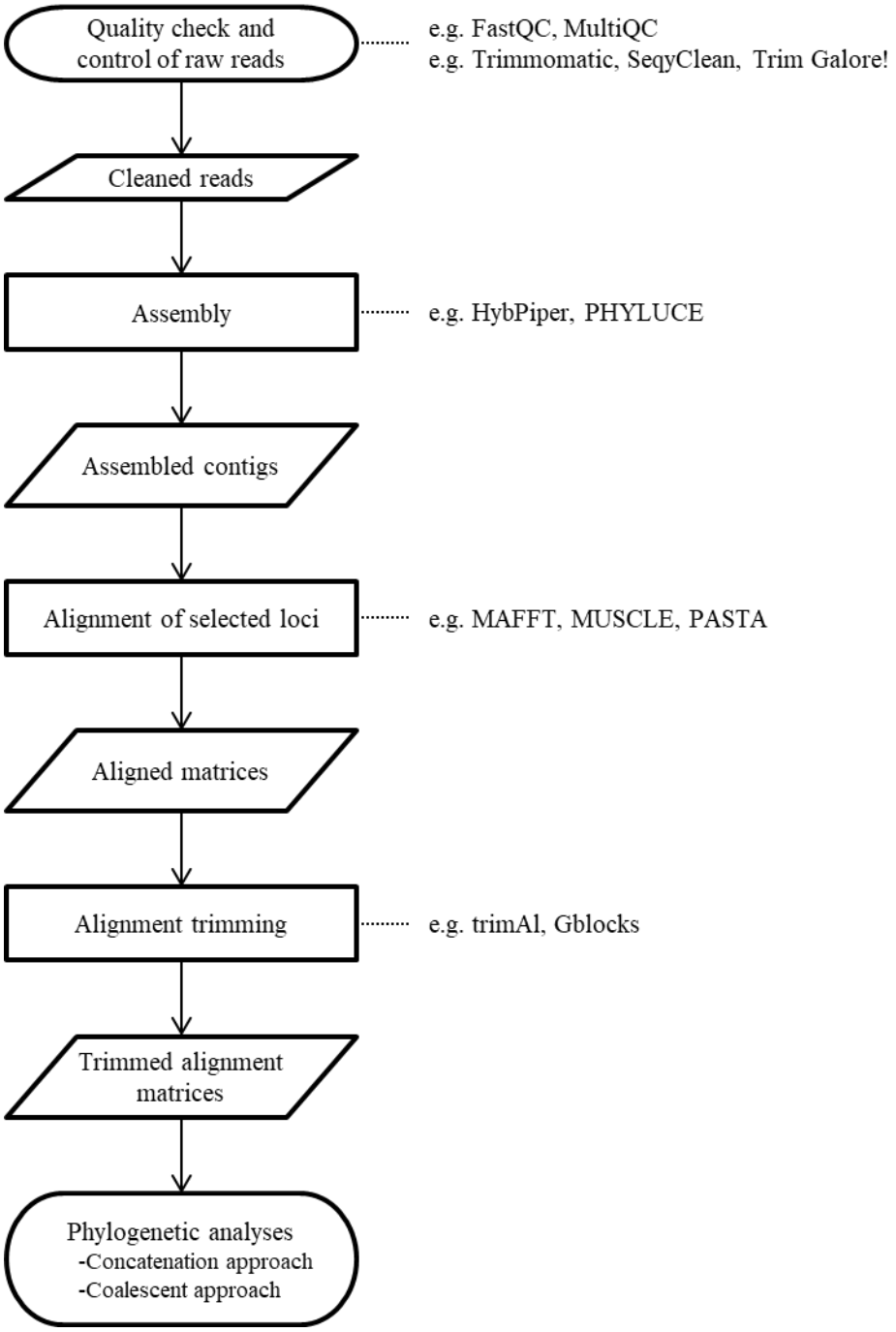


Fig. 5. Workflow of the Hyb-Seq data processing. Typical programs used in each step are indicated at the right side of rectangular boxes.

Chapter 2. Comparative and phylogenetic analyses of *Manglietia* (Magnoliaceae) based on complete chloroplast genomes.

2.1 Introduction

The *Manglietia* Blume was proposed as an independent genus by Blume (1823). The taxonomic status of *Manglietia* was debated in reducing it to genus *Magnolia*, since it was uncertain whether a difference in ovule-number (two ovules in *Magnolia* vs. four or more ovules in *Manglietia*) was sufficient grounds to allow *Manglietia* to be a separate genus (Dandy, 1927). Since then, the similarity in wood anatomy (Canright, 1955) and pollen morphology (Praglowski, 1974) showed that *Manglietia* and *Magnolia* were closely related. But, differences including the ovule-number in a carpel (Dandy, 1927), unique hair-base type on the epidermis in *Manglietia* (Baranova, 1972), and leaves having sclerified spongy mesophyll and either sclerified epidermis or hypodermis in *Manglietia* (Tucker, 1977) have been suggested as grounds for separating them. Also, molecular phylogeny studies to date have supported *Manglietia* as an independent subgroup in Magnolioideae by showing that *Manglietia* forms a monophyletic group (Azuma et al., 2001; Kim et al., 2001; Nie et al., 2008; Azuma et al., 2011; Kim and Suh, 2013). The system of Nooteboom (1985) recognized *Manglietia* as a genus, while the system of Figlar and Nooteboom (2004) included *Manglietia* to a section in *Magnolia* as a genus *Magnolia* extends

throughout Magnolioideae (Table 1). Also, as an independent subgroup, *Manglietia* and *Manglietiastrum* were located under one genus or section (Liang and Nooteboom, 1993; Nooteboom, 2000). However, phylogenetic studies showed that *Manglietiastrum* is related closely to *Gynopodium* rather than *Manglietia*, and section *Rytidospermum* (excluding *Magnolia macrophylla*, *Magnolia dealbata*, and *Magnolia fraseri*) and section *Oyama* are more related to *Mangleitia*. (Nie et al., 2008; Azuma et al., 2011; Kim and Suh, 2013).

In the World Checklist of Magnoliaceae (Govaerts et al., 2020), 41 species (46 taxa), which are considered to be included in *Manglietia* due to basionym of *Manglietia*, have been recorded. These species are distributed in tropical and subtropical Asia, of which 30 species are distributed in China (Govaerts et al., 2020). In the IUCN Red List, except in the case of data deficient, most *Manglietia* species have been rated near threatened or higher (IUCN, 2020). Although *Manglietia* is important for understanding the diversification of Magnoliaceae and conserving endangered species, phylogenetic relationships within *Manglietia* have not yet been analyzed. Therefore, as a little independent topic in the overall contents of this dissertation, this study is an intensive phylogenetic study focused on *Manglietia*, one of the major sub-clades in Magnoliaceae.

Chloroplast genomes of 47 samples from 40 samples representing 36 Manglietia taxa and from 7 taxa for the outgroup were sequenced and assembled. Variable regions, repeat sequences, and simple sequence repeats (SSRs) were investigated, which have potential usefulness in future phylogenetic analysis and

DNA barcode for additional samples of *Manglietia*. We reconstructed phylogenetic relationships within *Manglietia* based on the chloroplast genome.

2.2 Materials and Methods

A total of 47 chloroplast genomes for 40 samples representing 36 *Manglietia* taxa and seven samples for outgroup taxa were used in this study (Table 4). Completed chloroplast genome data for 22 samples with missing sequencing data in table 4 were provided by Dr. Xue-Jun Ge's lab in the South China Botanical Garden. Chloroplast genomes were sequenced from 25 samples representing 18 *Manglietia* taxa and seven outgroup taxa. Of these samples, 14 samples are the same materials used in the previous *ndhF* study of Kim et al. (2001) (Table 4). As an outgroup, *Magnolia officinalis*, *Magnolia obovata*, *Magnolia tripetala*, *Magnolia globosa*, *Magnolia wilsonii*, *Magnolia sieboldii*, and *Magnolia sieboldii* subsp. *sinensis* were selected based on previous molecular studies (Nie et al., 2008; Azuma et al., 2011; Kim and Suh, 2013). Methods for sample preparation, target enrichment, and sequencing are the same as described in Chapter 3.

The overall methods for genome assembly, gene annotation, sequence analyses, and phylogenetic analyses are the same as described in Chapter 3. Chloroplast genomes of *Manglietia glauca* (unpublished), *Magnolia officinalis* (JN867579), *Magnolia tripetala* (unpublished), and *Magnolia sieboldii*

(unpublished) were used as a reference for mapping reads in the assembly step. The phylogenetic analyses were run based on a dataset in alignment length 134,708 bp, excluding an IR.

Table 4. Voucher information of this study and their sequencing information

Sci. name	Voucher, Herbarium	Read length	No. of rawreads	No. of trimmed reads (incl. single end)	% of trimmed reads
Manglietia aromatica	Y.Q. Zhang SCBG00000492, IBSC	-	-	-	-
Manglietia calcarea	Y.Q. Zhang SCBG00000488, IBSC	-	-	-	-
Manglietia caveana	s.n. 03730, PE	151	1,355,994	1,310,192	96.6%
Manglietia chevalieri	N. Zhao and Y. Xu GL276, IBSC	-	-	-	-
Manglietia chingii	Y.Q. Zhang SCBG00000865, IBSC	-	-	-	-
Manglietia conifera	S. Kim 1030, NPRI*	101	2,991,278	2,893,318	96.7%
Manglietia crassipes	Y.Q. Zhang SCBG00000480, IBSC	-	-	-	-
Manglietia dandyi	Y.Q. Zhang SCBG00000472, IBSC	-	-	-	-
Manglietia decidua	N. Zhao,Y. Xu and T. Li HZ162, IBSC	-	-	-	-
Manglietia decidua	S. Kim 2015-0014, SWU	101	2,904,754	2,799,425	96.4%
Manglietia duclouxii	S. Kim 1092, NPRI*	101	2,087,722	2,013,619	96.5%
Manglietia fordiana	S. Kim 1031, NPRI*	101	3,678,952	3,559,818	96.8%
Manglietia forrestii	Y.Q. Zhang SCBG00000516, IBSC	-	-	-	-
Manglietia garrettii	S.Kim 20141027, SWU	101	2,517,148	2,427,018	96.4%
Manglietia glauca	Y.Q. Zhang SCBG00000571, IBSC	-	-	-	-
Manglietia glauca	L 530810, L	151	1,093,136	1,054,905	96.5%
Manglietia grandis	S. Kim 2015-0031, SWU	101	3,132,312	3,016,692	96.3%
Manglietia guangnanica	Y.Q. Zhang SCBG00000484, IBSC	-	-	-	-
Manglietia guangzhouensis	Y.Q. Zhang SCBG00000566, IBSC	-	-	-	-
Manglietia hainanensis	Y.Q. Zhang SCBG00000526, IBSC	-	-	-	-
Manglietia hookeri	S. Kim 2015-0029, SWU	101	1,402,836	1,355,652	96.6%
Manglietia insignis	S. Kim 1032, NPRI*	101	4,131,476	3,965,715	96.0%
Manglietia kaifui	Y.Q. Zhang SCBG00000506, IBSC	-	-	-	-
Manglietia kwangtungensis	S. Kim 1033, NPRI*	101	3,941,260	3,783,862	96.0%
Manglietia longipedunculata	Y.Q. Zhang SCBG00000507, IBSC	-	-	-	-
Manglietia longirostrata	Y.Q. Zhang SCBG00000512, IBSC	-	-	-	-
Manglietia lucida	Y.Q. Zhang SCBG00000493, IBSC	-	-	-	-
Manglietia lucida	DZL 3142A, KUN	151	2,157,130	2,074,175	96.2%
Manglietia maguanica	Y.Q. Zhang SCBG00000517, IBSC	-	-	-	-
Manglietia megaphylla	S. Kim 1056, NPRI*	101	1,336,734	1,280,785	95.8%
Manglietia miechangensis	Y.Q. Zhang SCBG00000570, IBSC	-	-	-	-
Manglietia ovoidea	Y.Q. Zhang SCBG00000479, IBSC	-	-	-	-
Manglietia ovoidea	S. Kim 2015-0036, SWU	101	1,628,506	1,557,670	96.9%
Manglietia patungensis	Y.Q. Zhang SCBG00000854, IBSC	-	-	-	-
Manglietia rufibarbata	S. Kim 2015-0005, SWU	101	1,306,976	1,260,279	96.4%
Manglietia sapaensis	Y.Q. Zhang SCBG00000850, IBSC	-	-	-	-
Manglietia szechuanica	S. Kim 2017-0201, SWU	151	2,163,596	2,070,518	95.7%
Manglietia utilis	H. P. Nooteboom 6137, L *	101	1,566,842	1,507,021	96.2%
Manglietia ventii	S.Kim 2015-0004, SWU	101	1,511,296	1,464,744	96.9%
Manglietia yuyuanensis	Y.Q. Zhang SCBG00000494, IBSC	-	-	-	-
Magnolia globosa	S. Kim 1101, NPRI*	101	11,068,824	10,647,972	96.2%
Magnolia obovata	S. Kim 1046, NPRI*	101	2,270,852	2,195,788	96.7%
Magnolia officinalis	S. Kim 1018, NPRI*	101	2,137,418	2,045,622	95.7%
Magnolia sieboldii	S. Kim 1047, NPRI*	101	4,493,858	4,353,794	96.9%
Magnolia sieboldii subsp. *sinensis*	S. Kim 1022, NPRI*	101	6,010,834	5,840,853	97.2%
Magnolia tripetala	S. Kim 1025, NPRI*	101	3,259,248	3,115,105	95.6%
Magnolia wilsonii	S. Kim 1028, NPRI*	101	5,814,396	5,597,913	96.3%

* The same materials used in the previous *ndhF* study of Kim et al. (2001)

2.3 Results

2.3.1 Structure of chloroplast genomes in *Manglietia*

The chloroplast genomes of *Manglietia* ranged from 159,733 bp (*Manglietia caveana*) to 160,148p (*Manglietia longipedunculata*) in length (Fig. 6 and Table 5), and all had a typical structure that consisted of a pair of IRs separated by LSC and SSC. The maximum length in chloroplast genomes, including outgroup taxa, was 160,151 bp of *Magnolia sieboldii* (Table 5). The lengths of LSC, IR, and SSC regions ranged from 87,803 bp (*Manglietia caveana*) to 88,139 bp (*Manglietia conifera* and *Manglietia insignis*), from 26,564 bp (*Manglietia forrestii*) to 26,600 bp (*Manglietia utils*), and from 18,745 bp (*Manglietia sapaensis*) to 18,878 bp (*Manglietia decidua*) respectively. Including outgroup taxa, the lengths of LSC, IR, and SSC regions ranged from 87,803 bp (*Manglietia caveana*) to 88,211 bp (*Magnolia sieboldii* subsp. *sinensis*), from 26,559 bp (*Magnolia globosa*) to 26,600 bp (*Manglietia utilis*), and from 18,745 bp (*Manglietia sapaensis*) to 18,878 bp (*Manglietia decidua*) respectively. The GC content was 39.3% in *Manglietia* and 39.2% in outgroup taxa. A few Ns remained in the intergenic spacer between *trnT-UGU* and *trnL-UAA* of chloroplast genomes of *Manglietia glauca* (SWU), *Manglietia ventii*, and *Manglietia caveana* (4, 11, and 131 bp respectively).

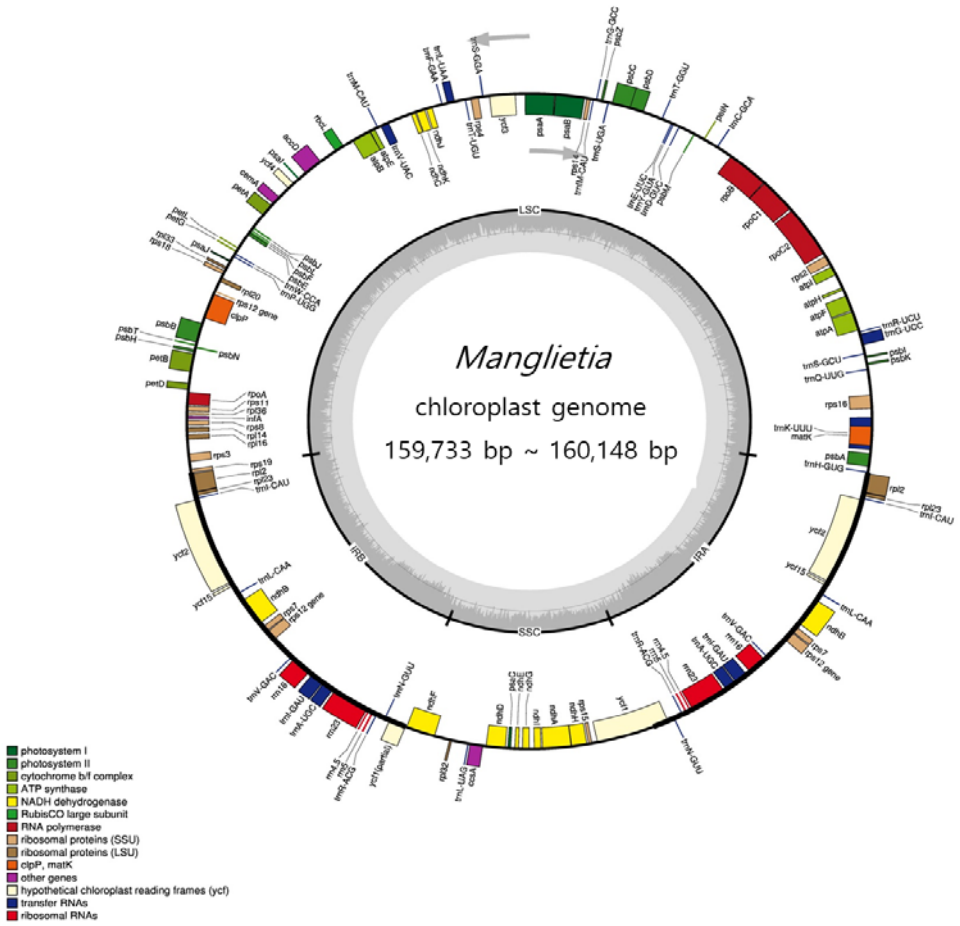


Fig. 6. A typical gene map from chloroplast genomes in *Manglietia*. Genes inside the circle are transcribed clockwise, and those outside are counter-clockwise. Genes belonging to different functional groups are color-coded. The light grey graph inner circle indicates GC content.

Table 5. Summary of features of *Manglietia* chloroplast genomes

Sci. name	Sequence Length (bp)	GC (%)	LSC (bp)	IR (bp)	SSC (bp)	genes	protein encoding genes	tRNA genes	rRNA genes	genes duplicated in IR (incl.*rps12*)
Manglietia aromatica	160,077	39.30	88,110	26,575	18,817	113	79	30	4	18
Manglietia calcarea	160,027	39.30	88,088	26,572	18,795	113	79	30	4	18
Manglietia caveana	159,733	39.30	87,803	26,569	18,792	113	79	30	4	18
Manglietia chevalieri	160,047	39.30	88,101	26,572	18,802	113	79	30	4	18
Manglietia chingii	160,140	39.30	88,117	26,582	18,859	113	79	30	4	18
Manglietia conifera	160,087	39.30	88,139	26,583	18,782	113	79	30	4	18
Manglietia crassipes	160,053	39.30	88,106	26,572	18,803	113	79	30	4	18
Manglietia dandyi	160,058	39.30	88,094	26,572	18,820	113	79	30	4	18
Manglietia decidua (IBSC)*	160,129	39.30	88,117	26,567	18,878	113	79	30	4	18
Manglietia decidua (SWU)*	160,127	39.30	88,115	26,567	18,878	113	79	30	4	18
Manglietia duclouxii	160,035	39.30	88,098	26,576	18,785	113	79	30	4	18
Manglietia fordiana	160,058	39.30	88,128	26,572	18,786	113	79	30	4	18
Manglietia forrestii	160,045	39.30	88,097	26,564	18,820	113	79	30	4	18
Manglietia garrettii	160,020	39.30	88,080	26,577	18,786	113	79	30	4	18
Manglietia glauca (IBSC)*	160,053	39.30	88,100	26,572	18,809	113	79	30	4	18
Manglietia glauca (L)*	160,101	39.30	88,098	26,572	18,859	113	79	30	4	18
Manglietia grandis	160,047	39.30	88,110	26,576	18,785	113	79	30	4	18
Manglietia guangnanica	160,066	39.30	88,105	26,576	18,809	113	79	30	4	18
Manglietia guangzhouensis	160,126	39.30	88,127	26,572	18,855	113	79	30	4	18
Manglietia hainanensis	160,078	39.30	88,128	26,572	18,806	113	79	30	4	18
Manglietia hookeri	160,066	39.30	88,124	26,583	18,776	113	79	30	4	18
Manglietia insignis	160,087	39.30	88,139	26,583	18,782	113	79	30	4	18
Manglietia kaifui	160,034	39.30	88,097	26,576	18,785	113	79	30	4	18
Manglietia kwangtungensis	160,110	39.30	88,107	26,572	18,859	113	79	30	4	18
Manglietia longipedunculata	160,148	39.30	88,131	26,572	18,873	113	79	30	4	18
Manglietia longirostrata	160,062	39.30	88,097	26,572	18,821	113	79	30	4	18
Manglietia lucida (IBSC)*	160,106	39.30	88,112	26,595	18,804	113	79	30	4	18
Manglietia lucida (KUN)*	160,109	39.30	88,109	26,572	18,856	113	79	30	4	18
Manglietia maguanica	160,069	39.30	88,109	26,576	18,808	113	79	30	4	18
Manglietia megaphylla	160,093	39.30	88,094	26,572	18,855	113	79	30	4	18
Manglietia miechangensis	160,072	39.30	88,113	26,576	18,807	113	79	30	4	18
Manglietia ovoidea (IBSC)*	160,075	39.30	88,107	26,572	18,824	113	79	30	4	18
Manglietia ovoidea (SWU)*	160,112	39.30	88,108	26,572	18,860	113	79	30	4	18
Manglietia patungensis	160,103	39.30	88,102	26,572	18,857	113	79	30	4	18
Manglietia rufibarbata	160,092	39.30	88,092	26,572	18,856	113	79	30	4	18
Manglietia sapaensis	159,974	39.30	88,077	26,576	18,745	113	79	30	4	18
Manglietia szechuanica	160,120	39.30	88,105	26,576	18,863	113	79	30	4	18
Manglietia utilis	160,066	39.30	88,097	26,600	18,769	113	79	30	4	18
Manglietia ventii	160,113	39.30	88,113	26,572	18,856	113	79	30	4	18
Manglietia yuyuanensis	160,075	39.30	88,114	26,572	18,817	113	79	30	4	18
Magnolia globosa	159,969	39.20	88,083	26,559	18,768	113	79	30	4	18
Magnolia obovata	160,087	39.20	88,190	26,562	18,773	113	79	30	4	18
Magnolia officinalis	160,055	39.20	88,161	26,562	18,770	113	79	30	4	18
Magnolia sieboldii	160,151	39.20	88,209	26,588	18,766	113	79	30	4	18
Magnolia sieboldii subsp. *sinensis*	160,146	39.30	88,211	26,587	18,761	113	79	30	4	18
Magnolia tripetala	160,043	39.30	88,147	26,572	18,752	113	79	30	4	18
Magnolia wilsonii	160,131	39.20	88,191	26,593	18,754	113	79	30	4	18
Min (except outgroup)	159,733	39.30	87,803	26,564	18,745	113	79	30	4	18
Max (except outgroup)	160,148	39.30	88,139	26,600	18,878	113	79	30	4	18
Min (incl. outgroup)	159,733	39.20	87,803	26,559	18,745	113	79	30	4	18
Max (incl. outgroup)	160,151	39.30	88,211	26,600	18,878	113	79	30	4	18

* Multiple samples from different sources in a taxon are distinguished by parenthesized herbarium abbreviations.

The chloroplast genomes of *Manglietia* and outgroup taxa encoded an identical set of 131 genes that consist of 113 genes including 79 protein-coding genes, 30 tRNA genes, and four rRNA genes (Table 5 and Table 6). Six protein coding genes (*ndhB, rpl2, rpl23, rps7, ycf15,* and *ycf2*), seven tRNA genes (*trnA-UGC, trnI-CAU, trnI-GAU, trnL-CAA*, *trnN-GUU, trnR-ACG,* and *trnV-GAC*), and four rRNA genes (*rrn16, rrn23, rrn4.5,* and *rrn5*) were duplicated in IR regions. The *rps12* had a unique split structure; 5' end exon was located in LSC region, and 3' end exon and intron were located in IR regions. Of the 113 genes, 13 genes (*rpl2, rpl16, rpoC1, petB, atpF, ndhA, ndhB, trnA-UGC, trnG-UCC, trnI-GAU, trnK-UUU, trnL-UAA,* and *trnV-UAC*) had one intron, and three protein coding genes (*rps12, clpP,* and *ycf3*) had two introns (Table 6).

2.3.2 Variation of IR borders

The positions of the IR border and adjacent genes were compared to identify the variation of expansion and contraction of the border regions in *Manglietia* chloroplast genomes concerning phylogeny (Fig. 7). The border between LSC and IRb was at the 5' end of rps19 and was located apart 60-61 bp from the 3' end of *rpl2*. The border between IRb and SSC was next to the 5' portion fragment of the *ycf1* and was 61-105 bp away from *ndhF*. The ycf1 gene crossed the border between the SSR and IRa, and the border was located at about four-fifths of the ycf1 gene toward the 5' end of the gene. The length of the 3'end portion of the *ycf1* gene on the SSC side was 4,259-4,370 bp, and the length of the 5'end

portion of the gene on the IRb side was 1,279 bp. Compared with the outgroup, the former was the shortest in *Magnolia* wilsonii (4,253 bp), and the latter was the shortest in *Magnolia globosa* (1,270 bp). It made 5' end portion fragment of *ycf1* next to the border between IRb and SSC. The border between IRa and LSC was separated from *rpl2* by the same distance between the border LSC/IRb and *rpl2* and was located 11-12 bp away from *trnH*. Overall, the border structures were very conserved.

Table 6. List of genes contained in the *Manglietia* chloroplast genomes

Genes categories	Group of genes	Name of genes
Self-replication	Ribosomal RNA genes	**rrn5, *rrn4.5, *rrn16, *rrn23*
	Transfer RNA genes	[a]**trnA-UGC, trnC-GCA, trnD-GUC, trnE-UUC, trnF-GAA, trnfM-CAU, trnG-GCC,* [a]*trnG-UCC, trnH-GUG, *trnI-CAU,* [a]**trnI-GAU,* [a]*trnK-UUU, *trnL-CAA,* [a]*trnL-UAA, trnL-UAG, trnM-CAU, *trnN-GUU, trnP-UGG, trnQ-UUG, *trnR-ACG, trnR-UCU, trnS-GCU, trnS-GGA, trnS-UGA, trnT-GGU, trnT-UGU, *trnV-GAC,* [a]*trnV-UAC, trnW-CCA, trnY-GUA*
	Small subunits of ribosomal protein genes	*rps2, rps3, rps4, *rps7, rps8, rps11,* [b]**rps12, rps14, rps15,* [a]*rps16, rps18, rps19*
	Large subunit of ribosomal protein genes	[a]**rpl2, rpl14, rpl16, rpl20, *rpl23, rpl32, rpl33, rpl36*
	RNA polymerase subunits	*rpoA, rpoB,* [a]*rpoC1, rpoC2*
Genes for photosynthesis	Subunits of photosystem Ⅰ	*psaA, psaB, psaC, psaI, psaJ*
	Subunits of photosystem Ⅱ	*psbA, psbB, psbC, psbD, psbE, psbF, psbH, psbI, psbJ, psbK, psbL, psbM, psbN, psbT, psbZ*
	Subunits of Cytochrome	*petA,* [a]*petB, petD, petG, petL, petN*
	Subunits of ATP-synthases	*atpA, atpB, atpE,* [a]*atpF, atpH, atpI*
	RuBisCo large subunit	*rbcL*
	Subunits of NADH dehydrogenase	[a]*ndhA,* [a]**ndhB, ndhC, ndhD, ndhE, ndhF, ndhG, ndhH, ndhI, ndhJ, ndhk*
Other genes	Translational initiation factor	*infA*
	Maturase	*matK*
	Protease	[b]*clpP*
	Envelope membrane protein	*cemA*
	Subunit of Acetyl-CoA- carboxylase	*accD*
	C-type cytochrome synthesis gene	*ccsA*
Unknown function	Conserved open reading frames	*ycf1* (part), **ycf2,* [b]*ycf3, ycf4, *ycf15*

[a] genes contain one intron; [b] genes contain two introns; [*] duplicate genes in IR

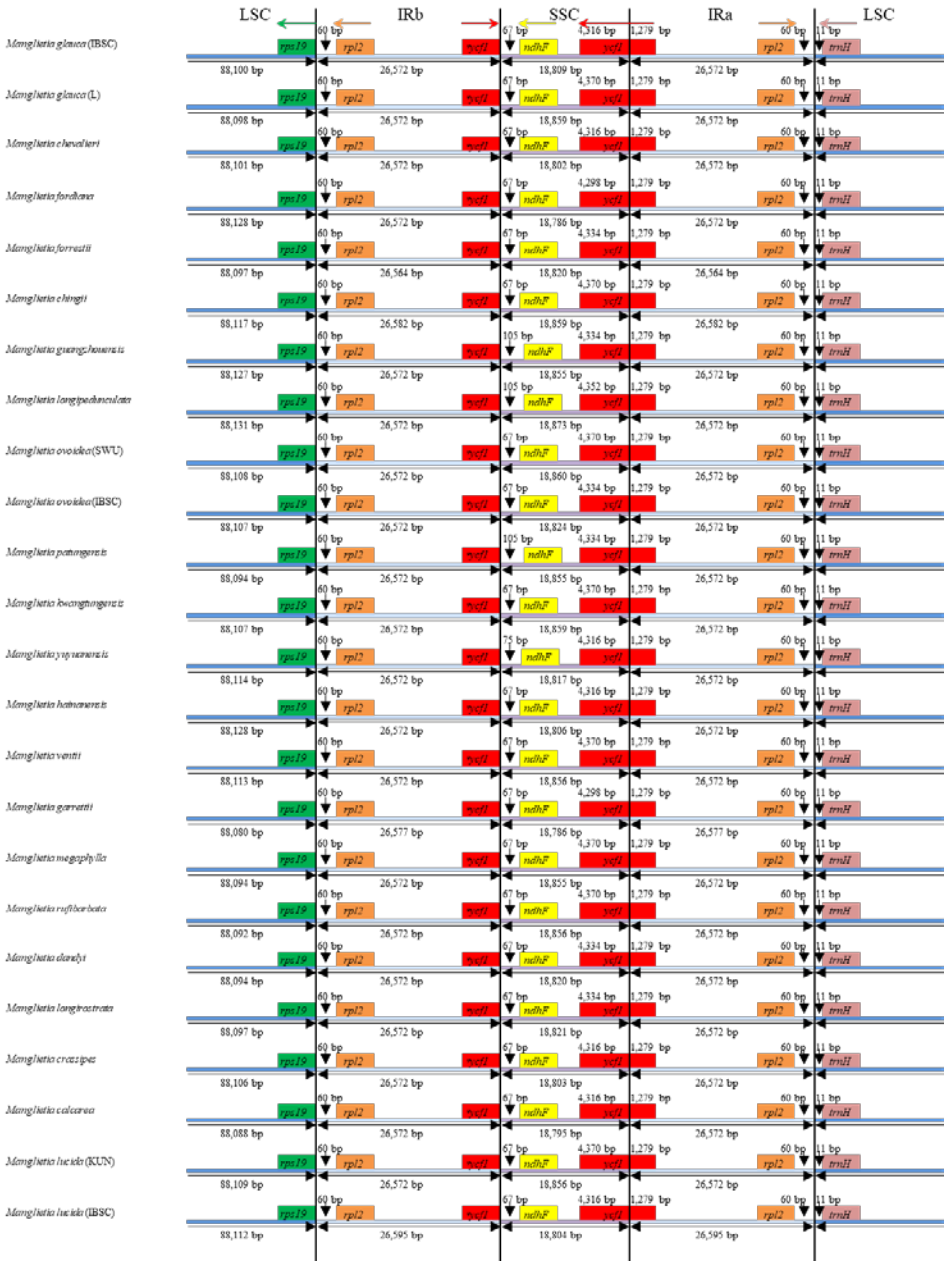


Fig. 7. Comparison of inverted repeat (IR) borders in chloroplast genomes of the 40 *Manglietia* and seven outgroup taxa. The order was arranged based on the phylogenetic tree reconstructed in this study. φ means pseudogene.

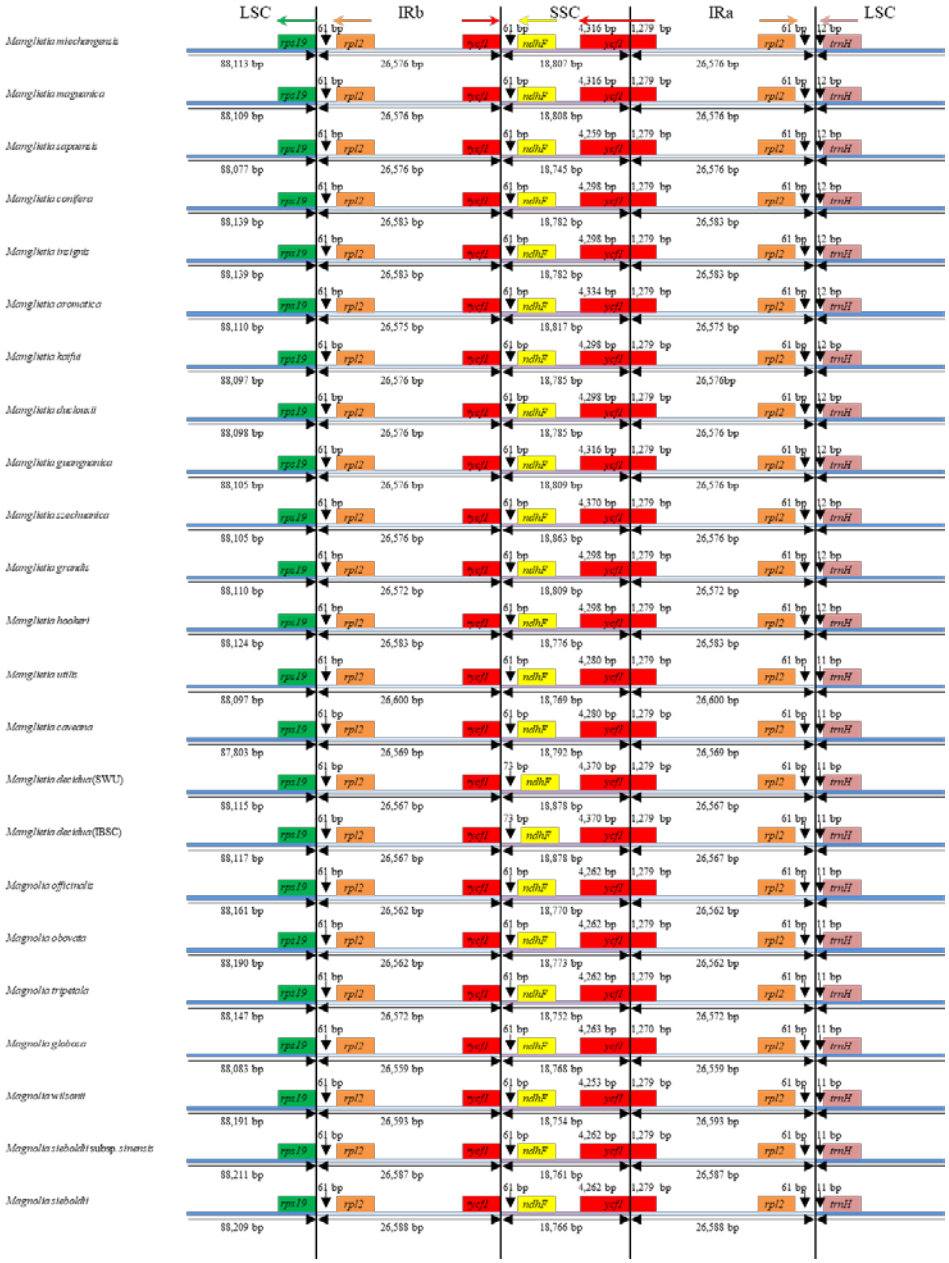


Fig. 7. (Continued)

2.3.3 Small repeated sequences

Four types of repeats, including forward, reverse, complement, and palindromic repeats with 30bp or longer, were identified in chloroplast genomes of *Manglietia* and outgroup taxa. Overall, 25 to 33 repeats were detected in each chloroplast genome, and 26 repeats were minimal in the *Manglietia* chloroplast genomes (Fig. 8 A). Forward and palindromic repeats were common, and reverse repeats were detected only in outgroup. The length of repeats ranged from 30 to 129 bp, which was the most common at 30 bp, followed by 33 bp, 42 bp, 39 bp, and 31 bp (Fig. 8B). Single sequence repeats (SSRs) were screened and counted on six types including mono-, di-, tri-, tetra-, penta-, hexanucleotide, and the number of SSR detected ranged from 43 to 59 in each chloroplast genome (Fig. 8C). The most common SSRs were mononucleotides, followed by tetranucleotides and dinucleotides (Fig. 8C and D). Pentanucleotide and hexanucleotide SSR were detected only in *Magnolia wilsonii* and *Magnolia globosa* of outgroup, respectively, and Trinucleotide SSR was not identified. Tetranucleotide SSRs consisting of AAAT / AATC / AATG / AATT / ACAT / CATT were identified throughout the taxa. SSRs consisting of A and T accounted for 81.2% of the total number of SSRs detected in *Manglietia*, and the proportion also was similar when including outgroup taxa (81.5%).

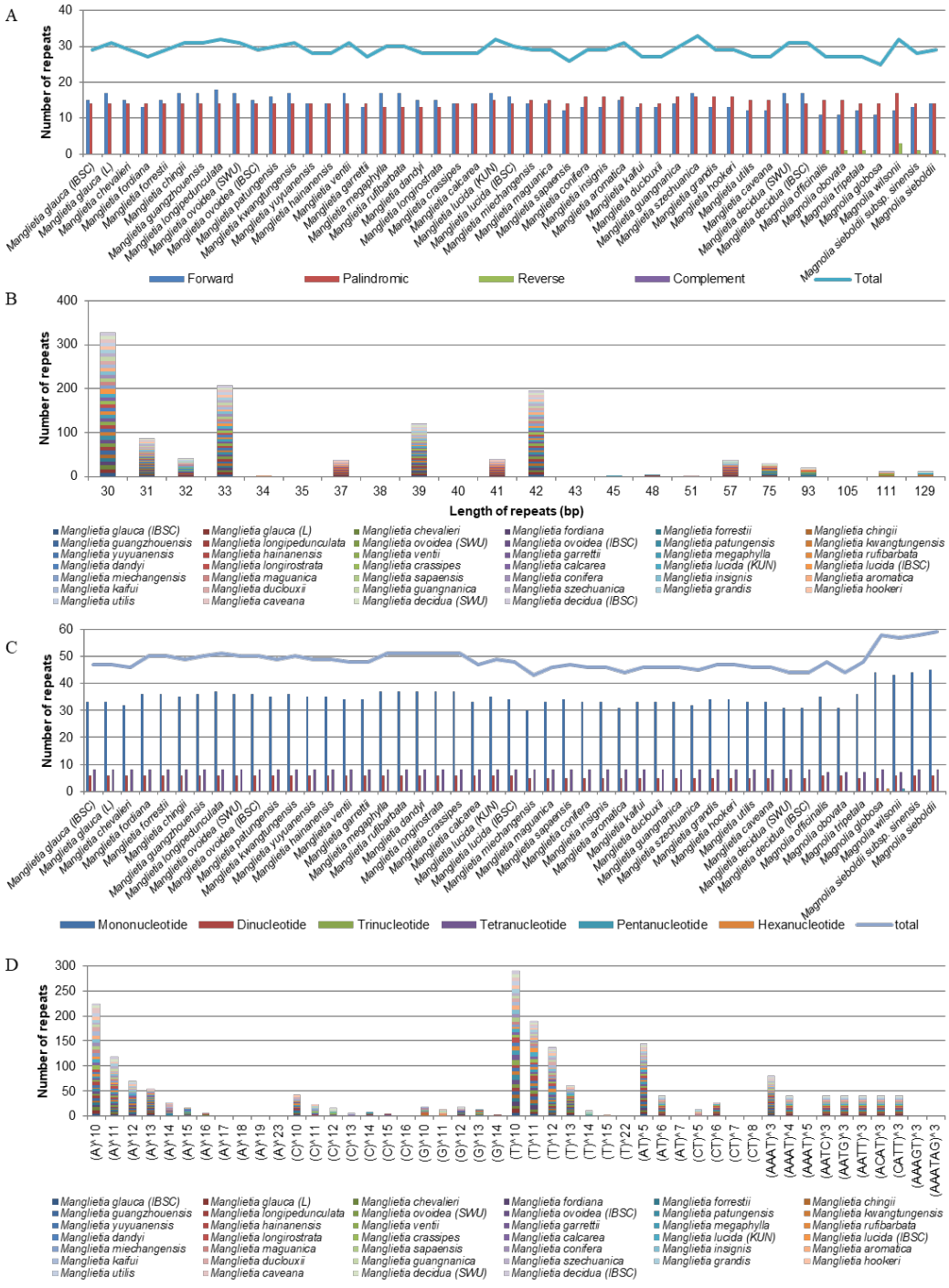


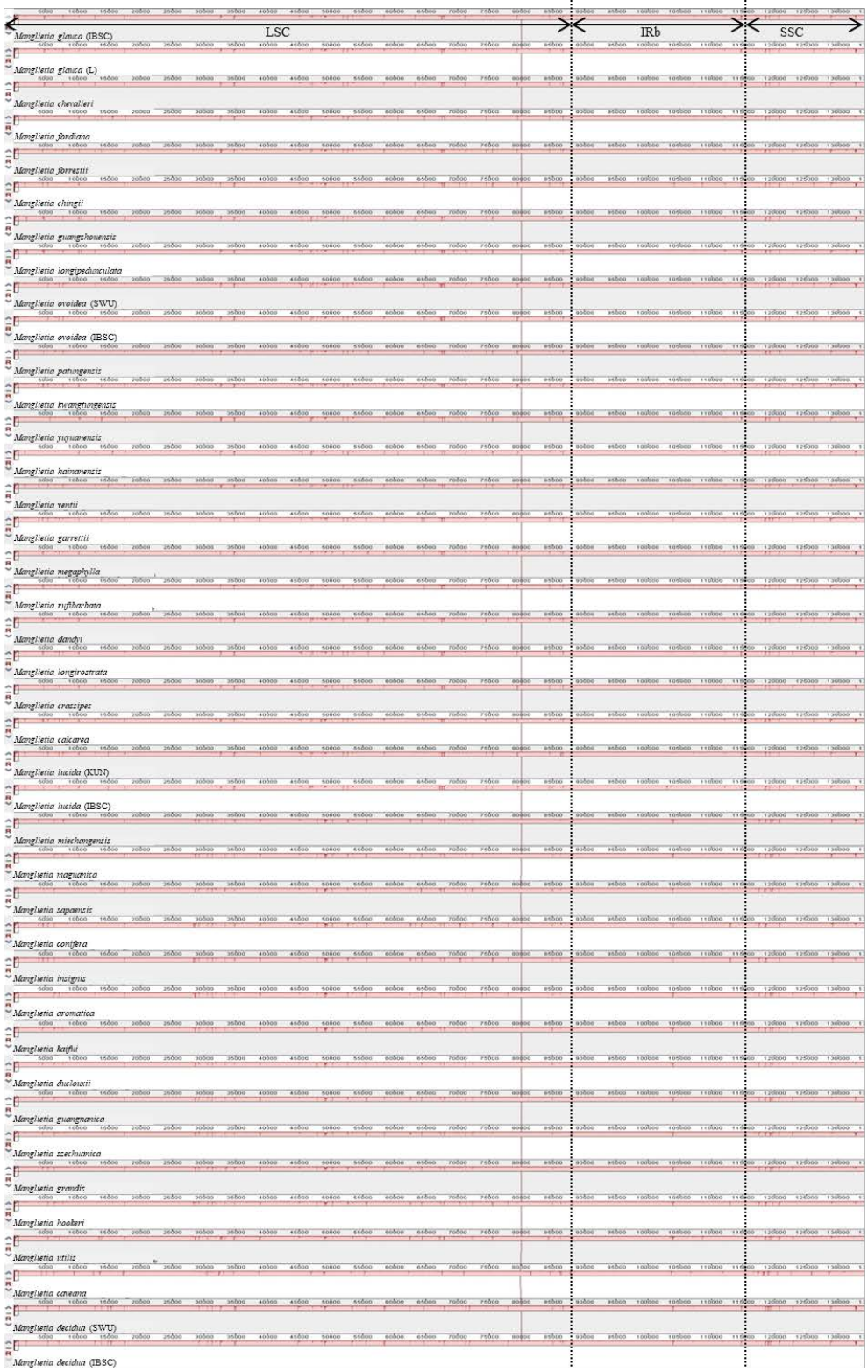
Fig. 8. The type and frequency of repeated sequences and simple sequence

repeats (SSRs) in chloroplast genomes in *Manglietia*. (A) Frequency of repeat by type. (B) Frequency of repeats by repeat length in 40 *Manglietia* chloroplast genomes. (C) Frequency of SSRs by type. (D) Frequency of SSRs by motif and copy number in 40 *Manglietia* chloroplast genomes. (A, C) Taxa including outgroups were arranged on the x-axis by the order in the phylogenetic tree reconstructed in this study.

2.3.4 Sequence divergence and hot spots

Multiple alignments by Mauve 2.4.0 were conducted to find rearrangement structure in *Manglietia* chloroplast genomes. The multiple alignments revealed high sequence similarity across the *Manglietia* chloroplast genomes, and no rearrangement in gene organization was observed (Fig. 9). The similarity profile drawn by MAUVE showed that IR region was more conserved than LSC and SSC regions. Multiple alignments, including outgroup taxa, were also the same as above (Appendix 3). The nucleotide variability (Pi) values were calculated with the 600bp of window length and 200 bp of step size using DnaSP v5.0 to evaluate the sequence divergence degree (Fig. 10). The Pi values in *Manglietia* were ranged from zero to 0.01414, and the average value was 0.00089, indicating that these sequences were quite similar (Fig. 10A). The average values in LSC, IR, and SSC were 0.00092, 0.00021, and 0.00173, respectively. It showed that IR region was more conserved than single copy regions, and SSC region was more variable than LSC and IR regions. The four variable regions (Pi

> 0.005) were detected in intergenic spacer regions of *petA-psbJ*, *rpl32-trnL-UAG*, *ccsA-ndhD,* and *rps15-ycf1*. The *petA-psbJ* had the highest value (Pi = 0.01414) and was located in LSC. The remainder, *rpl32-trnL-UAG*, *ccsA-ndhD,* and *rps15-ycf1*, were located in SSC. Also, five intergenic spacer regions of *rps16-trnQ-UUG*, *atpH-atpI*, *psbE-petL*, *ndhF-rpl32*, and *ndhE-ndhG*, and one coding region of *ccsA* showed relatively high Pi values (Pi > 0.003). When calculating the Pi values, including outgroup taxa, the three intergenic spacer regions (*rpl32-trnL-UAG*, *ccsA*-ndhD, and *rps15-ycf1*) had Pi values over 0.006 (Fig. 10B). Four intergenic spacers of *rpoB-trnC-GCA*, *trnC-GCA-petN*, *rps3-rps19* and one coding region of *ndhF* were also added to variable regions (Pi > 0.004), but Pi value of *atpH-atpI* did not increase relatively much (Fig. 10B). Of these regions, the seven regions (*rps16-trnQ-UUG*, *petA-psbJ*, *psbE-petL*, *ndhF-rpl32*, *rpl32-trnL-UAG*, *ccsA-ndhD*, and *rps15-ycf1*) were identified to be variable sites, even with or without outgroup taxa (Fig. 10).


LSC
IRb
SSC
Manglietia glauca (IBSC)
Manglietia glauca (L)
Manglietia chevalieri
Manglietia fordiana
Manglietia forrestii
Manglietia chingii
Manglietia guangzhouensis
Manglietia longipedunculata
Manglietia ovoidea (SWU)
Manglietia ovoidea (IBSC)
Manglietia patungensis
Manglietia hwangtungensis
Manglietia yuyuanensis
Manglietia hainanensis
Manglietia venii
Manglietia garrettii
Manglietia megaphylla
Manglietia ruffibarbata
Manglietia dandyi
Manglietia longirostrata
Manglietia crassipes
Manglietia calcarea
Manglietia lucida (KUN)
Manglietia lucida (IBSC)
Manglietia miechangensis
Manglietia maguanica
Manglietia zapaensis
Manglietia conifera
Manglietia insignis
Manglietia aromatica
Manglietia kaifui
Manglietia duclouxii
Manglietia guangnanica
Manglietia szechuanica
Manglietia grandis
Manglietia hookeri
Manglietia utilis
Manglietia caveana
Manglietia decidua (SWU)
Manglietia decidua (IBSC)

(previous page) Fig. 9. MAUVE alignment of 40 *Manglietia* chloroplast genomes. As the reference, *Manglietia glauca* is placed at the top of the figure. Within each of the alignment, local collinear blocks are represented by blocks of the same color connected by lines. The order is arranged based on the phylogenetic tree reconstructed in this study.

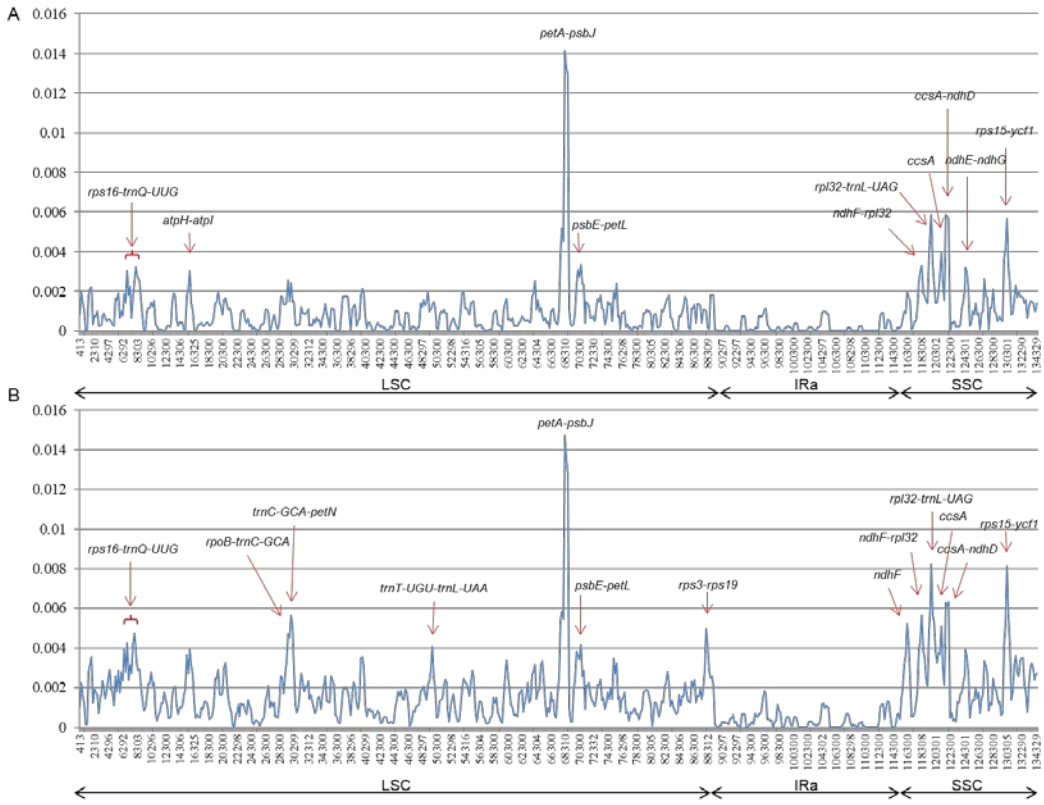


Fig. 10. Comparative analysis of the nucleotide diversity (Pi) values within *Manglietia* (A) and in *Manglietia* and outgroups (B). X-axis: a position of the midpoint of a window. Y-axis: nucleotide diversity.

2.3.5 Phylogenetic analyses in *Manglietia*

The 47 chloroplast genomes sequences excluding an IR, which included 40 samples representing 36 *Manglietia* taxa, and seven outgroup taxa closely related to *Manglietia*, used to estimate the phylogenetic relationships within *Manglietia*. The length of the aligned matrix was 134,708 bp, containing 1,730 variable sites (1.28%) and 1,004 parsimony-informative sites (0.75%). The phylogenetic trees were reconstructed by ML and BI analysis, and their topologies were almost identical (Fig. 11). In the tree, although bootstrap values (BS) in ML analysis and posterior probabilities (pp) in BI analysis that supported nodes were overall low, *Manglietia* formed a monophyletic group with highly supporting values (BS/PP = 100/1). *Manglietia decidua* was located at the basal in the *Manglietia* clade, and the remaining taxa formed a monophyletic group with relatively low supporting value (63/0.55). It indicated that *Manglietia decidua* might be a sister to the rest of *Manglietia*. In ML tree, *Manglietia caveana* was located at the basal in the clade excluding *Manglietia decidua*, with weak bootstrap value (BS=29) and formed polytomy with two large subgroups in BI tree. The remaining 34 taxa (37 samples) except *Manglietia decidua* and *Manglietia caveana* classified into two sub-clades with high support values (100/1). In the larger of these two subgroups, five sub-clades were recognized with relatively high support values in both ML and BI trees: a clade including *Manglietia glauca*, *Manglietia chevalieri*, *Manglietia fordiana*, and *Manglietia forrestii* (70/1); a clade of *Manglietia guangzhouensis* and *Manglietia longipedunculata* (90/1); a clade of *Manglietia yuyuanensis* and *Manglietia hainanensis* (83/1); a clade consisting of

Manglietia megaphylla, *Manglietia rufibarbata*, *Manglietia dandyi*, and *Manglietia longirostrata* (100/1); a clade comprising of *Manglietia crassipes*, *Manglietia calcarea*, and *Mangietia lucida* (80/1). In the other sub-clade, *Manglietia utilis* was the sister to others, and three sub-clades were supported by relatively high support values: a clade of *Manglietia conifera* and *Manglietia insignis* (100/1); a clade of *Manglietia kaifui* and *Manglietia duclouxii* (100/1); a clade including *Manglietia guangnanica*, *Manglietia szechuanica*, and *Manglietia grandis* (100/1).

2.4 Discussion

2.4.1 Structure of chloroplast genomes in *Manglietia*

Recently, the chloroplast genes and genomes have been used to reconstruct the phylogenetic relationships within Magnoliaceae (Azuma et al., 2011; Kim and Suh, 2013; Shen et al. 2018). This study focused on the *Manglietia* species of Magnoliaceae and included over 70% of Manglietia taxa listed up in the World checklist of Magnoliaceae (Govaerts et al., 2020), which is more than those in previous Magnoliaceae phylogenetic studies. The comparative chloroplast genome analyses for 40 *Manglietia* taxa and seven closely related outgroup taxa revealed that the genome structures and genes were highly conserved, and no rearrangement was found. The chloroplast genome size ranged from 159,733 bp to 160,148 bp in *Manglietia* (the maximum size including outgroup was 160,151 bp). The *Manglietia* chloroplast genomes had typical quadripartite structure

consisting of LSC, SSC, and two IR regions and included 113 genes consisting of 79 protein-coding genes, 30 tRNA genes, and four rRNA genes. The *rps12* showed a unique split structure in which the 5' end exon was located in the LSC region, and the 3' end exon and intron were located in the IR regions. Comparison of IR border regions showed high similarity in *Manglietia*, even with outgroup taxa, overall. The region between IR/SSC border and *ndhF* were variable relatively than the other borders. These variations in borders were noticeable between a large sub-clade (from *Manglietia glauca* to *Manglietia lucida*) located at the top of the tree and the rest, indicating that it follows phylogeny.

2.4.2 Diversity of repeated sequences and SSRs

Repeated sequences could affect rearrangements and sequence divergence, and each character generated from them could be useful for phylogenetic inference, by providing confidence for specific node in a phylogeny (Palmer, 1985; Palmer et al., 1988; Palmer, 1991). The frequencies of repeated sequences over 30 bp for the four repeat types were counted in each chloroplast genome, and the results were arranged in the order in phylogenetic tree reconstructed in this study on the x-axis of the graph (Fig. 8A). The taxa of the sub-clade, from *Manglietia glauca* to *Manglietia lucida*, showed a tendency to have more forward type than palindromic type, and the others *Manglietia* taxa and outgroup taxa showed the opposite tendency. The reverse repeats were detected in outgroup

taxa, but not in *Manglietia*. The taxa of the sub-clade, from *Manglietia glauca* to *Manglietia lucida*, had more SSRs than the other *Manglietia* taxa (Fig. 8C). The repeat types and the frequencies by the type, counted here were similar to those in the previous 26 Magnoliaceae chloroplast genome study (Shen et al., 2018).

2.4.3 Genome variation and hotspots

The multiple genome alignments and sliding window analyses for calculating pi values showed that *Manglietia* chloroplast genomes were highly conserved overall, and the IR region was the most conserved and followed by LSC and SSC regions. Also, seven regions of *rps16-trnQ-UUG*, *petA-psbJ*, *psbE-petL*, *ndhF-rpl32*, *rpl32-trnL-UAG*, *ccsA-ndhD*, and *rps15-ycf1* were revealed as highly variable sites, whether outgroup taxa were included or not. Of these regions, five regions (*rps16-trnQ-UUG, petA-psbJ*, *psbE-petL*, *ndhF-rpl32*, and *rpl32-trnL-UAG*) were suggested as the most variable regions across angiosperm lineages by Shaw et al. (2014). In the previous phylogenetic studies of Magnoliaceae, chloroplast regions of *ndhF*, *rbcL*, *matK*, ORF350, *trnL* intron, *trnL-trnF*, *trnH-psbA*, *rbcL-atpB*, *trnK* 5' intron, and *trnK* 3' intron have been mainly used (Azuma et al., 2001; Kim et al., 2001; Nie et al., 2008; Azuma et al., 2011; Kim and Suh, 2013). In low-level phylogenetic and phylogeographic studies of Manglietia and Magnoliaceae, the seven regions mentioned above, especially the five regions, also need to be considered as genetic markers together with markers that have been used universally.

2.4.4 Phylogenetic relationship within *Manglietia*

Previous phylogenetic studies have revealed the monophyly of *Manglietia* and the close relationship of *Manglietia*, section *Oyama*, and section *Rhytidospermum sensu stricto* (except for *Manglietia megaphylla*, *Manglietia fraseri*, and *Manglietia dealbata*), but the phylogenetic relationship within *Manglietia* has not been reconstructed with sufficient taxa, to date. In this study, over 70% of the reported *Manglietia* taxa were included and analyzed (Fig. 11). The phylogenetic analysis results suggested that *Manglietia decidua* may be the first basal taxa of *Manglietia* clade. It indicates that *Manglietia* may evolve from deciduous to evergreen since the outgroup taxa and *Manglietia decidua* are deciduous, and the rest of *Manglietia* is evergreen. *Manglietia caveana* may be the second basal taxa in *Manglietia*, but the bootstrap value was very low in ML, and polytomy was formed with two large sub-clades in BI. Thus the phylogenetic position of *Manglietia caveana* needs to be confirmed. Also, the phylogenetic results presented that *Manglietia* taxa except for *Manglietia decidua* and *Manglietia caveana* are divided into two sub-clades in *Manglietia*.

Several taxa in *Manglietia* have been controversial in their taxonomic treatment at the species level. *Manglietia hainanensis* was suggested as a species by Dandy (1930), who explained that the species was similar to *Manglietia fordiana* but could be distinguished from the latter by a short interval between the spathoid bract and bottom of the flower and by the leaf-lamina being distinctly reticulate on both surfaces. Xia et al. (2008) treated the taxa as a variety of *Manglietia*

fordiana, *Manglietia fordiana* var. *hainanensis*, but Hu (2011) suggested the taxa as a species based on the morphological characters of seed and hair base type of the leaves and unique distribution of the taxa. Our results support that they would be independent species by locating them separately in different sub-clades within the same major clade.

Manglietia megaphylla were reduced to *Manglietia dandyi* by Xia et al. (2008), but Hu (2011) noted that *Manglietia megaphylla* was different from *Manglietia dandyi* due to the differences of leaf size, shape, and petiole thickness in their holotype specimens. In our results, however, *Manglietia megaphylla* was closer to *Manglietia rufibarbata* than *Manglietia dandyi*.

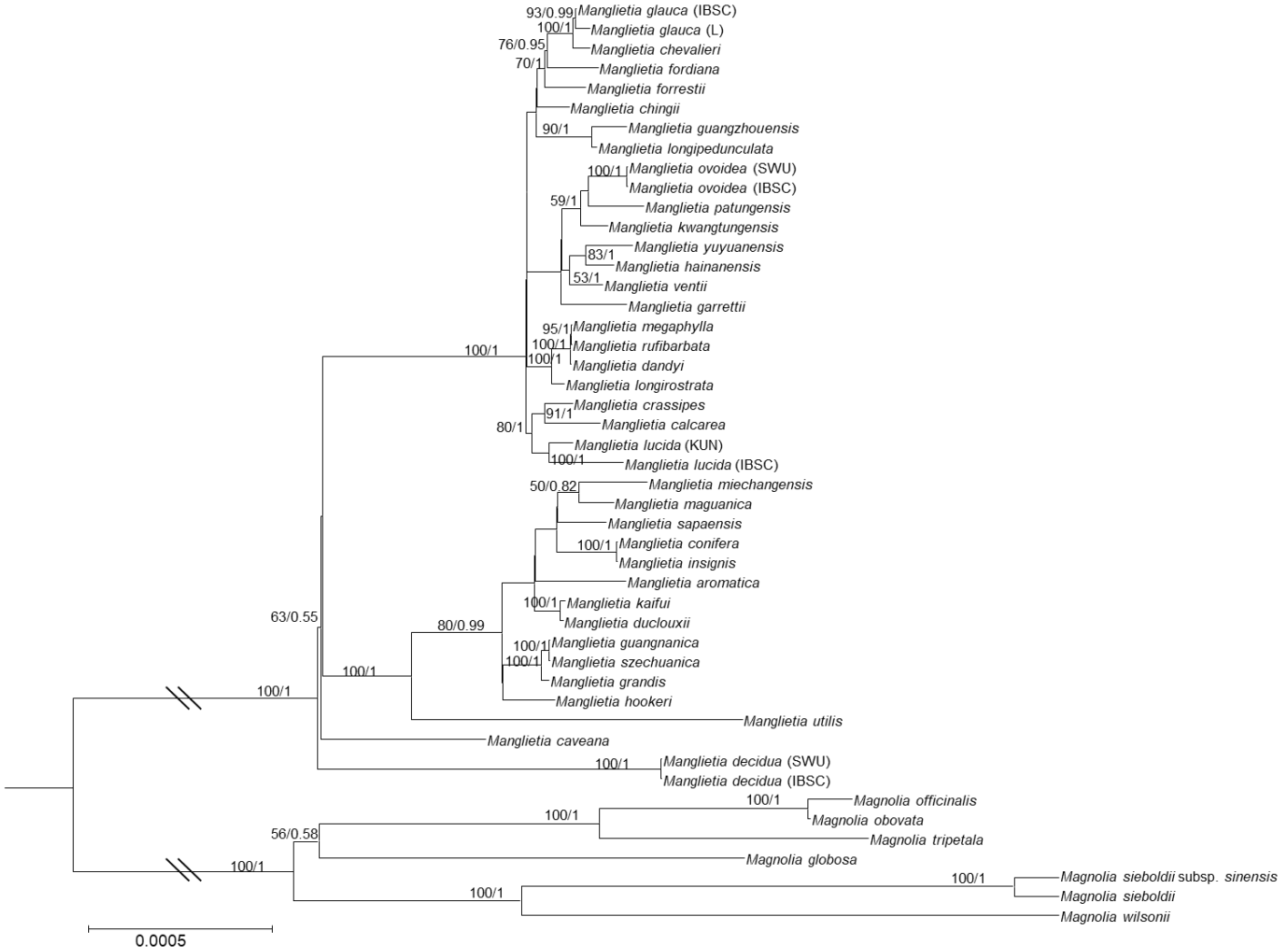
Manglietia maguanica was incorporated into *Manglietia insignis* by Liang and Nooteboom (1993) and Xia et al. (2008). Liang and Nooteboom (1993) considered *Manglietia insignis* has many variations in shape and size not only of the leaves but also of the flower because of the wide distribution of the taxa. However, Hu (2011) suggested *Manglietia maguanica* as an independent species based on characters that distinguish it from *Manglietia insignis*, such as hairless green branches with white powder, irregular ring-shaped stipules on the branches, and seed morphology. In our results, *Manglietia maguanica* did not form a clade with *Manglietia insignis*.

Xia et al. (2008) noted that *Manglietia miechangensis* belong to the *Manglietia insignis* but was not published validly because the type and Latin descriptions were not provided. Hu (2011) recognized *Manglietia miechangensis* as an

independent species, indicated types, and wrote descriptions for this species. In our results, *Manglietia miechangensis* did not form a clade with *Manglietia insignis*.

Manglietia longirostrata was presented as a new species by Liu (2004) under the name of *Manglietia rostrata* before it has been formally described, and Hu (2011) described the taxon under the name of *Manglietia longirostrata*. Hu et al. (2012) published the taxa as a variety of *Manglietia hookeri*, *Magnolia hookeri* var. *longirostrata*. Currently, this taxon was recorded as a heterotypic synonym of *Magnolia hookeri* in World checklist of *Magnoliaceae* (Govaerts et al., 2020). However, our results show that the taxa and *Manglietia hookeri* were located in different clade respectively.

Despite focusing on *Manglietia* and analyzing the chloroplast genome of considerable taxa, overall support values remain low, and unresolved phylogenetic relationships have remained, which caused by low proportions of variable sites and parsimony-informative sites in *Manglietia* chloroplast genome. Phylogeny of *Manglietia* need to be reconstructed by using additional DNA data set originated from other genomes, including more taxa. It is necessary to be analyzed 20 nuclear regions having high phylogenetic fidelity that induce quartet within a large sub-clade containing *Manglietia* similarly to the phylogenetic tree using 400 nuclear segments described in Chapter 4.


93/0.99
Manglietia glauca (IBSC)
100/1
Manglietia glauca (L)
76/0.95
Manglietia chevalieri
70/1
Manglietia fordiana
Manglietia forrestii
Manglietia chingii
90/1
Manglietia guangzhouensis
Manglietia longipedunculata
100/1
Manglietia ovoidea (SWU)
Manglietia ovoidea (IBSC)
59/1
Manglietia patungensis
Manglietia kwangtungensis
Manglietia yuyuanensis
83/1
Manglietia hainanensis
53/1
Manglietia ventii
Manglietia garrettii
95/1
Manglietia megaphylla
100/1
Manglietia rufibarbata
100/1
Manglietia dandyi
Manglietia longirostrata
Manglietia crassipes
91/1
Manglietia calcarea
80/1
Manglietia lucida (KUN)
100/1
Manglietia lucida (IBSC)
50/0.82
Manglietia miechangensis
Manglietia maguanica
Manglietia sapaensis
100/1
Manglietia conifera
Manglietia insignis
Manglietia aromatica
100/1
Manglietia kaifui
Manglietia duclouxii
100/1
Manglietia guangnanica
100/1
Manglietia szechuanica
Manglietia grandis
Manglietia hookeri
100/1
63/0.55
80/0.99
100/1
100/1
Manglietia utilis
Manglietia caveana
100/1
Manglietia decidua (SWU)
Manglietia decidua (IBSC)
100/1
Magnolia officinalis
100/1
Magnolia obovata
56/0.58
Magnolia tripetala
Magnolia globosa
100/1
100/1
Magnolia sieboldii subsp. sinensis
100/1
Magnolia sieboldii
Magnolia wilsonii
0.0005

(Previous page) Fig. 11. A result of phylogenetic analyses in *Manglietia* based on chloroplast genomes. Maximum likelihood (ML) and Bayesian inference (BI) approaches are used. Bootstrap values of over 50 in ML and posterior probabilities of over 0.5 in BI were indicated above the branches (BS/PP). Multiple samples from different sources in a taxon are distinguished by parenthesized herbarium abbreviations

Chapter 3. Comparative and phylogenetic analyses of chloroplast genomes in Magnoliaceae

3.1 Introduction

Chloroplast genome is generally 120-160 kb in size and is a circular chromosome consisting of four segments in which a small single-copy region (SSC) and a large single-copy region (LSC) are separated by a pair of inverted repeats (IRs) (Palmer, 1985, Palmer et al., 1988; Twyford and Ness, 2017). The chloroplast genome exists in a high-copy number of chloroplasts per cell, is inherited clonally through the maternal lineage, and is highly conserved in gene content and gene order of the genome in angiosperms (Palmer et al., 1988; Twyford and Ness, 2017). The continued use of chloroplast DNAs is due to its accessibility to make universal primers that amplify homologous loci in phylogenetically diverse species based on the features of the chloroplast genome (Twyford and Ness, 2017).

The recent molecular phylogenetic studies on Magnoliaceae analyzed ten chloroplast DNA regions for 48 taxa representing all genera and sections of the family and identified major eleven clades within Magnolioideae, but the relationships among them were unclear (Kim and Suh, 2013). In this study, we (1) sequenced and assembled the chloroplast genomes of 124 Magnoliaceae taxa representing all major subgroups of Magnoliaceae, applying target-enrichment sequencing (Hyb-seq) (2) compared the structural variation of the Magnoliaceae

cp genomes, (3) investigated variable regions, repeat sequences, and simple sequence repeats (SSRs) which have potential utility in phylogenetic analysis for additional samples in the future, and finally, (4) clarified relationships within Magnolioideae together with well-supported phylogeny of Magnoliaceae, based on the chloroplast genome data.

3.2 Materials and Methods

3.2.1 Taxon sampling, DNA extraction, and sequencing

A total of 124 taxa (125 samples), which are inclusive of all genera and sections (7 genera and 16 sections) recognized in the classification system of Magnoliaceae by Nooteboom (1985), were used in this study (Appendix 4). Of the total samples, 69 samples, 33 samples, and 25 samples were extracted from the same materials used in the previous studies of Kim et al. (2001), Kim and Suh (2013), and *Manglietia* study in chapter 2, respectively. We followed the Magnoliaceae classification of Nooteboom (1985), but we would refer to the following genus and section names for convenience in description: *Dugandiodendron* Lozano, and *Splendentes* Dandy ex A. Vazquez.

Total genomic DNA was extracted from leaves either fresh or dried by silica gel, or in herbarium specimens, using the Exgene^{TM} Plant SV mini kit (GeneAll, Seoul, Korea). Extracted DNA samples were quantified using Quant-iT™ PicoGreen™ dsDNA Assay Kit (Invitrogen, Oregon, USA) and SpectraMax M5 Microplate

Reader (Molecular Device, California, USA), and normalized to a concentration of 50 ng/μl and a volume of 50 μl. In the case of *Magnolia pterocarpa* and *Magnolia liliifera*, since the DNA samples were not enough in the volume and the concentration, and the whole genomes were amplified using REPLI-g® Mini Kit (QIAGEN, Hilden, Germany) following the manufacturer's manual.

Probes capturing chloroplast DNA from genomic DNA were designed as 1 x tiling without overlap based on *Magnolia kobus* chloroplast genome (JX280396; Song et al., 2018) in length 132,855 bp except for an IR region. Genomic DNA libraries were made by random mechanical shearing of DNA to an average size of 300 bp followed by an end-repair reaction, ligation of an adenine residue to the 3’-end of the blunt-end fragments to allow the ligation of barcoded adapters and PCR-amplification of the library. SureSelect probes (Agilent Technologies: Santa Clara, CA, USA) were used for solution-based target enrichment of pool of 16 libraries following SureSelectxt Target Enrichment System for Illumina Paired-End Multiplexed Sequencing Library protocol. Data was sequenced using Illumina HiSeq 3000 to generate paired-end 100 bp or 150 bp reads. Sequencing was performed in the RAPiD Genomics, LLC (Florida, USA).

We attempted to capture both chloroplast genome and hundreds of low copy nuclear genes simultaneously by making the proportions of probes capturing chloroplast DNA and nuclear DNA different like 1 x and 2 x tiling, since the proportion of organellar and nuclear targets in genomic DNA is different. We calculated the proportion of reads on the chloroplast genome by mapping

generated raw reads to the *Magnolia kobus* chloroplast genome, and it was approximately from 18.8% to 83.6% (Appendix 5). It is not recommended to capture both organellar DNAs and low copy nuclear genes at the same time (Weitemier et al. 2014). Strategies for mixing the enriched library and a small amount of unenriched library (Villarverde et al., 2018) or sequencing both the libraries separately to recover off-targeted high-copy elements enough (Dodsworth et al., 2019) has been suggested.

3.2.2 Genome assembly and annotation

The raw reads were checked on their qualities using FastQC v.0.11.5 (Andrews, 2010) and trimmed with the quality cutoff of 20 in the start and end of a read and 20 in a four bp sliding window, discarding any reads trimmed to less than 30 bp and adapter, using Trimmomatic v.0.36 (Bolger et al., 2014). The filtered reads were mapped to the chloroplast genome of closely related species either published or unpublished, using BWA v.0.7.15 (Li and Durbin, 2009) with default options: *Magnolia cathcartii* (JX280392), *Michelia odora* (JX280398; Song et al. 2019), *Magnolia acuminata* (JX280391), *Magnolia denudata* (JX280394), *Magnolia kobus* (JX280396; Song et al., 2018), *Magnolia liliiflora* (JX280397; Song et al. 2019), *Magnolia salicifolia* (JX280399), *Magnolia yunnanensis* (KF753638; Yang et al., 2014), *Magnolia kwangsiensis* (HM775382; Kuang et al., 2011), *Manglietia glauca* (unpublished), *Magnolia grandiflora* (JN867584), *Magnolia officinalis* (JN867579), *Magnolia dealbata* (JX280393; Song et al. 2019),

Magnolia pyramidata (JX280395; Song et al. 2019), *Magnolia coco* (unpublished), *Magnolia portoricensis* (unpublished), *Liriodendron chinense* (KU170538; Li et al., 2016), and *Liriodendron tulipifera* (DQ899947). The reference genome applied to each taxon was selected based on Kim and Suh (2013) and Nooteboom (1985). The mapped reads were sorted, and consensus sequences were obtained using bcftools v. 1.5 and SAMtools v1.5 (Li et al., 2009). All consensus sequences were revised by re-mapping their own cleaned reads with Geneious 11.1.3 (Kearse et al., 2012), and 125 chloroplast genomes were generated. These chloroplast genome sequences were aligned using MAFFT v 7.388 (Katoh and Standley, 2013) with the auto option, and the aligned sequences were manually revised in Geneious 11.1.3 (Kearse et al., 2012). The chloroplast genomes were annotated based on the *Magnolia kobus* chloroplast genome (JX280396; Song et al., 2018) and manually corrected for intron/exon boundaries by comparing genes in the alignment matrix using Geneious 11.1.3 (Kearse et al., 2012). The borders of the large single copy (LSC), small single copy (SSC), and two inverted repeats (IRs) were determined by aligning sequences around the borders of LSC/IRb and IRb/SSC, with reverse complemented sequences around the borders of IRa/LSC and SSC/IRa, using Geneious 11.1.3 (Kearse et al., 2012). The circular gene map based on a consensus sequence was drawn by the OGDRAW tool (Bock et al., 2019).

We also found 11 small inversions, including those within *matK* and *trnH-psbA* intergenic spacer, which were recognized in previous studies (Azuma et al., 1999; Azuma et al., 2011; Kim and Suh, 2013), by searching palindromic repeats with

short distance using REPuter online software (Kurtz et al., 2001). The length of the small inversions was a minimum of 2 bp to a maximum of 96-97 bp (Appendix 12-22). In the previous studies, the small inversions were excluded from the data matrix or substituted with their reverse complementary sequences, because it seemed to occur regardless of the lineage (Azuma et al., 1999; Kim and Suh, 2013) and to present heterogeneously at the infraspecific level in other plants (Ohsako and Ohnishi, 2000; Kim and Lee, 2005). However, we included these inversions in the data matrix for the following analyses since we thought the chloroplast genome dataset was large enough to cover the bias caused by the inversions. We also compared the small inversion sequences by arranging it in the order of the phylogenetic tree reconstructed in this study to see if it occurred regarding lineage.

3.2.3 Repeat structure and sequence divergence analyses

Repeat sequences including forward, reverse, complement, and palindromic repeats in these chloroplast genomes were identified using REPuter online software (Kurtz et al., 2001) with a minimum repeat size of 30 bp and sequence identity greater than 90% (Hamming distance of 3). Simple sequence repeats (SSRs) in these chloroplast genomes were detected using Msastcommader v0.8.2 (Faircloth, 2008) with the option set at ≥ ten for mononucleotides, ≥ five for dinucleotides, ≥ five for trinucleotides, and ≥ three for tetranucleotides, pentanucleotides, and hexanucleotides. Multiple alignments of these 125

chloroplast genome sequences exclusive of an IR region were performed using the progressive Mauve aligner in Mauve (Darling et al., 2004) to evaluate large-scale rearrangements and inversions. Nucleotide diversity (Pi) of these chloroplast genomes were calculated using a sliding window analysis in DNAsp 5.0 (Librado and Rozas, 2009) to screen variable regions, based on a matrix aligned by MAFFT v 7.388 (Katoh and Standley, 2013) and revised manually. The window length was 600 bp, and the step size was 200 bp.

3.2.4 Phylogenetic analyses

The 125 chloroplast genomes, including three *Liriodendron* taxa as the outgroup, were used to analyze phylogeny in Magnoliaceae. Phylogenetic analyses were conducted using two algorithms, Maximum likelihood (ML) and Bayesian inference (BI), after evaluating the best-fit substitution model by PartitionFinder 2 (Lanfear et al., 2016) based on the corrected Akaike information criterion. The analyses were run based on a dataset in alignment length 136,930bp exception of an IR. ML analysis was performed using raxmlGUI v. 1.5 (Silvestro and Michalak, 2012) with GTRGAMMAI model and bootstrap 500 replicates. BI analysis was conducted using MrBayes v3.2.6 (Ronquist et al., 2012) with 1,000,000 generations and trees were sampled every 500 generations with the first 25% discarded as burn-in. The analysis was run to completion, and the standard deviation of split frequencies was <0.01.

3.3 Results

3.3.1 Structure of chloroplast genomes in Magnoliaceae

The Magnoliaceae chloroplast genomes ranged from 159,269 bp (*Magnolia bankardiorum*) to 160,186 bp (*Magnolia carsonii*) in length (Fig. 12, Appendix 6). These chloroplast genomes had a typical structure that consisted of a pair of IRs separated by LSC and SSC. The length of LSC, IR, and SSC region ranged from 87,456 bp (*Magnolia stellata*) to 88,211 bp (*Magnolia sieboldii* subsp. *sinensis*), from 26,333 bp (*Liriodendron chinense* and *Liriodendron chinense* x *Liriodendron tulipifera*) to 26,613 bp (*Magnolia borneensis*), and from 18,690 bp (*Magnolia liliifera*) to 18,997 bp (*L. chinense* and *L. chinense* x *L. tulipifera*) respectively.

In Magnolioideae, the length of the IR region ranged from 26,442 bp (*Magnolia bankardiorum*) to 26,613 bp (*Magnolia borneensis*), and the length of the SSC region ranged from 18,690 bp (*Magnolia liliifera*) to 18,891 bp (*Manglietia pachyphylla*). The overall GC contents ranged from 39.20% to 39.30%. A few Ns have remained in the intergenic spacer of *trnT-UGU* and *trnL-UAA* in 13 chloroplast genomes (199 bp in *Magnolia acuminata* var. *subcordata*, 92 bp in *Magnolia albosericea*, 74 bp in *Magnolia campbellii*, 83bp in *Magnolia mindoensis*, 94 bp in *Magnolia ovata*, 37 bp in *Magnolia pterocarpa*, 18 bp in *Magnolia salicifolia*, 131 bp in *Manglietia caveana*, 4 bp in *Manglietia glauca*, 11 bp in *Manglietia ventii,* 48 bp in *Michelia compressa*, 29 bp in *Michelia maudiae*, and 79 bp in *Michelia salicifolia*).

The chloroplast genomes of 124 Magnoliaceae taxa (125 samples) encoded an identical set of 131 genes that comprise of 113 genes, including 79 protein-coding genes, 30 tRNA genes, and four rRNA genes were unique (Appendix 6 and Table 7). Six protein-coding genes (*ndhB*, *rpl2*, *rpl23*, *rps7*, *rps12*, *ycf15*, and *ycf2*), seven tRNA genes (*trnA*-UGC, *trnI*-CAU, *trnI*-GAU, *trnL*-CAA, *trnN*-GUU, *trnR*-ACG, and *trnV*-GAC), and four rRNA genes (*rrn16*, *rrn23*, rrn4.5, and *rrn5*) were duplicated in IR regions. The *rps12* had a unique split structure; 5' end exon of the *rps12* was placed in the LSC region, and 3' end exon and intron were located in the IR region. Among the 113 genes, 13 genes, including six tRNA genes and seven protein-coding genes (*trnA-UGC*, *trnG-UCC*, *trnI-GAU*, *trnK-UUU*, *trnL-UAA*, *trnV-UAC*, *rps16*, *rpl2*, *rpoC1*, *petB*, *atpF*, *ndhA*, and *ndhB*) had one intron, and three protein-coding genes (*rps12*, *clpP*, and *ycf3*) had two introns.



Fig. 12. A typical gene map from chloroplast genomes in Magnoliaceae. Genes inside the circle are transcribed clockwise, and those outside are counter-clockwise. Genes belongings to different functional groups are color-coded. The light grey graph inner circle indicates GC content.

Table 7. List of genes in chloroplast genomes from Magnoliaceae

Genes categories	Group of genes	Name of genes
Self-replication	Ribosomal RNA genes	**rrn5, *rrn4.5, *rrn16, *rrn23*
	Transfer RNA genes	[a]**trnA-UGC, trnC-GCA, trnD-GUC, trnE-UUC, trnF-GAA, trnfM-CAU, trnG-GCC,* [a]*trnG-UCC, trnH-GUG, *trnI-CAU,* [a]**trnI-GAU,* [a]*trnK-UUU, *trnL-CAA,* [a]*trnL-UAA, trnL-UAG, trnM-CAU, *trnN-GUU, trnP-UGG, trnQ-UUG, *trnR-ACG, trnR-UCU, trnS-GCU, trnS-GGA, trnS-UGA, trnT-GGU, trnT-UGU, *trnV-GAC,* [a]*trnV-UAC, trnW-CCA, trnY-GUA*
	Small subunits of ribosomal protein genes	*rps2, rps3, rps4, *rps7, rps8, rps11,* [b]**rps12, rps14, rps15,* [a]*rps16, rps18, rps19*
	Large subunit of ribosomal protein genes	[a]**rpl2, rpl14, rpl16, rpl20, *rpl23, rpl32, rpl33, rpl36*
	RNA polymerase subunits	*rpoA, rpoB,* [a]*rpoC1, rpoC2*
Genes for photosynthesis	Subunits of photosystem Ⅰ	*psaA, psaB, psaC, psaI, psaJ*
	Subunits of photosystem Ⅱ	*psbA, psbB, psbC, psbD, psbE, psbF, psbH, psbI, psbJ, psbK, psbL, psbM, psbN, psbT, psbZ*
	Subunits of Cytochrome	*petA,* [a]*petB, petD, petG, petL, petN*
	Subunits of ATP-synthases	*atpA, atpB, atpE,* [a]*atpF, atpH, atpI*
	RuBisCo large subunit	*rbcL*
	Subunits of NADH dehydrogenase	[a]*ndhA,* [a]**ndhB, ndhC, ndhD, ndhE, ndhF, ndhG, ndhH, ndhI, ndhJ, ndhk*
Other genes	Translational initiation factor	*infA*
	Maturase	*matK*
	Protease	[b]*clpP*
	Envelope membrane protein	*cemA*
	Subunit of Acetyl-CoA- carboxylase	*accD*
	C-type cytochrome synthesis gene	*ccsA*
Unknown function	Conserved open reading frames	*ycf1, *ycf2,* [b]*ycf3, ycf4, *ycf15*

[a] genes contain one intron; [b] genes contain two introns; [*] duplicate genes in IR.

3.3.2 Variation of IR borders

The locations of IR border regions and adjacent genes in Magnoliaceae chloroplast genomes were compared to identify the variation of expansion and contraction of the border region associated with phylogeny (Appendix 7). The border between LSC and IRb (LSC/IRb) was located between *rps19* and *rpl2*, and the border between IRb and SSC (IRb/SSC) was located between 5' portion fragment of the *ycf1*, and *ndhF*. The *ycf1* gene crossed the border between the SSR and IRa (SSC/IRa), and the border was located about four-fifths of the *ycf1* gene toward the 5' end of the gene. It allowed the 5' portion fragment of *ycf1* to

locate on the IRb region. The border between IRa and LSC (IRa/LSC) was located between *rpl2* and *trnH*.

In most of the chloroplast genomes of Magnolioideae, LSC/IRb was right next to the 5' end of *rps19*, but the IRb region sometimes was located away 1-6bp from *rps19* or expanded into the gene *rps19* with 1-4 bp. Also, the border of LSC/IRb was located apart 53-67 bp from the 3' end of *rpl2*. The border of IRb/SSC was 40-67 bp away from *ndhF* commonly, but it was 73bp and 105 bp away in *Manglietia decidua* and *Manglietia changhungtana*, respectively. The length of 5' portion fragment of *ycf1* on the IR regions by the border of SSC/IRa ranged 1,252 to 1,307 bp. The border of IRa/LSC was separated from *rpl2* by the same distance as the distance between border LSC/IRb and *rpl2*. The border of IRa/LSC was usually 11-16 bp away from *trnH*, but the distance in GWILLIMIA and TALAUMA was variable clade in the 2-22 bp range. In Magnolioideae, overall, the border structures were conserved, but the distances between the borders and adjacent genes were tended to be variable in taxa of TALAUMA clade and GWILLIMIA clade than in other taxa.

In Liriodendroideae, the border LSC/IRb was located three bp away from the 5' end of the *rps19* gene and 49 bp away from the 3' end of the *rpl2* gene. The distance between the border IRb/SSC and the 3' end of the *ndhF* gene ranged 80-112 bp, which was farther than that in Magnolioideae. The IRa region was contracted toward the 5' end of the *ycf1* gene, and it made a 5' portion fragment of *ycf1* with 1,090-1,119 bp in the IRb region, which was shorter than in

Magnolioideae. The border IRa/LSC was separated from *rpl2* by the same distance as the border LSC/IRb from the *rpl2* gene. The border was away 24-29 bp from the 3' end of the *trnH*, which was more distant than that in Magnolioideae

The length of the 3' end portion of the *ycf1* gene in the SSC region was determined by a variable repeat number of an 18 bp (TATTCTGATCATTATTGG) sequence (Appendix 8). Six bp direct repeat sequences (TATTGG) were found on both sides of the repeat, and no insertions were found without the short direct repeats. The number of repeats ranged from zero in *Magnolia cubensis* and *Liriodendron* taxa to seven in several *Manglietia* taxa. In *Panax*, the *ycf1* gene has duplicated insertions with short direct repeats on both ends (Kim and Lee, 2004), and these indels may have originated from intramolecular recombination events mediated by the short direct repeats (Ogihara et al., 1988).

3.3.3 Repeat sequences

Four types of repeats, including forward, reverse, complement, and palindromic repeats with 30bp or longer were identified in the Magnoliaceae chloroplast genomes. Overall, 21 to 37 pairs of repeats were detected in each chloroplast genome (Appendix 9). In the repeat types, palindrome and forward repeats were frequent, reverse repeats were rare, and no complement repeats were found (Appendix 9 and 11 A, B). The length of repeats ranged from 30 bp to 129 bp, and the repeats in length 30 bp were most frequent. Repeats with lengths of 31, 32, 33, 39, 41, and 42 bp were found a pair or more in each of chloroplast

genome, and repeat with length 93 bp or more were only detected in *Manglietia* taxa.

Single sequence repeats (SSRs) were screened and counted on six types, including mono-, di-, tri-, tetra-, penta-, and hexanucleotide, in each chloroplast genomes (Appendix 10 and 11 C, D). The total number of SSRs ranged from 32 to 72 and the most abundant SSRs are mononucleotide composed of A or T and follow by tetranucleotides and dinucleotides. On the other hand, trinucleotides, pentanucleotide, and hexanucleotides were rare. The chloroplast genomes of three Liriodendroideae taxa tended to have more SSRs relatively than those of Magnoliodieae taxa, in which the total numbers of the SSRs were 62, 62, and 72 in *Liriodendron chinense*, *Liriodendron chinense* x *Liriodendron tulipifera*, and *Liriodendron tulipifera* respectively.

Also, we found 11 small inversions, including the inversions in *matK* and *trnH-psbA* that were commented in previous molecular studies of Magnoliaceae (Azuma et al., 1999; Azuma et al., 2011; Kim and Suh, 2013). We surveyed these small inversions by searching palindromic repeats having a distance since these inversions occur in the spacer between a pair of inverted repeats that forms a stem of hairpin structure when single-stranded (Catalano et al., 2009). In addition to one inversion in *trnH-psbA* spacer region and three inversions in *matK*, one inversion was detected in each of *petN-psbM*, *rpl32-trnL*, *ccsA-ndhD*, and *rps15-ycf1* spacer region, and three inversions were found in *petA-psbJ* spacer region. The length of the spacer between inverted repeat sequences was ranged from 2

bp to 96 or 97 bp, and the length of the inverted repeat sequences was ranged from 7 bp to 29 bp. Several substitutions and indels existed in these regions in some taxa, and we compared these sequences by arranging in order of the phylogenetic tree (Appendix 12-22).

In *trnH-psbA*, two types of inversion sequences of 6 bp were located between a pair of inverted repeat sequences of 20 bp (Appendix 12). Species of YULANIA clade (except for *Magnolia acuminata*) had ATAGGA or TCCTAT (type B), the other taxa had ATAGAA or TTCTAT (type A), and the inversions were found heterogeneously. Only MACROPHYLLA clade taxa had ATAAAA, but no inversion of the sequence was identified. In *matK*, three inversions were verified. The lengths of inversion were two bp (GA or TC), three bp (GAA or TTC), and six bp (AATAGA or TCTAATT), and the lengths of inverted repeat sequences were eight bp, nine bp, and seven bp respectively (Appendix 13, 14, and 15). In the first small inversion in *matK*, taxa in GYNOPODIUM clade and *Magnolia cubensis* had TC instead of GA (Appendix 13). In the second small inversion, *Magnolia dawsoniana*, *Magnolia sargentiana*, taxa in clades of THEORHODON and GWILLIMIA, *Liriodendron chinense*, and *Liriodendron* hybrid taxon had TTC instead of GAA (Appendix 14). In the third small inversion, taxa in clades of MICHELIA, YULANIA, GYNOPODIUM, and KMERIA had AATAGA, and the other taxa had TCTATT (Appendix 15). In *petN-psbM* spacer region, a small inversion of 12 bp (AACTATATGAAC instead of GTTCATATAGTT) occurred only in *Magnolia coco* and *Magnolia championii*, which had 23 bp inverted repeat sequences matched completely (Appendix 16).

In *petA-psbJ* spacer region, three inversions were identified (Appendix 17, 18, and 19). In the first inversion in *petA-psbJ*, two types of inversion sequences were found (Appendix 17). The lengths of the inversion were 10 bp (GTGGAAAATT or AATTTTCCAC, type A) or 8 bp (TGGAAAAT or ATTTTCCA, type B), and the lengths of inverted repeat sequences were 17 bp or 18 bp, respectively (Appendix 17). AATTTTCCAC was found in *Manglietia utilis*, *Liriodendron chinense*, and *Liriodendron* hybrid taxa, and ATTTTCCA was identified in *Magnolia cylindrica* and *Magnolia denudata*. Several substitutions were found in this inverted repeats region. In the second inversion in *petA-psbJ* spacer, the length of the spacer forming a loop in the hairpin structure was 96-97 bp, which was the longest among inversions discussed here (Appendix 18). Taxa in MICHELIA clade had 20 bp inverted repeat sequences, and inversions were found in a part of *Michelia* taxa, and *Magnolia cathcartii* of section *Alcimandra*. Although the other taxa had partial inverted repeat sequences on both sides, no inversion was found. The length of the third small inversion in *petA-psbJ* was 12 bp (GAATCAGACAAA or TTTGTCTGATTC), the length of a pair of inverted repeat sequences was 29 bp, and the inversions were occurred heterogeneously (Appendix 19).

In a small inversion in *rpl32-trnL* spacer region, several indels were found, and three types of inversion sequences were identified (Appendix 20). The lengths of inversion were 3 bp (GAA or TTC, type A), 8 bp (GTTTTTCA or TGAAAAAC, type B), and 3 bp (GAA or TTC, type C), and the lengths inverted repeat sequences were 24 bp, 20 bp, and 22 bp, respectively. Type A was found in MICHEELIA,

GWILLIMIA, and TALAUMA clades, type B was found in YULANIA, GYNOPODIUM, KMERIA, MANGLIETIA, RYTIDOSPERMUM, THEORHODON, MACROPHYLLA, and FRASERI clades, and type C was found in *Liriodendron*. The small inversions occurred heterogeneously. Several taxa in YULANIA and MANGLIETIA clades had TTTCA in the inversion region, but inversion didn't found. In *ccsA-ndhD* spacer region, inversion sequences of 9 bp (TACTACTTG or CAAGTAGTA) were located between a pair of inverted repeat sequences of 24 bp, and the inversions appeared heterogeneously (Appendix 21). In *rps15-ycf1* spacer region, the length of inversion was three bp (GAA or TTC), the length of inverted repeats was 17 bp (Appendix 22). However, *Michelia* taxa had an insertion of A on one side of a pair of inverted repeat sequences.

3.3.4 Sequence divergence and hot spots

Multiple alignments by Mauve 2.4.0 were performed to find large-scale rearrangement in Magnoliaceae chloroplast genomes (Appendix 23). The multiple alignments showed high sequence similarity in the Magnoliaceae chloroplast genomes, and no rearrangement in gene organization was identified. The similarity profile drawn by MAUVE revealed that IR region was more conserved than LSC and SSC regions.

The nucleotide variability (Pi) values were calculated with 600 bp window and 200 bp step size using DnaSP v.5.0 to assess the sequence divergence level (Appendix 24). The Pi value ranged from zero to 0.03605, and the mean value

was 0.00450, showing that these sequences were quite similar. The mean values in LSC, IRb, and SSC were 0.00488, 0.00102, and 0.00758, respectively, indicating that IR region was more conserved than LSC and SSC regions, and SSC region was more variable than LSC and IR regions. We identified 11 considerably variable regions (Pi > 0.01) consisting of seven intergenic spacer regions (*trnH-psbA*, *atpH-atpI*, *ndhC-trnV*, *petA-psbJ*, *ndhF-rpl32*, *rpl32-trnL*, and *rps15-ycf1*) and four coding regions (*matK*, *ndhF*, *psaC*, and *ycf1*) in Magnoliaceae (Appendix 24 A). The distribution of nucleotide variability in Magnolioideae was similar to the result in Magnoliaceae. The Pi value in Magnolioideae ranged from zero to 0.03463, mean value was 0.004062, and nine variable regions (five intergenic spacer regions: *atpH-atpI*, *petA-psbJ*, *ndhF-rpl32*, *rpl32-trnL*, and *rps15-ycf1*, and four coding regions: *matK*, *ndhF*, *psaC* and *ycf1*) were detected (Pi > 0.01) (Appendix 24 B).

3.3.5 Phylogenetic analyses in Magnoliaceae

Phylogenetic relationships in Magnoliaceae were reconstructed based on 125 chloroplast genome sequences for 124 taxa, which represent all subgroups of Magnoliaceae. The length of the aligned matrix used in this phylogenetic analysis was 136,930 bp except for an IR region, and the dataset included 8,962 variable sites (6.54%) and 5,697 parsimonious informative sites (4.16%). Liriodendroideae was used as an outgroup for Magnolioideae, based on the previous studies that had no disagreement that Magnoliaceae is divided into two

subgroups, Magnolioideae and Liriodendroideae (Nooteboom, 1985; Azuma et al., 2001; Kim et al., 2001; Figlar & Nooteboom, 2004; Azuma et al., 2011; Kim and Suh, 2013). The phylogenetic trees were reconstructed by ML and BI analysis, and their topologies were identical completely (Fig. 13). The phylogenetic tree supported eleven major clades in Magnolioideae that were recognized by Kim and Suh (2013) based on ten chloroplast regions, with highly ML bootstrap values (BS) and BI posterior probability (PP) (BS/PP= 100/1). Therefore we used the same clade names as suggested in Kim and Suh (2013). The eleven clades were MICHELIA clade, YULANIA clade, GYNOPODIUM clade, KMERIA clade, MANGLIETIA clade, RYTIDOSPERMUM clade, THEORHODON clade, MACROPHYLLA clade, FRASERI clade, GWILLIMIA clade, and TALAUMA clade.

The MICHELIA clade included genera of *Michelia* and *Elmerrillia*, and sections of *Maingola*, *Alcimandra*, and *Aromadendron*. The section *Aromadendron*, *Magnolia carsonii* of section *Maingola*, and section *Alcimandra* formed a clade, and the clade was located at the basal in the MICHELIA clade and was sister to the other *Michelia* taxa. In the clade consisting of *Michelia* taxa, two sub-clades were identified, and the position of *Elmerrillia* in the clade was unclear with weak support values (35/0.68). *Magnolia griffithii* and *Magnolia carsonii* were classified in section *Maingola*, but they were located separately.

The YULANIA clade contained subgenus *Yulania*, comprising of sections of *Buergeria*, *Tulipastrum*, and *Yulania*. *Magnolia acuminata* was located at the basal in YULANIA clade and was sister to the other taxa in YULANIA clade. The

other taxa that were classified into the three sections, *Buergeria*, *Tulipastrum*, and *Yulania,* were scattered in the YULANIA clade. The GYNOPODIUM clade included *Pachylarnax*, section *Gynopodium*, and section *Manglietiastrum*. The KMERIA clade included *Kmeria*, and the MANGLIETIA clade contained *Manglietia*. The RYTIDOSPERMUM clade included section *Rytidospermum* sensu stricto (except for *Magnolia macrophylla*, *Magnolia dealbata*, and *Magnolia fraseri*) and section *Oyama*. In the RYTIDOSPERMUM clade, section *Rytidospermum* sensu stricto was monophyletic, but section *Oyama* was paraphyletic. *Magnolia globosa* was grouped with *Rytidospermum sensu stricto*.

The THEORHODON clade included section *Theorhodon sensu stricto*, excluding *Magnolia splendens*, *Magnolia portoricensis*, and *Magnolia cubensis*, which were separated into a section *Splendentes* by Vázquez-G (1994). The THEORHODON clade also contained section *Magnolia* and *Magnolia striatifolia*. The *Magnolia striatifolia* had been classified in *Dugandiodendron* by Lozano-Contreras (1975), and the taxonomic position of *Dugandiodendron* has been discussed continuously. The MACROPHYLLA clade contained *Magnolia macrophylla*, *Magnolia macrophylla* var. *ashei*, and *Magnolia dealbata*, and the FRASERI clade included *Magnolia fraseri* and *Magnolia fraseri* var. *pyrimidata*.

GWILLIMIA clade included sections of *Gwillimia*, *Lirianthe*, and *Blumiana*, and *Magnolia delavayi* was positioned at the basal, indicating being sister to the other taxa in the GWILLIMIA clade. TALAUMA clade contained section *Talauma*, and section *Splendentes* separated from section *Theorhodon* by Vázquez-G (1994).

The six species of *Talauma* in Ecuador (*Magnolia equatorialis*, *Magnolia kichuana*, *Magnolia mercedesiarum*, *Magnolia mindoensis*, *Magnolia pastazaensis*, and *Magnolia zamorana*) discovered recently, also belonged to this clade. In the TALAUMA clade, two sub-clades were identified, one consisting of section *splendentes* and *Magnolia bankardiourm* and the other comprising the remaining *Talauma* taxa.

The relationships among the eleven major clades were resolved with high support values (BS ≥ 95 and PP ≥ 0.93) (Fig. 13). In subfamily Magnolioideae, a clade consisting of the GWILLIMIA clade and the TALAUMA clade was located at the most basal. A clade comprising of the MACROPHYLLA clade and the FRASERI clade was placed at the second level basal. In the clade excluding basal clades, two sub-clades were identified, one including MICHELIA clade, YULANIA clade, GYNOPODIUM clade, and KMERIA clade and the other containing MANGLIETIA clade, RYTIDOSPERMUM clade, and THEORHODON clade. In the former sub-clade, the KMERIA clade was positioned at the basal, followed by the GYNOPODIUM clade. In the latter sub-clade, the THEORHODON clade branched before MANGLIETIA and RYTIDOSPERMUM clades.

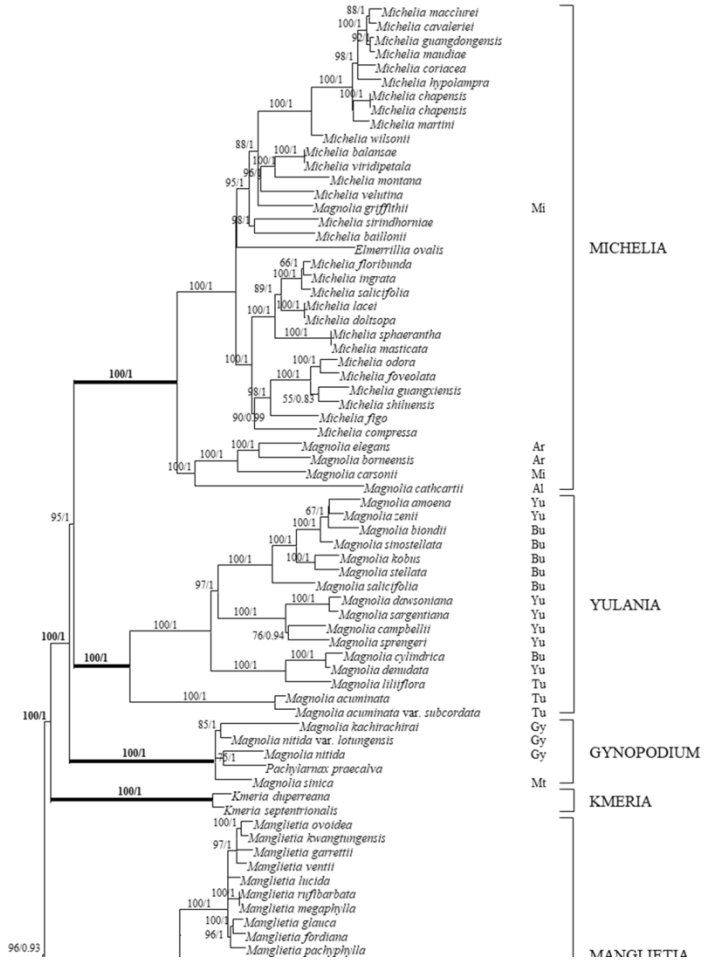


Fig. 13. (Continue)

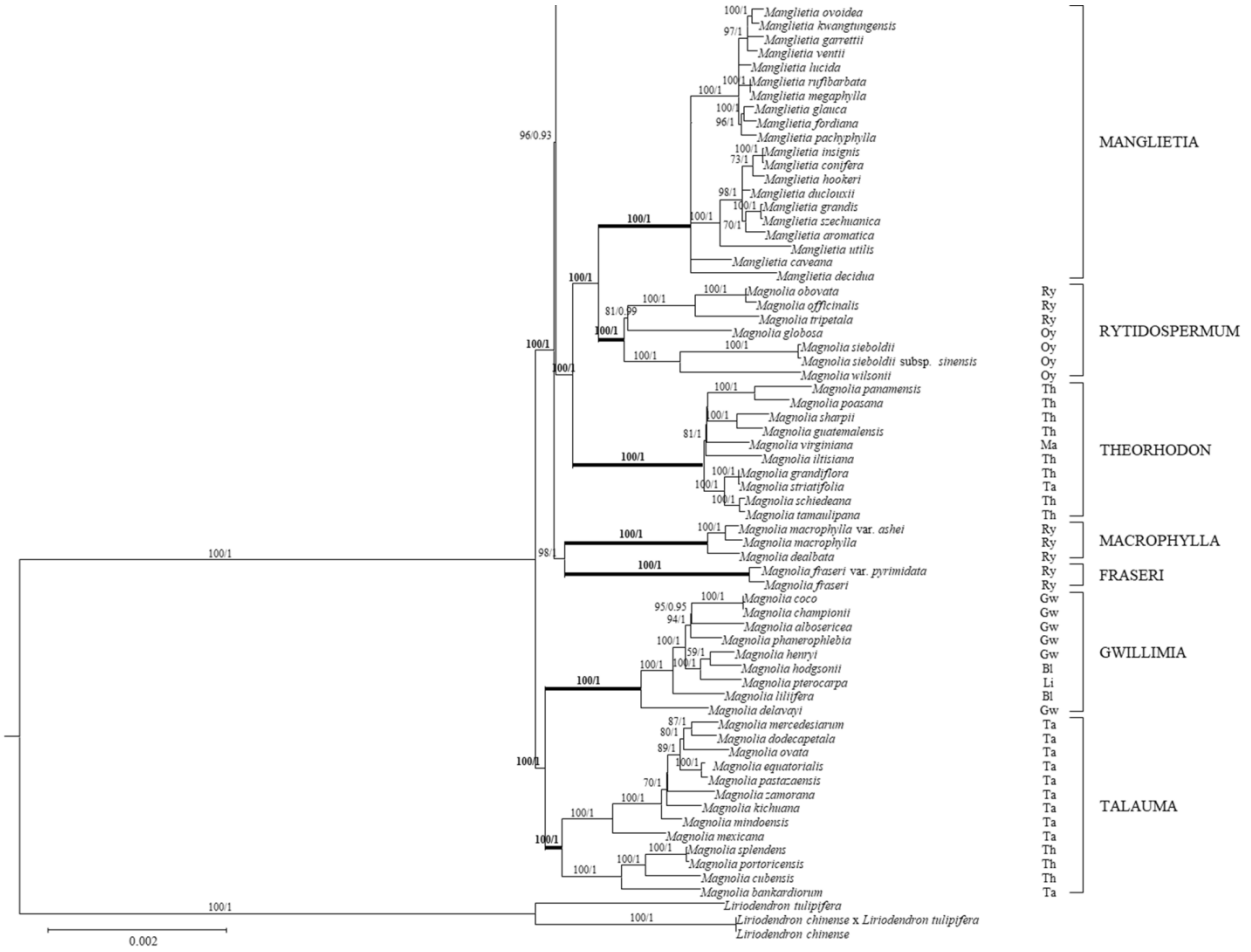


Fig. 13. (Continue)

(Previous page) Fig. 13. A result of phylogenetic analyses in Mangliaceae based on chloroplast genomes. Maximum likelihood (ML) and Bayesian inference (BI) approaches are used. Bootstrap values of over 50 in ML and posterior probabilities of over 0.5 in BI were indicated above the branches (BS/PP). Sectional abbreviations are followed those in Kim and Suh (2013): Mi, sect. *Maingola*; Ar, sect. *Aromadendron*; Al, sect. *Alcimandra*; Yu, sect. *Yulania*; Bu, sect. *Buergeria*; Tu, sect. *Tulipastrum*; Gy, Sect. *Gynopodium*; Mt, Sect. *Manglietiastrum*; Ry, sect. *Rytidospermum*; Oy, sect. *Oyama*; Th, sect. *Theorhodon*; Gw, sect. *Gwillimia*; Li, sect. *Lirianthe*; Bl, sect. *Blumiana*; Ta, sect. *Talauma*.

3.4 Discussion

The chloroplast genomes of 125 samples from 124 taxa, which covered all subgroups in Magnoliaceae, were sequenced and assembled, applying target-enrichment sequencing (Hyb-seq). Comparative and phylogenomic analyses of Magnoliaceae were performed based on the chloroplast genomes dataset. In this study, phylogenetic trees were reconstructed using an unprecedented amount of data in Magnoliaceae, and relationships among the major clade, that were unresolved in previous studies using a few nuclear or chloroplast regions, were resolved with strongly supported values. Nine regions showing high nucleotide diversity in Magnolioideae were suggested as proper DNA regions for future phylogenetic analysis of additional samples. This study, together with future

intensive studies of massive nuclear genome data, will elucidate the enigmatic evolution and the rapid diversification of Magnoliaceae.

3.4.1 Structure of chloroplast genomes in Magnoliaceae

Chloroplast genomes of Magnoliaceae used in this study have the typical quadripartite structure consisting of LSC, SSC, and two IR regions and contain 113 genes consisting of 79 protein-coding genes, 30 tRNA genes, and four rRNA genes. Comparative analyses of Magnoliaceae chloroplast genomes showed that genome structure and gene organization were highly conserved, and no rearrangement was found. However, the genome size varied from 159,269 to 160,186 bp. Genome size could be changed by changes in the number of repeated sequences and by changes in sequence complexity such as changes in gene content, intron content, and all types of indel (Palmer, 1991).

The IR borders structures were conserved overall, but some differences in the expansion and contraction of IR regions were found. When comparing the differences in IR borders based on the phylogenetic tree, the differences were pronounced in the taxa of TALAUMA and GWILLIMIA clades located at the basal of the tree. Also, tandem repeats of an 18 bp repeating unit with a pair of short direct repeats of 6 bp on both sides were in the 3' end portion of the *ycf1* gene in the SSC region. In *Magnolia cubensis* and *Liriodendron* taxa, which had no short direct repeats, no duplications were found, which may provide support for the idea that recombination is mediated by short direct repeats (Ogihara et al., 1988;

Kim and Lee, 2004). The number of the repeats determined the length of the 3' end portion of the *ycf1* gene, resulting in changing the length of the SSC region. Therefore, differences in IR borders and repeat sequences may have resulted in the variable genome sizes.

3.4.2 Diversity of repeated sequences and SSRs

In the chloroplast genome, repeat sequences have been considered as one of the elements that cause rearrangements useful for phylogenetic inference (Palmer, 1988; 1991). In the Magnoliaceae chloroplast genomes, investigating four types of long repeat sequences with 30bp or longer showed that forward and palindromic repeats were frequent, but reverse and complement repeats were rare Counting SSRs showed that Mononucleotides of A and T were most common, and tri-, penta-, and hexanucleotide were rare.

Small inversions flanked by inverted repeats are found commonly in the chloroplast genomes and are originate from Intra-molecular recombination between the inverted sequences generating flip-flop of the loops (Kim and Lee, 2005; Bain and Jansen, 2006; Catalano et al., 2009). In the Magnoliaceae chloroplast genomes, eleven of the small inversions were identified in seven regions of *trnH-psbA*, *matK*, *petN-psbM*, *petA-psbJ*, *rpl32-trnL*, *ccsA-ndhD*, and *rps15-ycf1.* The small inversions in *trnH-psbA* and *matK* were recognized in the previous phylogenetic studies of Magnoliaceae based on chloroplast DNA regions, and these inversions were substituted for their complementary

sequences or excluded in data for phylogenetic analysis (Azuma et al., 1999; Azuma et al., 2011; Kim and Suh, 2013). It was because similar inversions were found heterogeneously at the infraspecific level in other plants (Ohsako and Ohnish, 2000; Kim and Lee 2004). The small inversions may mislead when reconstructing phylogeny (Kim and Lee, 2005), but may provide useful phylogenetic information when point substitutions in the hairpin structure regions are considered along with the inversion (Bain and Jansen, 2006).

In our results, most of the inversions showed heterogeneously, the inversions were included in data for phylogenetic analyses since chloroplast genomes data was thought to be large enough to cover the bias from the inversions. When comparing the ML trees before and after adjustment to substitute the inversions to their reverse complementary sequences, topologies of two trees were identical considerably (Appendix 25). In other plants, inversions were found with different types, even within a single species (Ohsako and Ohnish, 2000; Kim and Lee 2004), but two samples for *Magnolia chapensis* included in this study showed identical patterns in all of the small inversions identified here. Therefore, the occurrence of inversion within a single species in Magnoliaceae needs to be confirmed using more samples.

3.4.3 Genome variation and hotspots

The nucleotide diversity values calculated by sliding window analysis and multiple genome alignment showed the chloroplast genome sequences of

Magnoliaceae were conserved overall, but the SSC region was more variable, and the IR region was more conserved than the other regions. As potentially useful DNA regions for future phylogenetic analysis of additional samples, the results suggested 11 regions, including seven intergenic spacer regions (*trnH-psbA*, *atpH-atpI*, *ndhC-trnV*, *petA-psbJ*, *ndhF-rpl32*, *rpl32-trnL*, and *rps15-ycf1*) and four coding regions (*matK*, *ndhF*, *psaC*, and *ycf1*), in Magnoliaceae. Nine regions excluding *trnH-psbA* and *ndhC-trnV* were suggested in Magnolioideae. Of the variable regions, five regions (*trnH-psbA*, *matK*, *petA-psbJ*, *rpl32-trnL*, and *rps15-ycf1*) included the small inversions. The noticeably high Pi value of *petA-psbJ* resulted from the small inversion of 96bp.

3.4.4 Phylogeny of Magnoliaceae based on chloroplast genomes

It has been accepted that Magnoliaceae divide into two subfamilies, Magnolioideae and Liriodendroideae, but classification within Magnolioideae has been discussed continuously (Dandy, 1927; Law, 1984; Nooteboom, 1985; Liang and Nooteboom, 1993; Law, 1996; Nooteboom, 2000; Figlar and Nooteboom, 2004; Nie et al., 2008). Previous phylogenetic study of Magnoliaceae based on ten chloroplast regions using taxa covering all subgroups of Magnoliaceae identified eleven major clades in Magnolioideae, but the relationships among them were unclear (Kim and Suh, 2013). In this study, phylogenetic analyses of 125 chloroplast genomes from 124 taxa representing all subgroups of Magnoliaceae provided a fully resolved tree with high supporting values, which

confirmed the major clades suggested by Kim and Suh (2013). The phylogeny based on the chloroplast genomes of Magnoliaceae showed that TALAUMA and GWILLIMIA might be the first basal group, MACROPHYLLA and FRASERI might be the secondary basal group, in Magnolioideae. In the rest, two sub-clades, one including MICHELIA, YULANIA, GYNOPODIUM, and KMERIA and the other containing MANGLIETIA, RYTIDOSPERMUM, and THEORHODON, were recognized.

The classification based on morphological characters proposed by Nooteboom (1985) recognized six genera and 16 sections in Magnolioideae. Among them, genera of *Manglietia* and *Kmeria*, and subgenus *Yulania* were identified as monophyletic groups by the phylogenetic result, but the others were dispersed or melded (Fig. 13). Recently, the classification suggested by Figlar and Nooteboom (2004) recognized a single genus, *Magnolia*, including three subgenera (*Magnolia*, *Yulania*, and *Gynopodium*) and 12 sections (including 13 subsections), within Magnolioideae. However, some conflicts between the classification and the phylogenetic result were found by not forming a monophyletic group in subgenus *Magnolia* and most of the subsections

Although the relationships among major clades based on chloroplast data within the subfamily of Magnolioideae were resolved with remarkably high support values, some relationships within each of the major clades have been still unresolved. Besides, the chloroplast genome data could have limitations in reconstructing and understanding the evolutionary history of plant lineages due to

the maternal inheritance of the genome (Duarte et al. 2010; Zimmer and Wen, 2013; Johnson et al., 2018). Therefore, in order to understand the evolution of Magnoliaceae, It would be necessary to infer phylogeny based on massive nuclear data and to compare chloroplast phylogeny and nuclear phylogeny. At the same time, taxonomic reconsideration would be needed, based on the phylogenomic data.

Chapter 4. Phylogeny of Magnoliaceae based on 400 nuclear DNA regions using target-enrichment NGS

4.1 Introduction

Phylogeny of Magnoliaceae based on chloroplast genome was reconstructed and described in Chapter 3. However, the chloroplast genome data could have limitations in understanding the evolutionary history of Magnoliaceae due to providing information on a single lineage. Therefore, in this study, probes for 504 single-copy nuclear genes were designed in Magnoliaceae, and massive nuclear data was generated from the same materials as those used in the previous chloroplast genome study (125 samples for 124 taxa representing all subgroups of Magnoliaceae), applying hybridization-based target enrichment sequencing (Hyb-seq). The goals of this study were (1) to reconstruct phylogeny based on 400 nuclear regions, (2) to compare chloroplast phylogeny and nuclear phylogeny, (3) to suggest a subset of the nuclear DNA regions that resolves similarly to the concatenated species tree using the entire data for future phylogenetic analysis of additional samples, and (4) to estimate molecular date and ancestor range to understand the evolutionary history of Magnoliaceae better.

4.2 Materials and Methods

4.2.1 Probe design

For probe design, unpublished preliminary transcriptome and genome data of *Magnolia kobus* were used. First, 1,772 single-copy candidate genes were picked out from the preliminary genome of *Magnolia kobus* (ver. 0.4, 1.91 Gbp; Park et al., 2017), by clustering genes with TRIBE-MCL (Enright et al., 2002). Excluding 81 incomplete genome sequences containing N, 1,691 single-copy candidate genes were obtained. Of these single-copy candidate genes, it was considered to include genes that hit one-to-one when blasting the preliminary transcriptome query against the 1,691 single-copy candidate genes database or shared with other species as single-copy genes. It was because multiple copy genes could be detected as single-copy genes due to incomplete genome assembly of the preliminary *Magnolia kobus* genome. Thus, 286 single-copy candidate genes of *Magnolia kobus* were selected as targets (189,798 bp), which included (1) 255 expressed genes which hit one-to-one when blasting transcriptome query against the candidate single-copy genes database, (2) 51 genes shared with the single-copy gene of *Amborella* that were clustered from the *Amborella* genome (AMTR1.0) by TRIBE-MCL, and (3) ten genes shared with 959 single-copy genes shared among *Arabidopsis*, *Populus*, *Oryza*, and *Vitis* (Duarte et al., 2010). The remaining three single copy candidate genes were included by mistake. Also, 215 genes (254,190 bp) which were not presumed as single-copy genes in *Magnolia kobus* but were shared with 959 single-copy genes shared among *Arabidopsis*, *Populus*, *Oryza*, and *Vitis* were included into targets. The probe design concept was summarized in Appendix 26 as a Venn diagram. Gene functions of these targets were estimated by blasting transcripts of these targets against to protein

database of *Arabidopsis thaliana* Genome version Araport 11 (Cheng et al., 2017) using blastx of blast+ version 2.9.0 (Camacho et al., 2009). Information on a total of 504 single or low copy nuclear genes (443,988 bp) was summarized in Appendix 27. SureSelect Custom probes (Agilent Technologies: Santa Clara, CA) of 120-mer were designed with 2× tiling when the target length was over 180 bp in the genome.

It was tried to capture both hundreds of low copy nuclear genes and chloroplast genome simultaneously, by making the density of probes capturing nuclear DNA and chloroplast DNA different, like 2 x and 1 x tiling, since the proportion of organellar and nuclear targets in genomic DNA is different. The reference genome contained in probe design to capture chloroplast DNA was a chloroplast genome of *Magnolia kobus* (132,760 bp without an IR region; JX280396; Song et al., 2018). However, the proportion of reads mapped on the *Magnolia kobus* chloroplast genome in generated raw reads in each sample was approximately from 18.8% to 83.6% (Appendix 28). Thus, additional sequencing should have been run on the same enriched libraries to generate enough data to assemble single-copy nuclear genes. Therefore, it is not recommended to capture both organellar DNAs and low copy nuclear genes at the same time (Weitemier et al. 2014). Strategies for mixing the enriched library and a small amount of unenriched library (Villarverde et al., 2018) or sequencing both the libraries separately to recover off-targeted high-copy elements enough (Dodsworth et al., 2019) has been suggested.

4.2.2 Taxon sampling, DNA extraction and sequencing

The same set of 125 samples for 124 taxa encompassing all subgroups in Magnoliaceae used for the chloroplast genome study, were used (Appendix 4). Genomic DNA was extracted from fresh or silica dried leaves or herbarium specimens using the Exgene™ Plant SV mini kit (GeneAll, Seoul, Korea). Extracted DNAs were quantified using Quant-iT™ PicoGreen™ dsDNA Assay Kit (Invitrogen, Oregon, USA) and SpectraMax M5 Microplate Reader (Molecular Device, California, USA) and were normalized to 50 ng/μl and 50 μl. In the case of *Magnolia pterocarpa* and *Magnolia liliifera*, samples were not enough in volume and concentration, and the whole genome was amplified using REPLI-g® Mini Kit (QIAGEN, Hilden, Germany) following the manufacturer's manual.

Genomic DNA libraries were made by random mechanical shearing of DNA to an average size of 300 bp followed by an end-repair reaction, ligation of an adenine residue to the 3'-end of the blunt-end fragments to allow the ligation of barcoded adapters and PCR-amplification of the library. SureSelect probes (Agilent Technologies: Santa Clara, CA) were used for solution-based target enrichment of pool of 16 libraries following SureSelect^{xt} Target Enrichment System for Illumina Paired-End Multiplexed Sequencing Library protocol. Data was sequenced using Illumina HiSeq 3000 to generate paired-end 100 bp or 150 bp reads. Sequencing was performed in the RAPiD Genomics, LLC (Florida, USA).

4.2.3 Assembly and alignment

The quality of raw data was checked using FastQC v.0.11.5 (Andrews, 2010). The raw reads were trimmed using Trimmomatic (Bolger et al., 2014) to filter reads which had a Phred score below 20 in the start and end of a read and below 20 in any 4 bp sliding window and to remove any trimmed reads under 30 bp and adapter (LEADING:20 TRAILING:20 SLIDINGWINDOW:4:20 MINLEN:30). All the process of assembly was conducted by HybPiper version 1.2 pipeline (Johnson et al., 2016) with default options. After trimmed, both paired and unpaired reads were mapped by BWA (Li and Durbin 2009), and each gene was assembled by SPAdes (Bankevich et al., 2012). Exons were extracted from contigs by Exonerate (Slater and Birney, 2005), and non-coding sequences flanking the coding sequences were obtained by intronerate.py in HybPiper (Johnson et al., 2016). Supercontig sequences, including exon and intron or intergenic spacer, were generated using HybPiper and were used in subsequent analysis steps.

The supercontigs of each gene were aligned using MAFFT v. 7.397 (Katoh and Standley, 2013) with options of G-INS-i, variable scoring matrix (VSM) with a_{max} 0.8, and --leavegappyregion. The VSM option controls over-alignment that is for unrelated segments to be aligned excessively, and the parameter of a_{max} was set to 0.8 suggested by Katoh and Standley (2016) as a rational setting. The sequences that seemed to be unrelated due to misassembled sequences were separated by the above options in an alignment matrix and were removed by trimming sites that were missing 70% data using phyutility v.2.2.6 (Smith and

Dunn, 2008). Then statistics for each supercontig matrix used in the phylogenetic analyses were obtained using AMAS (Borowiec, 2016). Subsequently, each supercontig was referred to as a locus.

4.2.4 Phylogenetic analyses

Of the 504 target genes, loci for 400 genes were selected, excluding (1) three genes not assembled by HybPiper, (2) 88 genes detected as paralogs by HybPiper, (3) two genes not aligned by the VSM option in MAFFT, and (4) 11 genes that had fewer sequences than 70% of the 125 samples after alignment trimming (more than 30% missing data). Phylogenetic analyses were performed on the 400 loci in two different approaches: the concatenation approach using a supermatrix in which aligned matrices were concatenated, and the coalescent approach using individual gene trees.

For the concatenation approach, the aligned and trimmed supercontigs matrices were concatenated into a supermatrix using concat option in Phyutility v.2.2.6 (Smith and Dunn, 2008). Phylogenetic trees were reconstructed by maximum likelihood (ML) using IQ-TREE v.1.6.3 (Nguyen et al., 2015) with 1000 ultrafast bootstraps after automatic model test by ModelFinder (Kalyaanamoorthy et al., 2017) in IQ-TREE and using Raxml v. 8.2.9 (Stamatakis, 2014) with the GTRGAMMAI model that was selected as the best fit model by PartitionFinder v.2.1.1 (Lanfear et al. 2016) and with 500 rapid bootstrap replicates.

For the coalescent approach, 400 individual gene trees were constructed using Raxml v. 8.2.9 (Stamatakis, 2014) with the GTRGAMMAI model, which was the same model used for the concatenation approach, and bootstrap replicates of 200. Branches with bootstrap support values below 33 were removed in each gene tree using nw_ed of Newick Utilities version 1.6.0 (Junior and Zdobnov, 2010) because eliminating branches with low support improves accuracy by decreasing noise in the coalescent approach (Zhang et al., 2018). The coalescent-based species tree was inferred using ASTRAL-Ⅲ v.5.6.3 (Zhang et al., 2018).

Each node in the coalescent tree (ASTRAL) was assessed for how many gene trees support and conflict, using PhyParts (Smith et al., 2015). The results were visualized in both species trees, respectively, with pie charts using phypartspiecharts.py (available from https://github.com/mossmatters/phyloscripts/tree/master/phypartspiecharts). Also, tanglegrams were drawn to compare the results of the two approaches and compare nuclear phylogeny and chloroplast phylogeny, using tanglegram function of the R (Core Team, 2019) package dendextend (Galili, 2015).

As a way of quantifying the phylogenetic fidelity of each gene tree (Villaverde et al., 2019), the number of quartets shared with the concatenated ML species tree was counted for each gene tree, using the R package 'Quartet' v. 1.0.2 (Smith, 2019). The phylogenetic fidelity of each gene tree was evaluated respectively in entire topologies and within five sub-clades (MICHELIA, YULANIA,

THEORHODON, GWILLIMIA+TALAUMA, and MANGLIETIA+ RYTIDOSPERMUM+OYAMA-RYTIDOSPERMUM+FRASERI+SPLENDENTES). The loci were lined up in order of the loci that induce a large number of quartets shared with the concatenated ML species tree, for each case of the entire topologies and the five subclades. For the entire topologies, as accumulating 20 loci matrices in the order, a total of 20 ML trees were drawn with the same options as the concatenation analysis, using IQtree. The subset consisting of best regions in a minimum number to reconstruct a tree similar to the concatenated ML species tree was identified, by recounting the number of quartets shared with the concatenated ML species tree for the 20 ML trees.

4.2.5 Molecular dating

With two calibration points, the age of the crown Magnoliaceae and the age of YULANIA clade were used for divergence time estimation. The age of the crown Magnoliaceae was determined based on a fossil record of *Archaeanthus* described from the Dakota Formation of Kansas by Dilcher and Crane (1984), since the reconstructed *Archaeanthus* has been supposed to be a direct ancestor of Magnoliaceae based on morphological features (Dilcher and Crane, 1984; Doyle and Endress, 2010; Massoni et al., 2015). Dilcher and Crane (1984) regarded the age of the locality of *Archaeanthus* as the mid-Cretaceous (uppermost Albian-mid-Cenomanian), but it has been discussed continuously since (Dilcher and Crane, 1984; Doyle and Endress, 2010; Massoni et al., 2015).

In this study, the age of crown Magnoliaceae was set to be 96.5 million years ago (mya), based minimum age of *Archaeanthus* recently proposed by Massoni et al. (2015). The age of the YULANIA clade was set to 25 mya, which was suggested by Azuma et al. (2001) based on comparability of *Magnolia acuminata* with fossil records from North America and the phylogenetic position of *Magnolia acuminata* located at the basal of the YULANIA clade in chloroplast phylogeny.

Divergence time was estimated by treePL, a divergence time estimation software for large phylogenies, using a penalized likelihood method (Smith and O'Meara, 2012), based on the phylogenetic tree obtained under the concatenation approach (IQ-TREE, 400 loci). The optimal parameters (opt = 4, optad = 2, and optcvad = 2) were identified using prime option. The smoothing parameter was determined as 100 by a random subsample and replicate cross-validation, using randomcv option. It was attempted to estimate the divergence time using BEAST 2 (Bouckaert et al., 2019) with 251GB of physical RAM, but It was expected that it would take a too much time to reach a reasonable effective sample size value (ESS >200). Thus treePL (Smith and O'Meara, 2012) was used, and it was described to run fast on large data sets and recovers divergence dates similar to software BEAST (Stubbs et al., 2018; Herrando-Moraira et al., 2019). To estimate a range of possible ages of the nodes, 100 bootstrap trees were randomly selected from 1,000 bootstrap trees written with branch lengths using IQtree, based on the concatenated matrix and dated trees were generated on those 100 bootstrap trees individually using treePL with the same options and calibration points as described above. The 100 dated trees were summarized on

the concatenated ML tree (IQ-TREE) dated by treePL using TreeAnnotator v2.6.0 (Bouckaert et al., 2019). The summarized tree was visualized using Figtree v. 1.4.4 (Rambaut, 2018).

4.2.6 Biogeographical analysis

Ancestral geographic ranges in Magnoliaceae were estimated with the R package 'BioGeoBEARS' (Matzke, 2013) based on the concatenated ML tree dated by treePL. All six cases, including three models DEC, DIVALIKE, and BAYAREALIKE with and without founder-event speciation (+J), were tested. The best-fit model was determined based on the likelihood-ratio test (LRT) and the Akaike Information Criterion (AIC). Four geographic regions were categorized following the Continental and Regional Schemes of the World geographical scheme for recording plant distributions (TDWG geographical codes; Brummitt, 2001), based on the distribution information recorded in the World Checklist of Magnoliaceae (Govaerts et al., 2020): ASIA-TEMPERATE (including Russian Far East, China, and Eastern Asia), ASIA-TROPICAL (including Indian Subcontinent, Indo-China, Malesia, and Papuasia), NORTHERN AMERICA (including Eastern Canada, USA, and Mexico), and SOUTHERN AMERICA (including Central America, Caribbean, Western South America, and Brazil). The maximum range size, representing the maximum number of areas to be reconstructed on each node, was set to four.

4.3 Results

4.3.1 Sequencing, assembly, and alignment

The average number of reads per sample obtained was 3,180,008, ranging from 392,612 to 11,068,824 (Table 8, Appendix 28). After quality control, an average 96.2% of raw reads per sample were collected and at least 89.5% or more. The average percentage of chloroplast reads per sample was 56.4%, ranging from 18.8% to 83.6%, which was the result of the simultaneous capture of chloroplast DNA and nuclear DNA. Nevertheless, the Magnoliaceae specific probes employed here captured target nuclear genes efficiently in Magnoliaceae. The average number of reads mapped on nuclear target was 459,332, ranging from 67,440 to 1,134,719. HybPiper generated sequences corresponding to an average of 484 loci (up to 499) out of 504 target loci per sample. In Liriodendroideae, 425 loci were generated on the average per sample, which were slightly less than an average of 485 loci per sample generated in Magnolioideae. An average of the sum of the length for coding sequences per sample assembled by Hyb-piper was 386,983 bp, which was 87.16% of coding sequences of 504 loci used for probe design (443,988bp) (Table 8, Appendix 29). The heat map provided by HybPiper showed that loci shared with *Arabidopsis*, *Populus*, *Oryza*, and *Vitis* were recovered better than the others and that the probes worked well in Magnoliaceae, except for *Magnolia borneensis* and *Pachylarnax praecalva,* due to degradation of DNA (Fig. 14). The statistics of the recovered loci described in this paragraph were calculated based on the 504 loci

used in probe design, including loci excluded later due to missing data and paralogs.

Table 8. Statistics of sequencing and assembly results analyzed using HybPiper

	Min.	Max.	Ave.
No. of Read pairs	196,306	5,534,412	1,590,004
No. of reads	392,612	11,068,824	3,180,008
No. of trimmed reads	350,808	10,647,972	3,061,701
Percent of trimmed reads (%)	89.4	97.8	96.2
Chloroplast reads	148,271	8,733,359	1,969,218
Percent chloroplast reads (%)	18.8	83.6	56.4
No. of reads on target	67,440	1,134,719	459,332
Percent reads on target (%)	4.4	45.8	17.7
No. of genes mapped	442	503	500
No. of genes with contigs	161	499	487
No. of genes with sequences	139	499	484
ParalogWarnings	0	30	11
Total length of captured exons (bp)	25,641	416,574	386,983
Percentage captured (against of total length 443.988 bp) (%)	5.8	93.8	87.2

Statistics for each alignment of the 400 loci used in phylogenetic analyses were summarized by AMAS (Table 9, Appendix 30). The final concatenated matrix was 765,376 bp in alignment length and included 321,537 variable sites (42.01%), and 186,094 parsimony informative sites (24.31%). The chloroplast phylogeny of Magnoliaceae used to compare with nuclear phylogeny in this study was reconstructed in chapter 3, based on 136,930 bp in alignment length without an IR region, including 8,962 variable sites (6.54%) and 5,697 parsimony informative sites (4.16%).

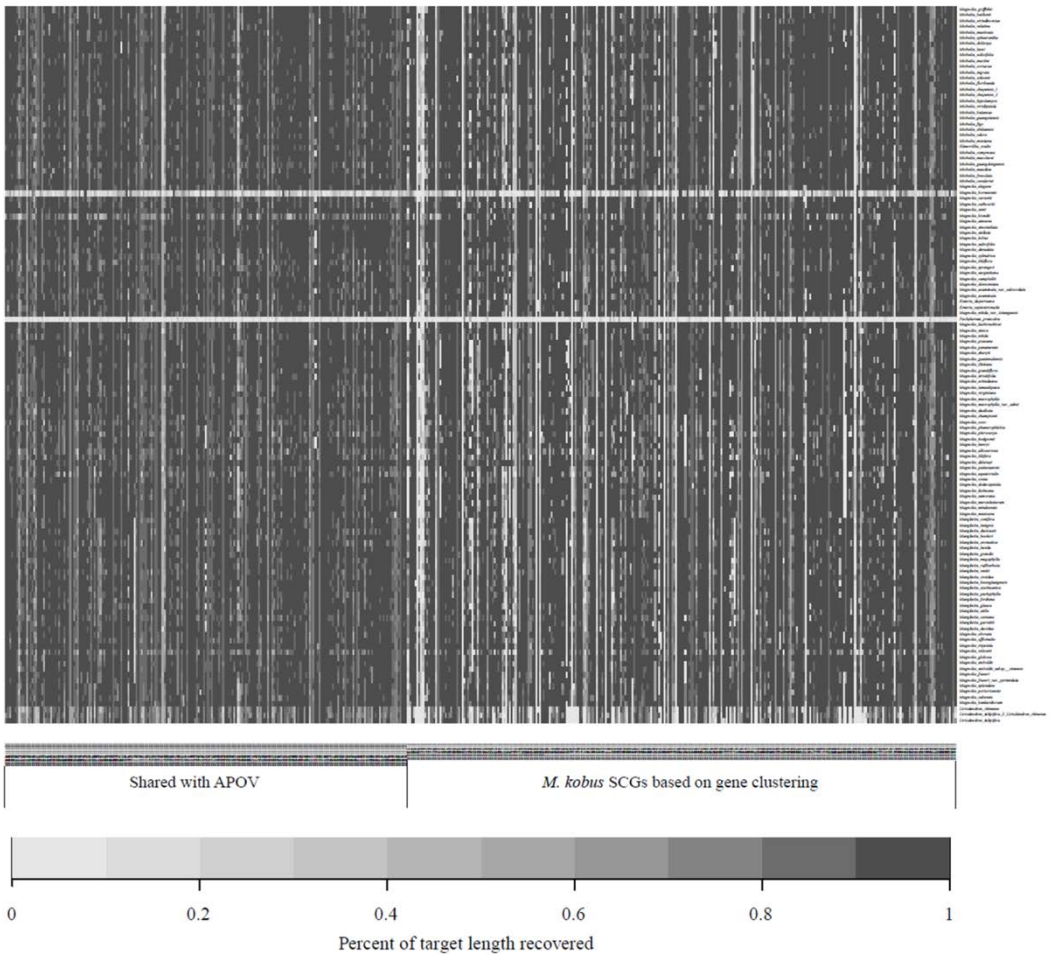


Fig. 14. A heat map showing the percentage of the recovered region in 504 genes in each taxon analyzed using HybPiper. Each row corresponds to a sample, and each column corresponds to an individual gene. Ratio of the recovered region is calculated by dividing the recovered region with the length of a target gene, and the values are represented with gray-darkness. The darker color indicates, the higher the percentage recovered.

Table 9. Statistical summary of a concatenated matrix which is based on 400 nuclear loci used in phylogenetic analyses

	Concatenated matrix	Min.	Max.	Ave.
No_of_taxa	125	86	125	120
Alignment_length	765,376	259	4,954	1,913
Total_matrix_cells	95,672,000	22,533	614,296	230,796
Undetermined_characters	9,743,128	988	61,708	15,973
Missing_percent (%)	10.184	0.865	24.257	6.948
No_variable_sites	321,537	52	2094	804
Proportion_variable_sites	0.42	0.026	0.848	0.430
Parsimony_informative_sites	186,094	21	1180	465
Proportion_parsimony_informative	0.243	0.01	0.745	0.251
GC_content	0.417	0.342	0.59	0.422
No_of_quartets resolved identically	9691375	294903	8042130	5098527
Proportion_of_quartets resolved identically	1.00	0.03	0.83	0.53

4.3.2 Phylogenetic analyses results

The topologies of ML trees reconstructed by IQ-TREE and Raxml were identical, and bootstrap values were slightly higher in IQ-TREE than Raxml (Fig. 15 and Appendix 31). Thus, regarding the concatenated ML tree, it was described based on the result of IQ-TREE. Both concatenation analysis (IQ-TREE) and coalescent analysis (ASTRAL) using 400 loci supported major 13 clades in Magnolioideae with high support value (Bootstrap support (BS) = 100, Local posterior probability (LPP) ≥ 0.99) (Fig. 15 and Appendix 32). The major 13 clades were the following: MICHELIA, YULANIA, KMERIA, GYNOPODIUM, THEORHODON, MACROPHYLLA, GWILLIMIA, TALAUMA, MANGLIETIA, RYTIDOSPERMUM, OYAMA, FRASERI, and SPLENDENTES clades. The names of these clades were written with reference to Kim and Suh (2013).

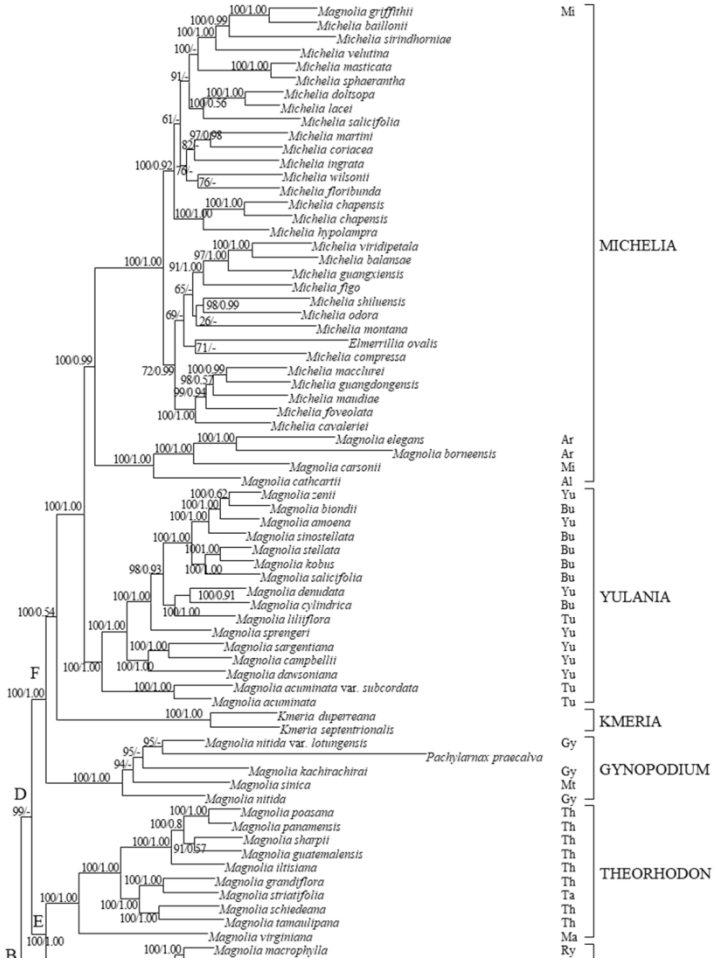


Fig. 15. (Continue)

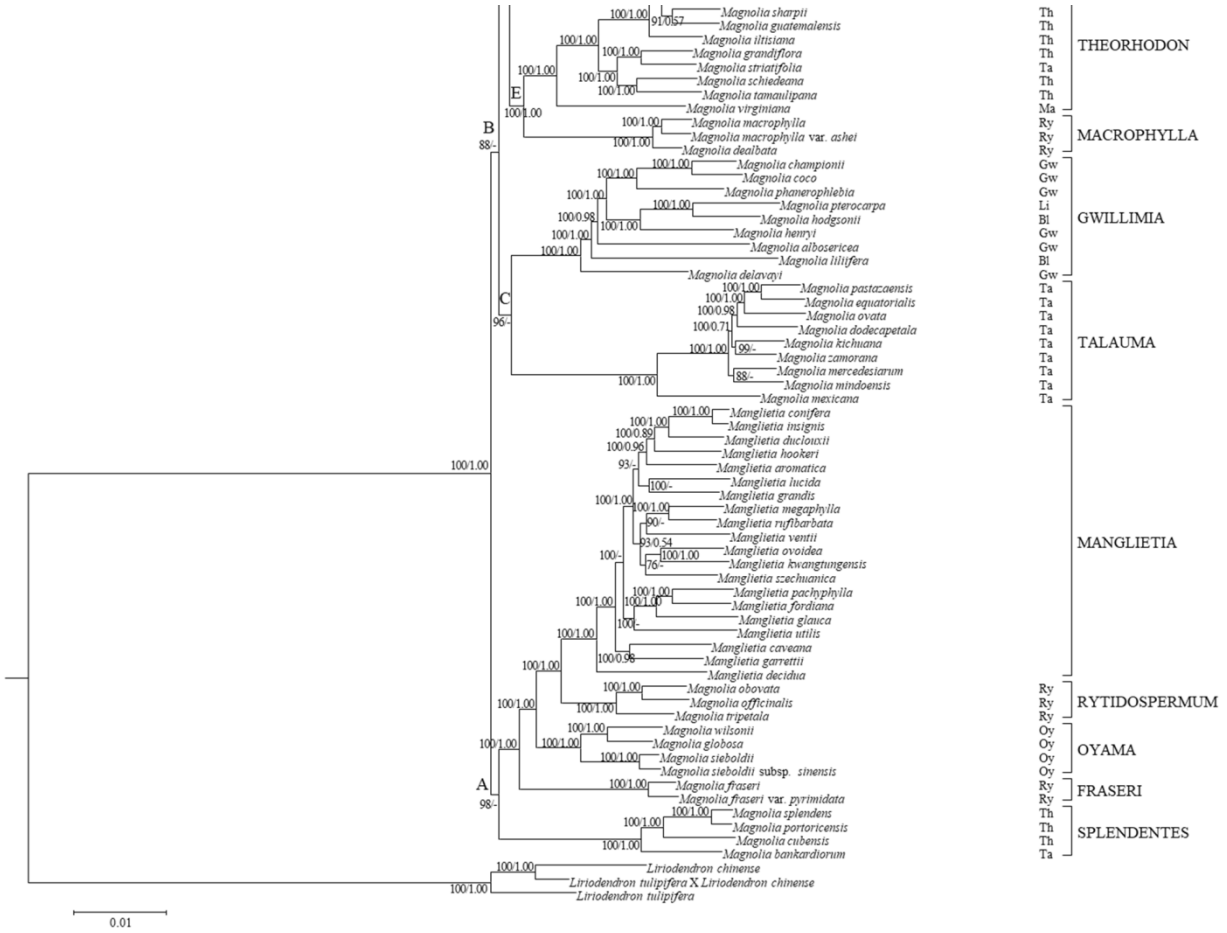


Fig. 15. (Continue)

(Previous page) Fig. 15. Maximum likelihood tree of Magnoliaceae reconstructed by IQ-TREE based on the concatenated matrix from 400 loci obtained by HybPiper. Supporting value above branches indicates bootstrap (BS)/local posterior probability (LPP). The LPP values were obtained in the species tree estimated by the coalescent approach using ASTRAL-III. The dash (-) indicates a branch not supported in the ASTRAL tree. Sectional abbreviations are followed those in Kim and Suh (2013): Mi, sect. *Maingola*; Ar, sect. *Aromadendron*; Al, sect. *Alcimandra*; Yu, sect. *Yulania*; Bu, sect. *Buergeria*; Tu, sect. *Tulipastrum*; Gy, Sect. *Gynopodium*; Mt, Sect. *Manglietiastrum*; Ry, sect. *Rytidospermum*; Oy, sect. *Oyama*; Th, sect. *Theorhodon*; Gw, sect. *Gwillimia*; Li, sect. *Lirianthe*; Bl, sect. *Blumiana*; Ta, sect. *Talauma*.

The MICHELIA clade included two genera of *Michelia* and *Elmerrillia*, and three sections of *Maingola*, *Alcimandra*, and *Aromadendron*. The section *Aromadendron*, section *Alcimandra*, and *Magnolia carsonii* of section *Maingola* formed a clade located at the basal in the MICHELIA clade and were sister to the other *Michelia* taxa. The clade consisting of *Michelia*, *Elmerrillia*, and *Magnolia griffithii* of section *Maingola* was divided into two sub-clades. *Magnolia griffithii* and *Magnolia carsonii* were classified in section *Maingola* but were located separately within the MICHELIA clade. The YULANIA clade contained subgenus *Yulania* including sections of *Buergeria*, *Tulipastrum*, and *Yulania*. *Magnolia acuminate* was located at the basal in the YULANIA clade and was sister to the

other taxa of the YULANIA clade. The KMERIA clade included *Kmeria*, and the GYNOPODIUM clade contained *Pachylarnax*, section *Gynopodium*, and section *Manglietiastrum*. The THEORHODON clade included section *Theorhodon sensu stricto*, excluding *Magnolia splendens*, *Magnolia portoricensis*, and *Magnolia cubensis*, which Vázquez- G (1994) separated into a section *Splendentes*. The THEORHODON clade also contained *Magnolia virginiana* of section *Magnolia* and *Magnolia striatifolia* of section *Talauma*. The *Magnolia virginiana* was located at the basal in the clade. The *Magnolia striatifolia* had been classified in genus *Dugandiodendron* by Lozano-Contreras (1975). The MACROPHYLLA clade included *Magnolia macrophylla* and *Magnolia dealbata*. The GWILLIMIA clade contained sections of *Gwillimia*, *Lirianthe*, and *Blumiana*, and *Magnolia delavayi* was located at the basal and was sister to the other taxa of GWILLIMIA clade. The TALAUMA clade included section *Talauma* and six *Talauma* species recently published in Ecuador (*Magnolia equatorialis*, *Magnolia kichuana*, *Magnolia mercedesiarum*, *Magnolia mindoensis*, *Magnolia pastazaensis*, and *Magnolia zamorana*) (Vázquez-García et al., 2012; Arroyo et al., 2013; Arroyo and Pérez, 2013; Vázquez-García et al., 2017; Vázquez-García et al., 2018), and *Magnolia maxicana* was located at the basal in the TALAUMA clade. The MANGLIETIA clade consisted of *Manglietia*, and *Manglietia decidua* was placed at the basal in the MANGLIETIA clade. The RYTIDOSPERMUM clade contained section *Rytidospermum sensu stricto*, excluding *M. macrophylla*, *M. dealbata*, and *M. fraseri*. The OYAMA clade included section *Oyama*, and the FRASERI clade contained *Magnolia fraseri*. The SPLENDENTES clade comprised *Magnolia*

bankardiorum of section *Talauma* and section *Splendentes* separated from section *Theorhodon* by Vázquez- G (1994), including *Magnolia splendens*, *Magnolia portoricensis*, and *Magnolia cubensis*.

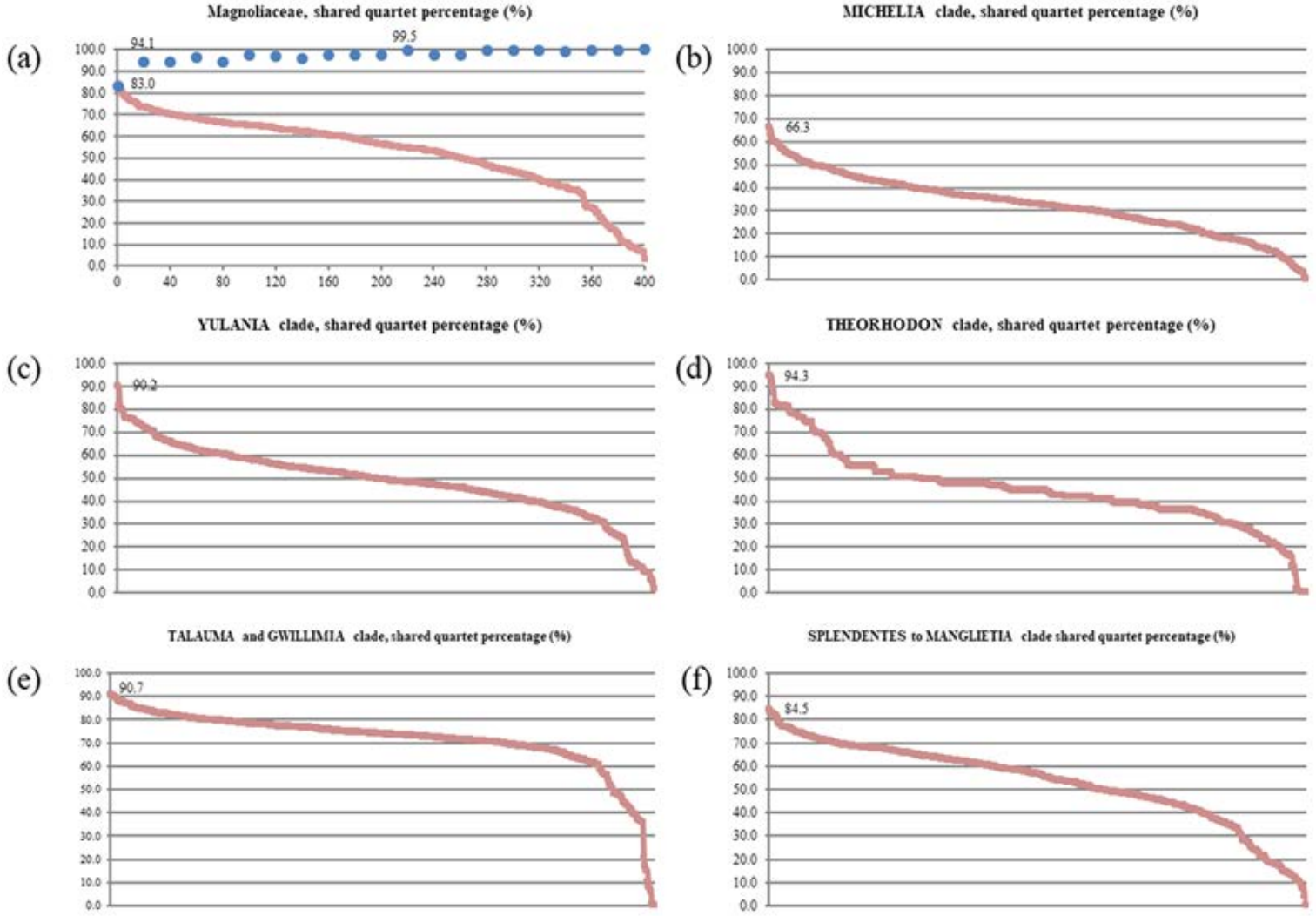
The concatenated ML tree and the coalescent ASTRAL tree showed slightly different topologies in the relationships among the 13 major clades (Fig. 15 and Appendix 32). The concatenated ML tree represented that there were two large sub-clades in Magnolioideae. One consisted of MANGLIETIA, RYTIDOSPERMUM, OYAMA, FRASERI, and SPLENDENTES (clade A, BS= 98), and the other comprised of MICHELIA, YULANIA, KMERIA, GYNOPODIUM, THEORHODON, MACROPHYLLA, GWILLIMIA, and TALAUMA (clade B, BS= 88). In clade A, the SPLENDENTES clade was branched at first and located at the basal, followed by FRASERI clade, OYAMA clade, RYTIDOSPERMUM clade, and MANGLIETIA clade. In clade B, GWILLIMIA and TALAUMA clades formed a clade (clade C, BS = 96), which was sister to a clade comprising of MICHELIA, YULANIA, KMERIA, GYNOPODIUM THEORHODON, and MACROPHYLLA clades (clade D, BS= 99). In clade D, THEORHODON and MACROPHYLLA clades formed a clade (clade E, BS= 100), which was sister to a clade consisting of MICHELIA, YULANIA, KMERIA, and GYNOPODIUM clades (clade F, BS= 100). Overall, the results showed that the relationships among these major clades were supported with high bootstrap values (BS≥88), but branches in the backbone determining these relationships were quite short in length. The result was summarized on the left in Figure 18.

In the coalescent ASTRAL tree, the clade A, B, C, and D were not supported (Appendix 32 and 33). TALAUMA, SPLENDENTES, and GWILLIMIA clades formed a clade with a very low support value (LPP= 0.41), which was located at the basal in Magnolioideae. THEORHODON and MACROPHYLLA clades created a clade with a high support value (LPP= 1), which was placed at the second level basal. And two large sub-clades formed a clade with a relatively low support value (LPP= 0.73), of which one included MICHELIA, YULANIA, KMERIA, and GYNOPODIUM clades, and the other contained MANGLIETIA, RYTIDOSPERMUM, OYAMA, and FRISERI clades. The conflicts of phylogenetic relationships at shallow levels were only found in MICHELIA, GYNOPODIUM, MANGLIETIA, and TALAUMA clades (Appendix 33). The nodes in the coalescent ASTRAL tree conflicting with the concatenated ML tree mostly had low LPP values (Appendix 33) and had considerable discordance among individual gene trees (Appendix 34). Pie charts showed the source of the gene tree discordance at those nodes was mostly low-frequency alternative bipartitions (big red slice of the pie chart), except for within GYNOPODIUM clade (Appendix 34). Nodes in the GYNOPODIUM clade were detected to have not only gene trees supporting the nodes, but also three gene tree discordance sources including the dominant alternative bipartition (green slice), the low-frequency alternative bipartition (red slice), and the poorly supported bipartition (BS < 33) (gray slice). The result of the coalescent analysis might have reflected different evolutionary histories at different loci, but might have resulted from noises due to insufficient phylogenetic signals in each locus. Thus, subsequent analyses were conducted based on the

result of the concatenation analysis.

The number of quartets shared with the concatenated ML tree was counted in each gene tree for entire topologies and five sub-clades, to suggest a core subset of loci in resolving similarly to the concatenated ML tree (Appendix 35). Loci reconstructing a gene tree containing many shared quartets were different in each case of entire topologies and five sub-clades. For the entire topology, the gene tree of MKT028511_1_4_APOV, which was estimated to be related to RNA ligase, recovered 83% of the concatenated ML tree (Fig. 16 a, Appendix 35). The alignment length for the gene used in phylogenetic analysis was 3,642 bp, including 1,444 variable sites (40%) and 850 parsimony informative sites (23%) (Appendix 30). For the four sub-clades except for MICHELIA clade, the gene tree with the most number of shared quartets recovered more than 80% of the reference, but less than 70% in MICHELIA clade (Fig. 16 b-f).

For the entire topology, 400 loci were lined up in order of loci inducing many shared quartets, reconstructed 20 concatenated ML trees with adding 20 loci in the order, and recounted the number of shared quartets for the 20 ML trees. The result showed that a concatenated ML tree reconstructed by the top 20 loci recovered 94% of the total number of quartets for the concatenated ML tree using 400 loci, and a concatenated ML tree using 220 loci recovered 99.5% (Fig. 16 a).


(a)
Magnoliaceae, shared quartet percentage (%)
94.1
99.5
83.0
(b)
MICHELIA clade, shared quartet percentage (%)
66.3
(c)
YULANIA clade, shared quartet percentage (%)
90.2
(d)
THEORHODON clade, shared quartet percentage (%)
94.3
(e)
TALAUMA and GWILLIMIA clade, shared quartet percentage (%)
90.7
(f)
SPLENDENTES to MANGLIETIA clade shared quartet percentage (%)
84.5

(Previous page) Fig. 16. Plotting of the percentage of shared quartets between each gene tree with the concatenated ML tree in decreasing order. (a) Magnoliaceae; blue dots represent the accumulated percentage of shared quartets; accumulated value of the top-rated 20 genes and 220 genes are 94.1 and 99.5%, respectively. (b) MICHELIA clade, (c) YULANIA clade, (d) THEORHODON clade, (e) TALAUMA + GWILLIMIA clade, and (f) a clade including SPLENDENTES, FRASERI, RYTIDOSPERMUM-OYAMA, RYTIDOSPERMUM, and MANGLIETIA.

4.3.3 Comparison between phylogenies based on nuclear and chloroplast dataset

The tanglegram was drawn to compare between the concatenated ML tree based on 400 nuclear loci and the ML tree based on the chloroplast genome described in Chapter 3 (Fig. 17). Thirteen major clades were identified with high bootstrap values (BS=100) in both phylogenetic trees, excluding the position of *Magnolia globosa* in chloroplast phylogeny. *Magnolia globosa* was included in the OYAMA clade in the nuclear phylogeny, while it was in the RYTIDOSPERMUM clade in the chloroplast phylogeny. The comparison of relationships among major clades in Magnolioideae between nuclear phylogeny and chloroplast phylogeny was summarized in Figure 18. The chloroplast phylogeny represented that GWILLIMIA, SPLENDENTES, and TALAUMA formed a clade at the first basal group, and MACROPHYLLA and FRASERI formed a clade at the second basal

group. Also, two sub-clades were identified, one consisted of MICHELIA, YULANIA, GYNOPODIUM, and KMERIA, and the other comprised of MANGLIETIA, RYTIDOSPERMUM, OYAMA, and THEORHODON. Conflicts between chloroplast phylogeny and nuclear phylogeny were frequently found within each major clade as well as among the major clades. These conflicts might have been caused by ancient hybridization events.

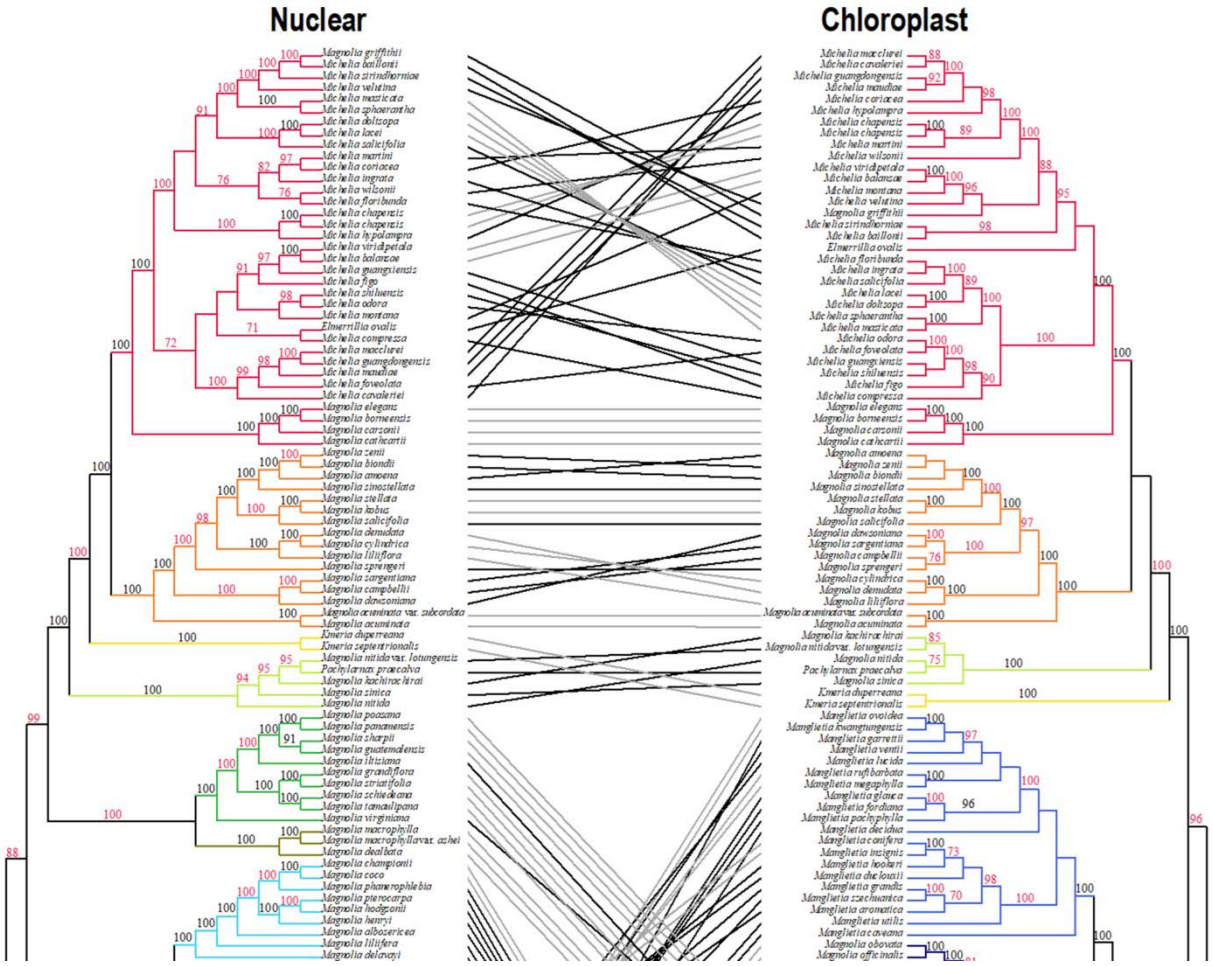


Fig. 17. (Continue)

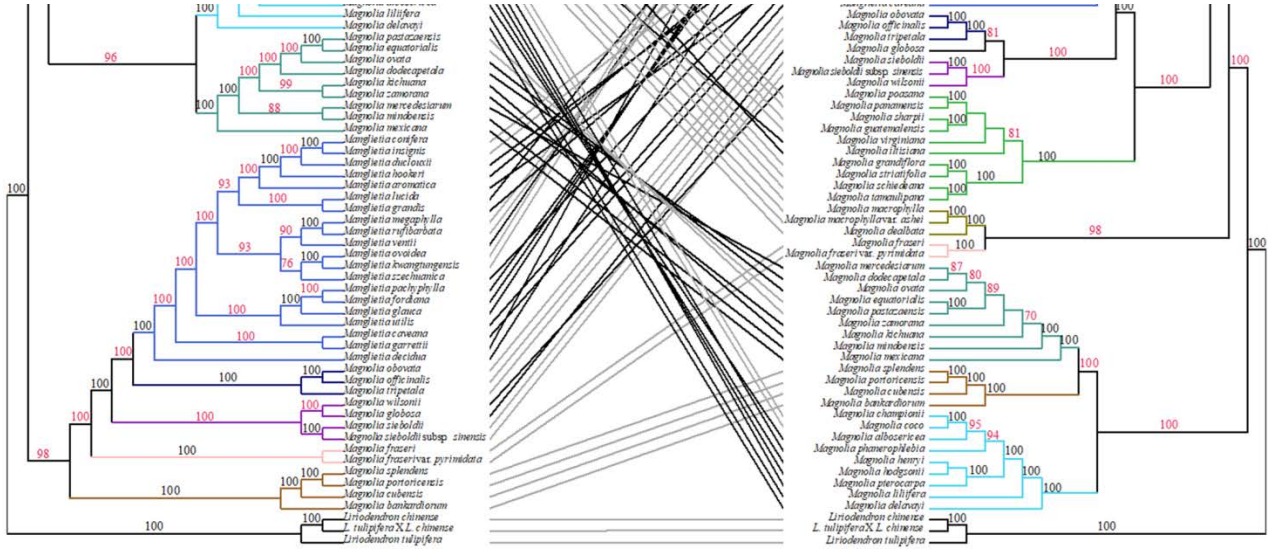


Fig. 17. A tanglegram of phylogenetic trees based on the concatenated nuclear data (left) and chloroplast genome data (right). Branch colors indicate major thirteen clades in the subfamily Magnolioideae recognized in this study. Bootstrap values over 70 are indicated above nodes. Black connecting lines indicate positional conflict between two trees, and red-colored values are bootstrap support of these relationships

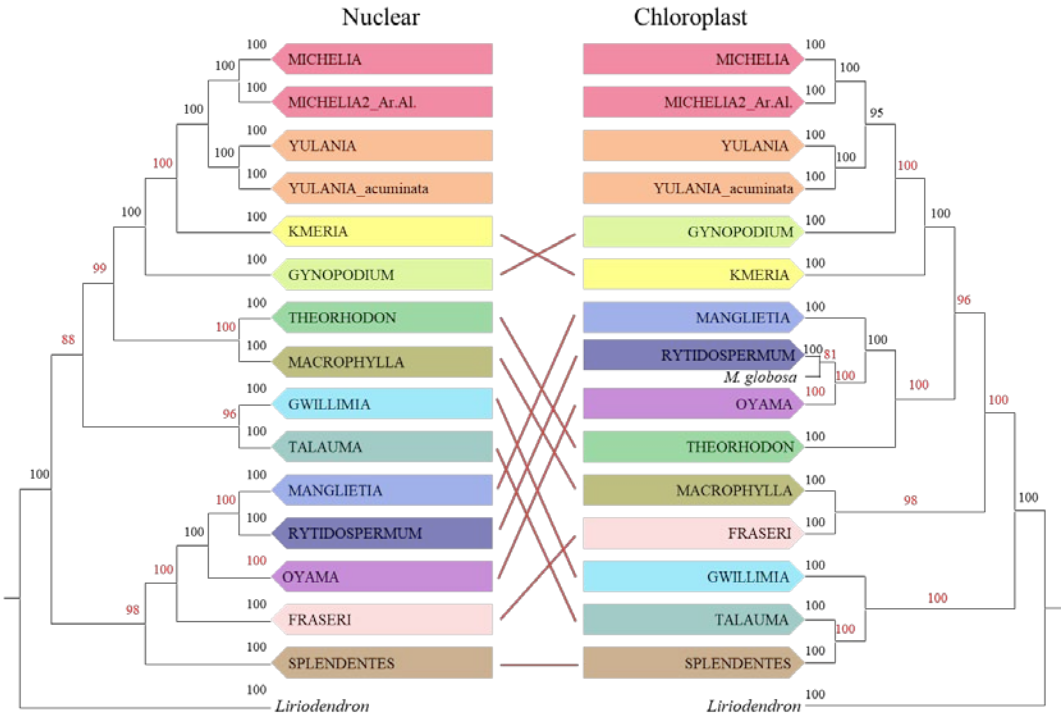


Fig. 18. Summarized comparison between nuclear phylogeny and chloroplast phylogeny. Bootstrap supports (BS) are shown on branches. Red connecting lines indicate positional conflict between two trees, and red-colored values are bootstrap support of these relationships.

4.3.4 Molecular divergence time estimation

In the chronogram generated by the treePL analysis, the crown ages of subfamily Magnolioideae and Liriodendroideae were estimated at 37.84 mya (the late Eocene) and 17.54 mya (the early Miocene), respectively (Appendix 36, Appendix 37). The divergence time between the clade including MICHELIA, YULANIA, KMERIA, GYNOPODIUM, THEORHODON, and MACROPHYLLA and the clade containing GWILLIMIA and TALAUMA was estimated to be 36.97 mya. The divergence time between GWILLIMIA and TALAUMA was dated at 35.27 mya. The divergence time between the clade consisting of MICHELIA, YULANIA, KMERIA, and GYNOPODIUM and the clade comprising THEORHODON, and MACROPHYLLA was estimated to be 35.52 mya. The divergence time between the clade including MANGLIETIA, RYTIDOSPERMUM, OYAMA, and FRASERI and the clade of SPLENDENTES was dated at 36.42 mya. These estimated divergence times were concentrated in the late Eocene, according to the ICS International chronostratigraphic chart (Cohen et al., 2019). The divergence time between the clade including MICHELIA and YULANIA and the clade of KMERIA was dated at 32.4 mya. The divergence time between THEORHODON and MACROPHYLLA was estimated to be 32.50 mya. The divergence time between the clade containing MANGLIETIA, RYTIDOSPERMUM, and OYAMA and the clade of FRASERI was dated at 32.04 mya. These divergence times were in the early Oligocene (Cohen et al., 2019). The result showed that the divergence times from the most recent common ancestor of Magnolioideae to major clades were densely distributed in the late Eocene and the early Oligocene. Divergence

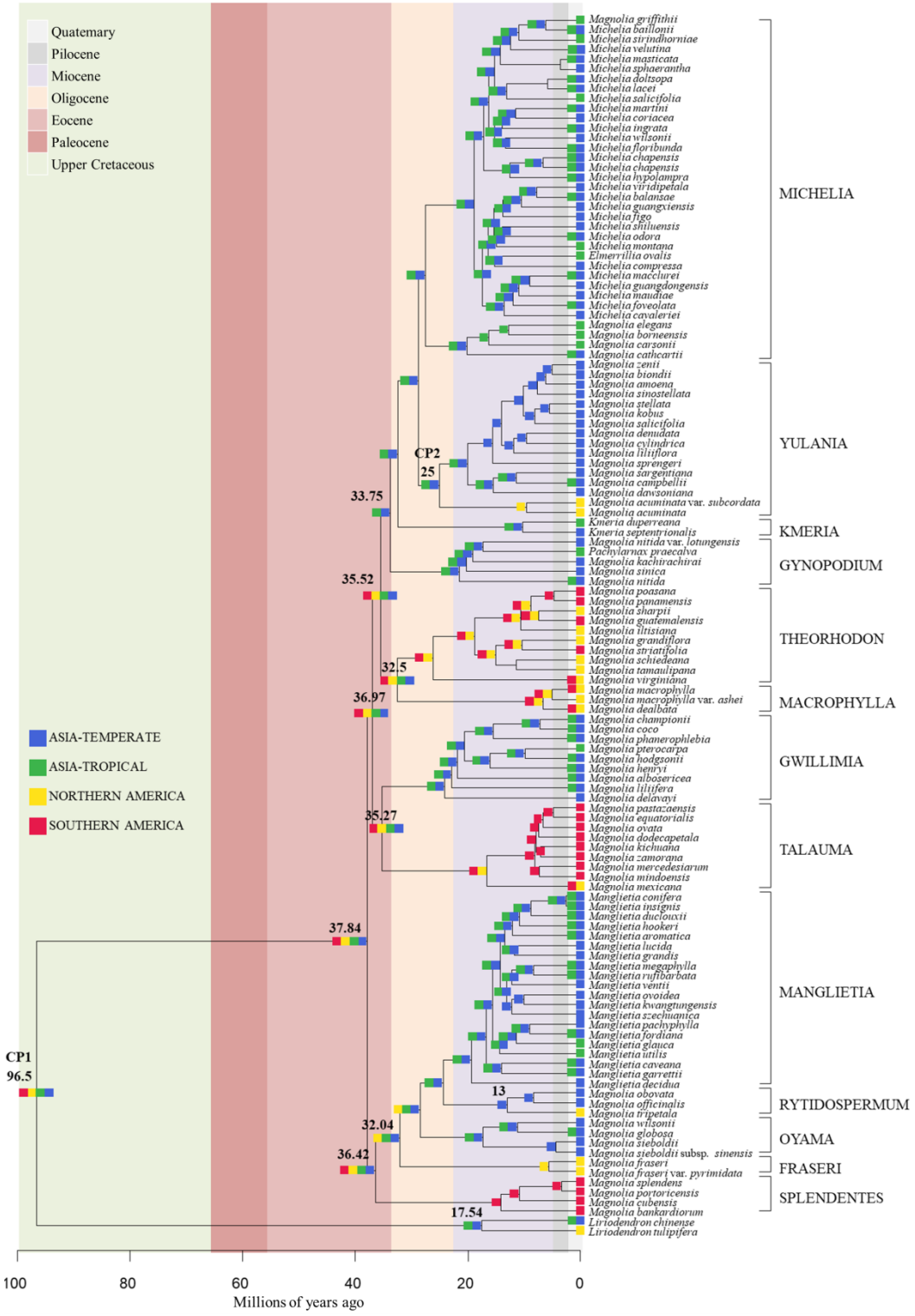
times of the major clades were summarized in Appendix 37.

4.3.5 Biogeography

Four regions were coded for biogeographic analysis, referring to TDWG geographical codes (Brummitt, 2001) based on the distribution information recorded on the World checklist of Magnoliaceae (Govaerts et al., 2020): ASIA-TEMPERATE (including Russian Far East, China, and Eastern Asia), ASIA-TROPICAL (including Indian Subcontinent, Indo-China, Malesia, and Papuasia), NORTHERN AMERICA (including Eastern Canada, USA, and Mexico), and SOUTHERN AMERICA (including Central America, Caribbean, Western South America, and Brazil). In the ancestral range estimation using BioGeoBEARS, the BAYAREALIKE with the founder-event parameter (+J) was determined to be the best fit model for our data by the likelihood-ratio test (LRT) and the Akaike information criterion (AIC). The biogeographic model estimated that the origin of the Magnoliaceae and Magnolioideae originated all over the four regions (Fig. 19). From this large ancestral region, the clade including MICHELIA, YULANIA, KMERIA, and GYNOPODIUM clades, and the GWILLIMIA clade were inferred to be separated into Asia. THEORHODON, MACROPHYLLA, and TALAUMA clades were estimated to be separated into the Americas. In the clade, including MANGLIETIA, RYTIDOSPERMUM, OYAMA, FRASERI, and SPLENDENTES clades, the biogeographic model estimated that the SPLENDENTES clade was first separated to southern America from the large ancestral region, followed by

the FRASERI clade to North America and the rest clades to Asia.

Events that appear to be separated from Asia to North America were identified in *Liriodendron tulipifera*, *Magnolia tripetala* of RYTIDOSPERMUM clade, and *Magnolia acuminata* of YULANIA clade. The age at which *Magnolia acuminata* diverged from the YULANIA clade was set to 25 mya as a calibration point, and the divergence times of *Liriodendron tulipifera* and *Magnolia tripetala* were estimated to be 17.54 mya and 13.00 mya of the Miocene period. The biogeographic patterns showed that the ancestral magnolias originated in both the Americas and Asia and have formed a current distribution of Magnoliaceae.


Quatemary
Pilocene
Miocene
Oligocene
Eocene
Paleocene
Upper Cretaceous
ASIA-TEMPERATE
ASIA-TROPICAL
NORTHERN AMERICA
SOUTHERN AMERICA
CP1
96.5
CP2
25
33.75
35.52
32.5
36.97
35.27
37.84
13
32.04
36.42
17.54
MICHELIA
YULANIA
KMERIA
GYNOPODIUM
THEORHODON
MACROPHYLLA
GWILLIMIA
TALAUMA
MANGLIETIA
RYTIDOSPERMUM
OYAMA
FRASERI
SPLENDENTES
100
80
60
40
20
0
Millions of years ago

(Previous page) Fig. 19. Reconstruction of the ancestral geographic region in each clade using BioGeoBEARS with BAYAREALIKE+J model based on the concatenated ML tree dated using treePL. Each color represents color codes for four geographic regions.

4.4 Discussion

This study presents the first phylogenomic analyses of Magnoliaceae based on 400 nuclear regions, including intron and exon, sampled for 124 taxa (125 samples) covering all subgroups of Magnoliaceae, by applying enrichment targeted sequencing, Hyb-Seq. The results of the analyses showed that the probes designed in this study worked well by capturing an average of 87%for 504 target loci (total length of target transcripts 443,988 bp) per sample across the Magnoliaceae. The phylogenetic results identified the 13 major clades in Magnolioideae and provided a more improved phylogenetic tree of Magnoliaceae based on massive nuclear data. Also, priorities were given to 400 loci by counting quartets shared with the concatenated ML tree reconstructed by 400 loci in each gene tree for entire topologies and each case of the five large sub-clades in Magnoliaceae. Subsets consisting of 20 loci and 220 loci, which recovered 94.1% and 99.5% of total quartets present in the concatenated ML tree, were proposed. These priorities and subsets of loci can provide criteria in selecting proper DNA regions for future phylogenetic analysis of additional samples in Magnoliaceae.

4.4.1 Alignment of Hyb-Seq data

When trimmed data were assembled using Hyb-Piper, and the assembled sequences were aligned using MAFFT without VSM options, although the taxa included in this analysis are closely related, distinctly dissimilar sequence segments were sometimes found in matrices. Besides, phylogenetic trees reconstructed using a concatenated matrix, which contains the dissimilar segments, showed a tendency to have long branches at the tips. Although the dissimilar sequence segments might be real, it needs to be suspected that unusual factors such as sequencing errors or alternative splicing inserted these segments (Katoh and Standley, 2016). Thus, these dissimilar segments may be non-homologous sequences that should be excluded from phylogenetic analysis. In most multiple sequence alignment (MSA), the sequences end up being aligned (over-alignment), even though unrelated sequences are in input data because MSA methods generally assume that the input sequences are all homologous (Katoh and Standley, 2016). The noise that can affect downstream analyses needs to be aligned correctly by using options implemented in MAFFT versions 7.263 and higher, which control the over-alignment utilizing a variable scoring matrix for different pairs of sequences in an MSA based on the global similarity of each pair (Katoh and Standley, 2016). Finally, the unrelated sequences could be removed by deleting missing sites above the threshold using alignment trimming tools.

4.4.2 Comparison of phylogeny-reconstruction methods

To infer the species tree, two approaches, maximum likelihood inference from a concatenated matrix and coalescent-based estimation from a set of gene trees using ASTRAL, were used. Some conflicts in topologies between the two trees were found (Appendix 33). PhyParts and PieCharts analyses showed discordance among gene trees on nodes of the ASTRAL tree, which supported different topologies from ML tree, and the major source of the discordance was identified as low frequent alternative topology (Appendix 34). The gene tree discordance might have originated from horizontal gene transfer, gene duplication, hybridization, and recombination (Degnan and Rosenberg, 2009). However, it might be caused by insufficient phylogenetic signals in sampled loci, such as the short length of some loci or missing data or taxa in matrices (Villaverde et al., In press). Therefore it was focused on the concatenate-based ML tree than the coalescent-based ASTRAL tree.

The results of this study also showed considerable conflicts between chloroplast phylogeny and nuclear phylogeny in relationships among major clades and within each clade (Fig. 17). These conflicts might come from the different properties of chloroplast and nuclear genome. The chloroplast genome is inherited maternally, has little recombination, and is conserved (Twyford and Ness, 2017). The nuclear genome contains recombination that generates inconsistent trees, leading to complicate phylogenetic resolution, but it provides improved insights for evolutionary history by including data inherited from bi-

parents (Badro et al., 2019). Thus, these conflicts between chloroplast phylogeny and nuclear phylogeny may support ancient hybridization events in evolutionary history (Stephens et al., 2015 Sarracenia; Vargas et al., 2019). Also, these conflicts might have made it difficult to resolve phylogenetic relationships of Magnoliaceae using a few chloroplast or nuclear DNA regions.

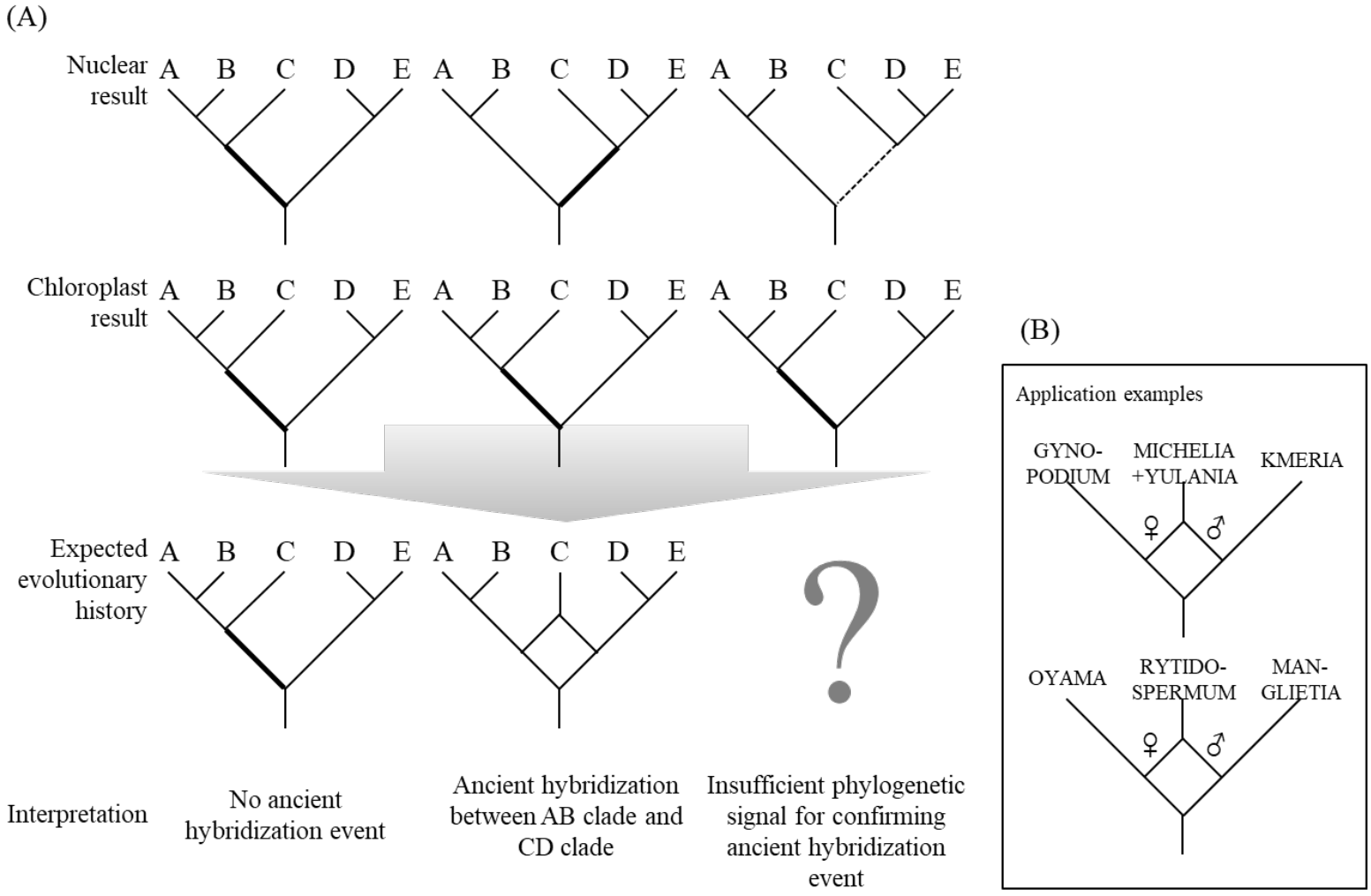
4.4.3 Ancient hybridization history in the evolution of Magnoliaceae

It was simulated how nuclear phylogeny and chloroplast phylogeny would be reconstructed if ancient hybridization occurred (Fig. 20). In figure 20, a true phylogeny was assumed that the ancient hybridization occurred between an ancestor of A and B, which was maternal for C and an ancestor of D and E, which was paternal for C, and taxon C was speciated through the ancient hybridization. If the maternal inheritance was stronger than the paternal inheritance, and the target loci contained more maternal variants, taxon C would form a monophyletic group with A and B, which were the maternal lineage, in both nuclear phylogeny and chloroplast phylogeny. In this case, the ancient hybridization would not be recognized in the consensus tree. If the paternal inheritance was stronger than the maternal inheritance and the target loci included more paternal variants, taxon C would form a clade to paternal lineage in nuclear phylogeny but would form a clade to maternal lineage in chloroplast phylogeny. In this case, the clade including taxon C would be supported with a slightly lower bootstrap value in nuclear phylogeny due to the influence of the maternal lineage, while a higher

bootstrap value in chloroplast phylogeny. Thus, the ancient hybridization that occurred between the ancestors of AB clade and CD clade could be inferred. If maternal and paternal inheritance were similar and the target loci included half of the maternal and paternal variants, taxon C would form a polytomy with a low bootstrap value between paternal and maternal lineages, but would follow the maternal lineage in the chloroplast phylogeny. In this case, it would be unclear whether the polytomy in the nuclear phylogeny is due to ancient hybridization or insufficient phylogenetic signals due to missing data.

Based on the above, the MICHELIA + YULANIA clade could be inferred to be diverged by ancient hybridization between the maternal lineage of GYNOPODIUM clade and the paternal lineage of KMERIA clade (Fig. 18). Similarly, RYTIDOSPERMUM clade might have diverged by ancient hybridization between the maternal lineage of OYAMA clade and the paternal lineage of MANGLIETIA clade (Fig. 18). Although the more ancient hybridizations at deeper nodes, the more complicated it is to be recognized and interpreted, the result of the comparison between nuclear phylogeny and chloroplast phylogeny showed that ancient hybridizations might have occurred between MANGLEITIA + RHYTIDOSPERMUM + OYAMA + FRASERI + SPLENDENTES and GWILLIMIA + TALAUMA, and between MANGLEITIA + RHYTIDOSPERMUM + OYAMA + FRASERI and THEORHODON + MACROPHYLLA. At shallower nodes, *Magnolia globosa* formed the monophyletic group with RHYTIDOSPERMUM clade in chloroplast phylogeny, but with *Magnolia wilsonii* of OYAMA clade in nuclear phylogeny. It showed that *Magnolia globosa* might have diverged by ancient

hybridization between the maternal lineage of RYTIDOSPERMUM clade and the paternal lineage of an ancestor of both *Magnolia wilsonii* and *Magnolia globosa* of OYAMA clade (Fig. 18).


(A)
Nuclear result
A B C D E
A B C D E
A B C D E
Chloroplast result
A B C D E
A B C D E
A B C D E
Expected evolutionary history
A B C D E
A B C D E
?
Interpretation
No ancient hybridization event
Ancient hybridization between AB clade and CD clade
Insufficient phylogenetic signal for confirming ancient hybridization event
(B)
Application examples
GYNO-PODIUM
MICHELIA +YULANIA
KMERIA
♀
♂
OYAMA
RYTIDO-SPERMUM
MAN-GLIETIA
♀
♂

(Previous page) Fig. 20. (A) Three interpretations for the evolutionary history for addressing ancient hybridization based on observations of reconstructed nuclear and chloroplast trees with the analyses of extent taxa. Bold lines indicate highly supported nodes, and a dashed line indicates poorly supported nodes. (B) Examples of suggested ancient hybridization across the evolutionary history of Magnoliaceae recognized in this study.

4.4.4 Molecular date and biogeography of Magnoliaceae

In the previous studies, Nie et al. (2008) estimated the divergence time of the crown node of subfamily Magnolioideae to be around 54 mya (the early Eocene) using three nuclear regions (*PHYA*, *LFY*, and *GAI1*), and Azuma et al. (2001) estimated to be about 42 mya (the middle Eocene) using *matK*. They also inferred that the global warming event at early Eocene might have caused the spreading of an ancestral lineage of Magnolioideae to high latitudes in the Northern Hemisphere, leading intercontinental migrations via both the Bering and North Atlantic land bridge (Azuma et al., 2001; Nie et al., 2008). And it was thought that subsequent cooling events might have caused their movement to lower latitudes, leading to disjunctions of the ancestral lineage of Magnolioideae between North America and Eurasia (Azuma et al., 2001; Nie et al., 2008). Hebda and Irving (2004) inferred the process of accomplishing present Magnoliaceae distribution based on fossil records, climate, and tectonics and described that magnolias originated in North America in high mid-latitudes,

spread eastwards during the global warming of Eocene, migrated to Europe and Asia via Disko Island and Thulean isthmuses, shifted to low latitudes with global cooling, and happened extinction in Europe and southern Siberia.

In this study, dating and biogeographic analyses presented that subfamily Magnolioideae might be originated in both the Americas and Asia at 37.84 mya in late Eocene (Fig. 19). The results indicated that disjunction between Asia and the Americas might have occurred at 32-35 mya in the late Eocene and early Oligocene based on divergence times between Asian groups (MICHELIA+YULANIA+KMERIA+GYNOPODIUM, GWILLIMIA, and MANGLIEATIA+RYTIDOSPERMUM+OYAMA) and the American groups (THEORHODON+MACROPHYLLA, TALAUMA, FRASERI, and SPLENDENTES). After global warming in the early Eocene (Early Eocene Climatic Optimum, 51-53 mya; Zachos et al., 2008), a cooling occurred enough to create large glaciers in Antarctica at about 34 mya in the Late Eocene (Hansen et al., 2013). This cooling event might correlate with the disjunction between Asia and the Americas in shifting ancestral lineages of Magnolioideae to the lower latitude and preventing further intercontinental migration.

The results also confirmed three cases in which taxon in North America forms a clade with Asian taxa: *Liriodendron tulipifera*, *Magnolia tripetala* in RYTIDOSPERMUM clade, and *Magnolia acuminata* in YULANIA clade. These temperate disjunctions have been identified in previous studies (Azuma et al., 2001; Nie et al., 2008). Nie (2008) estimated the divergence time of *Liriodendron*

tulipifera to be 14.15 mya (95% HPD: 8.69-21.01 mya), *Magnolia tripetala* to be 10.57 mya (95% HPD: 5.98-15.91 mya), and *Magnolia acuminata* to be 28.29 mya (95% HPD: 20.58-36.55 mya). These disjunctions were inferred to be caused by warm-cool fluctuations of the early Oligocene and mid-Miocene (Azuma et al., 2001; Hebda and Irving, 2004; Nie et al., 2008). In this study, the results estimated the divergence time of *Liriodendron tulipifera* to be 17.54 mya (95% CI 16.83-17.54) and the divergence time of *Magnolia tripetala* to be 13.00 mya (95% CI 11.25-13.02), which were close to the estimate by Nie et al. (2008). Although the divergence time of the *Magnolia acuminata* in the YULANIA clade was set to 25 mya as a calibration point based on Azuma et al. (2001), it was also similar to the estimate by Nie et al. (2008). According to Hansen et al. (2013), the global climate fluctuated following Antarctic glaciation, and the global climate during the Mid-Miocene Climatic Optimum (MMCO, 15 Mya) was as warm as that at 34 mya in the Late Eocene. Therefore the results presented that these independent temperate disjunctions occurred during the global climate fluctuating period in early Oligocene and mid-Miocene. These disjunctions might have resulted from migration from Asia to North America since the climate during the MMCO (15 Mya) was as warm as that in the late Eocene (34 mya).

However, the divergence time estimation using penalized likelihood seems to produce younger estimates relatively than the Bayesian method (Nie et al., 2008; Stubbs et al., 2018). Thus, the divergence times need to be compared with those estimated by the Bayesian method even though this method has a computational burden and takes a long time. Overall, the relationships among major clades

diverged along relatively short branch lengths for a quite narrow time, and this might have made it difficult to reconstruct the backbone of Magnoliaceae using a few DNA regions.

4.4.5 Further studies

In Magnoliaceae, the taxonomic position of *Dugandiodendron* Lozano-Contreras (1975) has changed continuously for a long time. *Dugandiodendron* was suggested as an independent genus by Lozano-Contreras (1975), was included in the genus *Magnolia* by Nooteboom (1985), was belonged to section *Theorhodon* as a subsection by Nooteboom (2000), and was contained in section *Talauma* as a subsection by Figlar and Nooteboom (2004). In previous molecular phylogenetic studies, *Dugandiodendron* was suggested to be a sister to section *Splendentes* in the *matK* gene tree (Azuma et al., 2001), and formed a monophyletic group with section *Splendentes* and the section *Talauma* in the *ndhf* gene tree (Kim et al., 2001). It was also formed a monophyletic group with section *Splendentes* in a species tree reconstructed by five nuclear regions (*AGT1*, *GAI1*, *LEAFY*, *PHYA*, and *SQD1*) and six chloroplast regions (*ndhF*, *rbcL*, *trnK*, *atpB-rbcL*, *ndhF-rpl32*, and *psbA-trnH*) (Veltjen et al., In press). However, in this study, phylogenetic results showed that *Magnolia striatifolia* belonging to the *Dugandiodendron* group was located in the THEORHODON clade. Therefore, to clarify the taxonomic position of *Dugandiodendron*, phylogenetic analysis involving more *Dugandiodendron* taxa is required.

The recent classification of Figlar and Nooteboom (2004) recognized three subgenera (*Magnolia*, *Yulania*, and *Gynopodium*) and 12 sections within Magnolioideae based on findings of previous molecular phylogenetic studies of Magnoliaceae. However, in this study, the phylogenetic result does not support the classification system, since subgenus Magnolia, section *Talauma*, section *Rytidospermum*, section *Gynopodium*, subsection *Gwillimia*, subsection *Blumiana*, subsection *Yulania*, subsection *Tulipastrum*, subsection *Michelia*, and subsection *Maingola* were not formed of the monophyletic group. The phylogenetic result based on chloroplast genome data also presented that subgenus *Magnolia* and several subsections were not monophyletic (Chapter 3). Therefore, based on the phylogenetic tree reconstructed by massive nuclear data containing evolutionary history of bi-parental lineages, phylogenetically useful morphological characters need to be reconsidered, and a new classification system of Magnoliaceae needs to be proposed, referring to the rules of the International society for phylogenetic nomenclature (http://phylonames.org/).

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ABSTRACT IN KOREAN

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특정 분류군에 대한 계통의 재구성은 그 분류군의 진화와 종다양화 역사를 이해하기 위한 중요한 정보를 제공한다. 목련과의 계통연구는 주로 소수의 엽록체 또는 핵 DNA 구간들을 사용하여 수행된 바 있다. 목련과의 최근 분자적 계통 연구는 목련과의 모든 하위 그룹들을 대표하는 48 개의 분류군에서 10 개의 엽록체 DNA 구간들을 분석하였고 목련아과 내에서 주요 11 개의 분계군를 확인하였지만, 이들 간의 유연관계는 아직 명확하게 판명되지는 않았다. Hyb-Seq 기술은 혼성화 기반의 표적 농축과 유전체를 얕게 훑는 시퀀싱(skimming)을 결합한 방법으로, 모델 식물이 아닌 분류군에서도 수백 개의 개체들로부터 수백 개의 단일(또는 적은) copy 수의 핵 유전자들과 세포소기관의 유전체에 대한 데이터들을 생성해낼 수 있다. 본 연구는 목련과 식물들의 명확한 계통유연관계를 밝히고 이들에 대한 진화의 역사를 이해하기 위하여 Hyb-Seq 기술을 적용하여 목련과의 모든 하위 그룹들을 대변하는 총 124 개의 분류군(125 개 샘플) 각각에 대하여 엽록체 유전체 전체와 400 개의 핵 구간들의 염기서열을 결정하였다. 목련과 식물의 엽록체 유전체들은 LSC와 SSC에 의해 분리 된 한 쌍의 IR로 구성된 전형적인 구조이고, 159,269 ~ 160,186 bp의 길이이며, 각각 79 개의 단백질 암호화 유전자, 30 개의 tRNA 유전자 및 4 개의 rRNA 유전자를 포함하고 있다. 하나의 IR을 제외하고 길이가 136,930 bp의 정렬된

매트릭스에 대해 비교유전체학적 분석이 수행되었는데, 이 자료에서는 8,962 개의 변이(6.54%)와 5,697 개의 계통학적 정보를 갖는 변이(4.16%)가 발견되었다. 목련과 식물들의 엽록체 유전체의 서열들은 유전체의 구조, 유전자 구성 및 IR 경계가 전반적으로 잘 보존되어 있었다. 엽록체 유전체를 기반으로 한 계통수는 이전 연구에서 인식된 목련아과 내 11 개의 주요 분계군들을 확인하였고, 높은 신뢰도의 계통유연관계를 보여주었다. 계통수의 기저에(이하 대문자로 표시된 단어들은 분계군의 이름을 나타냄), TALAUMA와 GWILLIMIA의 분계군이 위치하였고, MACROPHYLLA와 FRASERI의 분계군이 두 번째 기저 그룹으로 확인되었다. 이 네 개의 그룹에 이어서, MICHELIA, YULANIA, GYNOPODIUM, KMERIA를 포함한 분계군과 MANGLIETIA, RYTIDOSPERMUM, THEORHODON을 포함하는 분계군으로 구성된 두 개의 하위 분계군들이 확인되었다. 추가 시료에 대한 이후 계통학적 분석을 위해 완성된 엽록체 유전체 전체 서열들을 분석한 결과를 바탕으로 최상의 계통학적 정보를 포함한 구간들(5 개의 유전자 간 구간들: *atpH–atpI*, *petA–psbJ*, *ndhF–rpl32*, *rpl32–trnL*, *rps15–ycf1*; 4 개의 단백질 암호화 구간들: *matK*, *ndhF*, *psaC, ycf1*)이 제시되었다. Hyb–Seq에 의한 핵 데이터 분석에서는 504 개의 single–copy의 핵 유전자들을 포획하기 위하여 목련과 식물들에 대한 맞춤형 탐침들이 설계되었다. 이들에 대한 염기서열을 결정한 결과는 탐침 설계에 사용된 총 표적 전사물 서열 길이(443,988 bp)에 대해 평균 87%를 얻었음을 보여주었고, 이는 탐침이 성공적으로 잘 작동하였음을 보여주고 있다. 핵 유전체에 의한 계통학적 분석은 최종 얻어진 400 개 구간에 대해서 수행되었고, 전체 유전자들이 연결된 자료는 정렬된 길이가 765,376 bp였으며 321,537 개의 변이(42.01%)와 186,094 개의 계통학적인 정보를 갖는 변이(24.31%)를 포함하였다. 계통학적 분석은 concatenation 접근과 coalescent 접근의 두 가지 접근 방식으로 이루어졌는데,

이들의 계통수 작성 일부 서로 상충되는 부분들이 확인되었다. 그러나 concatenated ML 계통수와 상충되는 coalescent ASTRAL 계통수의 절들은 대부분 LPP 값이 낮았고, 해당 절에 대한 유전자 계통수들 간의 불일치가 있었다. 이러한 불일치의 주요 원인은 유전자 계통수들이 모두 서로 다른 bipartition들을 지지하기 때문인 것으로 확인되었다. Coalescent 분석의 결과는 유전자 구간마다 서로 다른 진화 이력을 반영했을 수 있지만, 각 구간에서 불충분한 계통학적 신호의 노이즈로 인한 것으로 판단되었고, 따라서, 후속 분석은 concatenated ML 계통수를 기반으로 수행하였다. Concatenated ML 계통수는 목련아과 내에 13개의 주요 분계군들이 존재하며, 이들은 두 개의 큰 분계군을 형성함을 보여주었다: 분계군 A (BS=98)은 MANGLIETIA, RYTIDOSPERMUM, OYAMA, FRASERI, SPLENDENTES를 포함하고, 분계군 B (BS=88)는 MICHELIA, YULANIA, KMERIA, GYNOPODIUM, THEORHODON, MACROPHYLLA, GWILLIMIA, TALAUMA로 구성되었다. 분계군 A에서 SPLENDENTES가 가장 먼저 분지 된 다음 FRASERI, OYAMA, RYTIDOSPERMUM, MANGLIETIA가 차례로 분지되었다. 분계군 B는 분계군 C와 D를 포함하는데, 분계군 C는 GWILLIMIA와 TALAUMA가 단계통군(BS=96)을 이루고, 이들은 MICHELIA, YULANIA, KMERIA, GYNOPODIUM, THEORHODON, MACROPHYLLA로 구성된 분계군 D (BS=99)과 자매군을 형성하였다. 분계군 D 내에서는 THEORHODON과 MACROPHYLLA가 독립된 분계군(분계군 E; BS=100)을 형성하였고, 이는 MICHELIA, YULANIA, KMERIA 및 GYNOPODIUM으로 구성된 분계군(분계군 F; BS=100)과 자매군을 형성하였다. 분계군 F에서 GYNOPODIUM이 가장 먼저 분지되었고 KMERIA, YULANIA, MICHELIA가 차례로 분지되었다. 각 유전자 계통수에서 concatenated ML 계통수와 공유된 quartet의 수를 세어 공유도가 높은 순으로 400 개의 구간들 각각에 순위를

부여하였는데, 상위 20개 구간으로 구성된 부분집합은 concatenated ML 계통수의 총 quartet의 94.1%를 공유하였다. 이들 높은 순위의 유전자들은 향후 목련과 식물들에 대하여 추가적인 시료 확보를 통한 확장된 연구를 위해 적합한 DNA 구간들로 제시되었다. 엽록체 유전체와 핵 유전체에 의해 도출된 분계군들이 서로 상충되지만, 각각의 계통수에 있어서 높은 지지도를 보일 경우 이것은 ancient hybridization의 결과로 추정할 수 있다. 목련과 식물에서는 계통수 분석 결과 1) MICHELIA+YULANIA는 GYNOPODIUM(암)과 KMERIA(수)의 고대 계통 간에, 그리고 2) RYTIDOSPERMUM은 OYAMA (암)와 MANGLIETIA (수)의 고대 계통 간에 ancient hybridization이 일어났음을 제시하였다. 분자 연대 측정 및 생물 지리학적 분석 결과, 1) 목련아과는 Eocene 후기(37.84 mya)에 아시아와 아메리카를 포함한 하나의 큰 조상 지역에서 유래됨을 보여주었고, 2) 고대 목련과의 최초 분포지가 아시아와 아메리카로 대륙간 분리가 일어난 것은 Eocene 후기에서 Oligocene 초기(32–35 mya)로 추정되는데, 이는 Eocene 초기의 지구 온난화 이후 Eocene 후기의 지구한랭화와 연관되어진다. 분석결과는 *Liriodendron* (*L, tulipifera* 와 *L. chinense* 간; 17.54 mya), RYTIDOSPERMUM (*M. tripetala*와 *M. obovata*와 *M. officinalis*로 구성된 분계군 간; 13.00 mya) 및 YULANIA (*M. acuminata*와 분계군 내 다른 분류군들 간; 25 mya; 교정 지점)에서 온대 지역에서의 독립적인 분지는 Oligocene 초기 및 Miocene 중기의 지구 기후 변동 기간 동안에 일어났음을 제시하고 있다. 이는 Mid-Miocene Climatic Optimum (MMCO, 15 Mya) 동안에 기후가 Eocene 후기(34 mya)만큼 따뜻했던 것이 가설에 의해 뒷받침된다. 목련과의 현재 분류 체계는 단편적인 분자 계통 학적 연구 결과들에 의해 목련아과 내에 3개의 아속(*Magnolia*, *Yulania, Gynopodium*)과 12 개의 절을 인식하고 있었다. 본 연구에서는 부계와 모계의 공통 계통(핵)과 모계의 계통(엽록체)을 반영하는 대량의

분자 데이터를 도출하였고, 이를 이용하여 높은 신뢰도로 지지된 계통수들을 재구성하였다. 본 연구결과는 이후 새 분류 체계 제시를 위한 직접적인 증거가 될 것이며, 목련의 진화와 분화 역사의 이해를 돕는 주된 자료가 될 것이다.

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Appendices for chapter 2

Appendix 1. Long repeats comparison of chloroplast genome of 40 *Manglietia* samples and seven outgroup taxa.

Appendix 2. SSRs comparison of chloroplast genome of 40 *Manglietia* samples and seven outgroup taxa.

Appendix 3. MAUVE alignments of 47 taxa chloroplast genomes including outgroup taxa.

Appendix 1. Long repeats comparison of chloroplast genome of 40 *Manglietia* samples and seven outgroup taxa.

Sci. name	Palindromic	Forward	Reverse	Complement	Total	30	31	32	33	34	35	37	38	39	40	41	42	43	45	48	51	57	75	93	105	111	129
Manglietia glauca (IBSC)	14	15	0	0	29	9	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia glauca (L)	14	17	0	0	31	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	1	1
Manglietia chevalieri	14	15	0	0	29	9	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia fordiana	14	13	0	0	27	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	0	0	0	0	0
Manglietia forrestii	14	15	0	0	29	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	0	0
Manglietia chingii	14	17	0	0	31	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	1	1
Manglietia guangzhouensis	14	17	0	0	31	9	2	1	5	0	0	1	0	3	0	1	5	0	0	1	0	1	1	1	0	0	0
Manglietia longipedunculata	14	18	0	0	32	9	2	1	5	0	0	1	0	3	0	1	5	0	0	1	0	1	1	1	0	1	0
Manglietia ovoidea (SWU)	14	17	0	0	31	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	1	1
Manglietia ovoidea (IBSC)	14	15	0	0	29	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	0	0
Manglietia patungensis	14	16	0	0	30	9	2	0	5	0	0	1	0	3	0	1	5	0	0	1	0	1	1	1	0	0	0
Manglietia kwangtungensis	14	17	0	0	31	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	1	1
Manglietia yuyuanensis	14	14	0	0	28	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia hainanensis	14	14	0	0	28	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia ventii	14	17	0	0	31	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	1	1
Manglietia garrettii	14	13	0	0	27	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	0	0	0	0	0
Manglietia megaphylla	13	17	0	0	30	8	2	1	5	0	0	1	0	3	0	1	4	0	0	0	0	1	1	1	0	1	1
Manglietia rufibarbata	13	17	0	0	30	8	2	1	5	0	0	1	0	3	0	1	4	0	0	0	0	1	1	1	0	1	1
Manglietia dandyi	13	15	0	0	28	8	2	1	5	0	0	1	0	3	0	1	4	0	0	0	0	1	1	1	0	0	0
Manglietia longirostrata	13	15	0	0	28	8	2	1	5	0	0	1	0	3	0	1	4	0	0	0	0	1	1	1	0	0	0
Manglietia crassipes	14	14	0	0	28	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia calcarea	14	14	0	0	28	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia lucida (KUN)	15	17	0	0	32	8	2	1	5	0	0	1	0	3	0	1	5	0	1	0	0	1	1	1	0	1	1
Manglietia lucida (IBSC)	14	16	0	0	30	10	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia miechangensis	15	14	0	0	29	9	2	2	5	0	0	0	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia maguanica	15	14	0	0	29	8	3	1	6	0	0	0	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia sapaensis	14	12	0	0	26	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	0
Manglietia conifera	16	13	0	0	29	8	3	1	6	0	0	1	0	3	0	1	5	0	0	0	0	1	0	0	0	0	0
Manglietia insignis	16	13	0	0	29	8	3	1	6	0	0	1	0	3	0	1	5	0	0	0	0	1	0	0	0	0	0
Manglietia aromatica	16	15	0	0	31	8	2	2	5	1	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	0	0
Manglietia kaifui	14	13	0	0	27	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	0	0	0	0	0
Manglietia duclouxii	14	13	0	0	27	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	0	0	0	0	0
Manglietia guangnanica	16	14	0	0	30	8	3	1	6	0	0	1	0	3	0	1	5	0	0	0	0	1	1	0	0	0	0
Manglietia szechuanica	16	17	0	0	33	8	3	1	6	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	1	1
Manglietia grandis	16	13	0	0	29	8	3	1	6	0	0	1	0	3	0	1	5	0	0	0	0	1	0	0	0	0	0
Manglietia hookeri	16	13	0	0	29	8	3	1	6	0	0	1	0	3	0	1	5	0	0	0	0	1	0	0	0	0	0
Manglietia utilis	15	12	0	0	27	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	1	0	0	0	0	0	0
Manglietia caveana	15	12	0	0	27	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	1	0	0	0	0	0	0
Manglietia decidua (SWU)	14	17	0	0	31	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	1	1
Manglietia decidua (IBSC)	14	17	0	0	31	8	2	1	5	0	0	1	0	3	0	1	5	0	0	0	0	1	1	1	0	1	1
Magnolia officinalis	15	11	1	0	27	8	2	1	5	0	0	1	0	2	1	1	5	1	0	0	0	0	0	0	0	0	0
Magnolia obovata	15	11	1	0	27	8	2	1	5	0	0	1	0	2	1	1	5	1	0	0	0	0	0	0	0	0	0
Magnolia tripetala	14	12	1	0	27	9	2	1	5	0	0	1	0	2	1	1	5	0	0	0	0	0	0	0	0	0	0

Magnolia globosa	14	11	0	0	25	8	2	1	5	0	0	1	0	2	0	1	5	0	0	0	0	0	0	0	0	0	0
Magnolia wilsonii	17	12	3	0	32	9	2	3	6	0	1	1	1	2	0	1	5	0	0	0	1	0	0	0	0	0	0
Magnolia sieboldii subsp. *sinensis*	14	13	1	0	28	9	2	1	4	0	0	1	2	2	0	1	5	0	0	0	1	0	0	0	0	0	0
Magnolia sieboldii	14	14	1	0	29	9	3	1	4	0	0	1	2	2	0	1	5	0	0	0	1	0	0	0	0	0	0

Appendix 2. SSRs comparison of chloroplast genome of 40 *Manglietia* samples and seven outgroup taxa.

sci. name	Mono nucleotide	Di nucleotide	Tri nucleotide	Tetra nucleotide	Penta nucleotide	Hexa nucleotide	(A)^10	(A)^11	(A)^12	(A)^13	(A)^14	(A)^15	(A)^16	(A)^17	(A)^18	(A)^19
Manglietia glauca (IBSC)	33	6	0	8	0	0	5	3	1	3	0	0	1	0	0	0
Manglietia glauca (L)	33	6	0	8	0	0	7	2	0	3	0	1	0	0	0	0
Manglietia chevalieri	32	6	0	8	0	0	6	3	0	2	0	0	1	0	0	0
Manglietia fordiana	36	6	0	8	0	0	4	2	4	1	1	1	0	0	0	0
Manglietia forrestii	36	6	0	8	0	0	5	3	3	1	1	1	0	0	0	0
Manglietia chingii	35	6	0	8	0	0	4	2	3	2	1	0	0	0	0	0
Manglietia guangzhouensis	36	6	0	8	0	0	5	2	3	2	0	0	1	0	0	0
Manglietia longipedunculata	37	6	0	8	0	0	5	2	3	2	0	0	1	0	0	0
Manglietia ovoidea (SWU)	36	6	0	8	0	0	4	3	2	2	0	1	0	0	0	0
Manglietia ovoidea (IBSC)	36	6	0	8	0	0	4	3	2	2	0	1	0	0	0	0
Manglietia patungensis	35	6	0	8	0	0	5	4	1	1	1	0	0	0	0	0
Manglietia kwangtungensis	36	6	0	8	0	0	3	3	3	2	1	0	0	0	0	0
Manglietia yuyuanensis	35	6	0	8	0	0	5	2	3	2	1	1	0	0	0	0
Manglietia hainanensis	35	6	0	8	0	0	6	3	1	2	0	1	0	0	0	0
Manglietia ventii	34	6	0	8	0	0	4	4	2	2	0	1	0	0	0	0
Manglietia garrettii	34	6	0	8	0	0	3	3	2	2	1	0	0	0	0	0
Manglietia megaphylla	37	6	0	8	0	0	4	4	1	2	0	1	0	0	0	0
Manglietia rufibarbata	37	6	0	8	0	0	5	3	1	1	1	1	0	0	0	0
Manglietia dandyi	37	6	0	8	0	0	4	4	1	1	1	1	0	0	0	0
Manglietia longirostrata	37	6	0	8	0	0	5	4	1	1	2	0	0	0	0	0
Manglietia crassipes	37	6	0	8	0	0	8	3	1	2	0	1	0	0	0	0
Manglietia calcarea	33	6	0	8	0	0	5	2	3	2	0	1	0	0	0	0
Manglietia lucida (KUN)	35	6	0	8	0	0	7	0	4	2	0	1	0	0	0	0
Manglietia lucida (IBSC)	34	6	0	8	0	0	6	3	0	3	1	0	0	0	0	0
Manglietia miechangensis	30	5	0	8	0	0	6	4	2	0	1	0	0	0	0	0
Manglietia maguanica	33	5	0	8	0	0	8	3	1	1	1	0	0	0	0	0
Manglietia sapaensis	34	5	0	8	0	0	7	4	1	0	1	0	0	0	0	0
Manglietia conifera	33	5	0	8	0	0	7	3	1	2	1	0	0	0	0	0
Manglietia insignis	33	5	0	8	0	0	7	3	1	2	1	0	0	0	0	0
Manglietia aromatica	31	5	0	8	0	0	7	2	1	1	0	1	0	0	0	0
Manglietia kaifui	33	5	0	8	0	0	8	2	1	0	2	0	0	0	0	0

Manglietia duclouxii	33	5	0	8	0	0	8	2	1	0	2	0	0	0	0	0
Manglietia guangnanica	33	5	0	8	0	0	5	5	2	0	1	0	0	0	0	0
Manglietia szechuanica	32	5	0	8	0	0	5	5	2	0	1	0	0	0	0	0
Manglietia grandis	34	5	0	8	0	0	5	4	2	1	1	0	0	0	0	0
Manglietia hookeri	34	5	0	8	0	0	7	2	3	0	1	0	0	0	0	0
Manglietia utilis	33	5	0	8	0	0	7	1	3	1	1	0	0	0	0	0
Manglietia caveana	33	5	0	8	0	0	10	2	0	2	0	0	1	0	0	0
Manglietia decidua (SWU)	31	5	0	8	0	0	4	4	2	0	0	0	0	1	0	0
Manglietia decidua (IBSC)	31	5	0	8	0	0	4	5	1	0	0	0	0	0	0	1
Magnolia officinalis	35	6	0	7	0	0	8	1	2	1	1	1	0	0	0	0
Magnolia obovata	31	6	0	7	0	0	6	1	1	1	2	1	0	0	0	0
Magnolia tripetala	36	5	0	7	0	0	11	0	2	2	0	0	0	0	1	0
Magnolia globosa	44	5	0	8	0	1	4	8	3	2	0	1	0	0	0	0
Magnolia wilsonii	43	6	0	7	1	0	9	5	3	4	1	0	0	0	0	0
Magnolia sieboldii subsp. *sinensis*	44	6	0	8	0	0	9	3	4	0	1	1	0	0	0	0
Magnolia sieboldii	45	6	0	8	0	0	7	5	2	1	1	1	0	0	0	0

Appendix 2. (Continued)

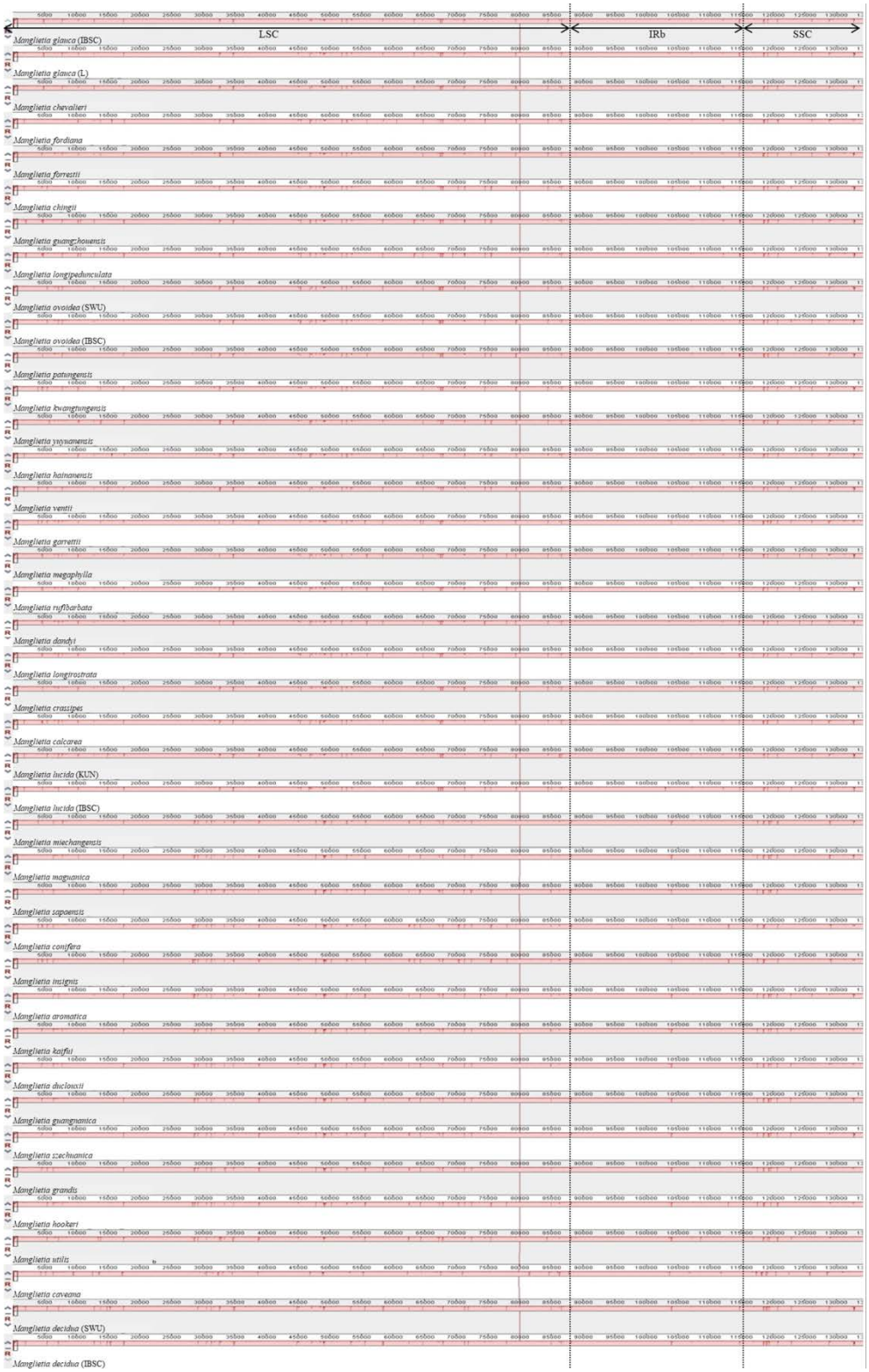
sci. name	(A)^23	(C)^10	(C)^11	(C)^12	(C)^13	(C)^14	(C)^15	(C)^16	(G)^10	(G)^11	(G)^12	(G)^13	(G)^14	(T)^10	(T)^11	(T)^12	(T)^13	(T)^14	(T)^15	(T)^22
Manglietia glauca (IBSC)	0	2	0	0	0	0	0	1	0	0	1	0	0	7	4	2	3	0	0	0
Manglietia glauca (L)	0	2	0	0	0	1	0	0	0	0	1	0	0	7	4	2	3	0	0	0
Manglietia chevalieri	0	2	0	0	0	0	1	0	0	0	1	0	0	6	5	2	3	0	0	0
Manglietia fordiana	0	1	0	0	0	1	0	0	1	0	0	1	0	8	8	2	1	0	0	0
Manglietia forrestii	0	2	0	0	0	1	0	0	0	0	0	1	0	8	4	4	2	0	0	0
Manglietia chingii	0	1	0	0	1	1	0	0	1	0	0	0	0	6	8	3	1	1	0	0
Manglietia guangzhouensis	0	2	1	0	0	0	0	0	0	0	1	0	1	7	6	2	3	0	0	0
Manglietia longipedunculata	0	2	1	0	0	0	0	0	0	0	1	0	1	7	6	3	3	0	0	0
Manglietia ovoidea (SWU)	0	1	0	1	0	1	0	0	0	0	1	1	0	8	6	3	2	0	0	0
Manglietia ovoidea (IBSC)	0	1	0	1	0	0	1	0	0	0	2	0	0	8	6	3	2	0	0	0
Manglietia patungensis	0	1	0	0	0	1	0	0	1	1	0	0	0	11	2	2	2	1	1	0
Manglietia kwangtungensis	0	2	0	1	0	0	0	0	1	0	0	1	0	6	6	5	2	0	0	0
Manglietia yuyuanensis	0	1	0	0	0	0	1	0	1	0	1	0	0	7	6	2	2	0	0	0
Manglietia hainanensis	0	0	1	0	0	0	1	0	1	0	0	1	0	5	10	1	2	0	0	0
Manglietia ventii	0	0	0	1	0	0	0	0	0	0	0	1	0	11	3	2	3	0	0	0
Manglietia garrettii	0	0	1	0	1	0	0	0	0	0	0	1	0	11	4	4	1	0	0	0
Manglietia megaphylla	0	2	1	0	0	0	0	0	1	0	0	1	0	8	5	6	1	0	0	0
Manglietia rufibarbata	0	3	0	0	0	0	0	0	1	0	0	1	0	8	5	6	1	0	0	0
Manglietia dandyi	0	2	1	0	0	0	0	0	1	0	0	1	0	8	5	6	1	0	0	0
Manglietia longirostrata	0	1	1	1	0	0	0	0	1	0	0	1	0	9	4	5	1	0	0	0
Manglietia crassipes	0	0	2	1	0	0	0	0	1	0	1	0	0	6	6	4	1	0	0	0

Manglietia calcarea	0	0	0	1	0	0	0	0	1	0	1	0	0	6	6	4	1	0	0	0
Manglietia lucida (KUN)	0	0	0	1	0	1	0	0	0	0	0	1	0	6	8	1	3	0	0	0
Manglietia lucida (IBSC)	0	0	1	0	1	0	0	0	0	1	0	0	0	4	9	2	1	1	0	1
Manglietia miechangensis	0	0	1	0	0	0	0	0	1	1	0	0	0	5	4	3	2	0	0	0
Manglietia maguanica	0	1	1	0	0	0	0	0	1	1	0	0	0	5	5	4	1	0	0	0
Manglietia sapaensis	0	2	0	1	0	0	0	0	1	1	0	0	0	8	2	3	2	1	0	0
Manglietia conifera	0	1	1	0	0	0	0	0	1	0	0	0	0	8	2	4	1	1	0	0
Manglietia insignis	0	1	1	0	0	0	0	0	1	0	0	0	0	8	2	4	1	1	0	0
Manglietia aromatica	0	0	1	1	0	0	0	0	0	1	0	0	0	8	5	2	0	1	0	0
Manglietia kaifui	0	1	1	0	0	0	0	0	1	0	1	0	0	7	2	6	1	0	0	0
Manglietia duclouxii	0	1	1	0	0	0	0	0	0	1	1	0	0	7	2	6	1	0	0	0
Manglietia guangnanica	0	1	1	0	0	0	0	0	0	2	0	0	0	6	4	4	0	1	0	0
Manglietia szechuanica	0	1	1	0	0	0	0	0	0	1	1	0	0	5	4	5	1	0	0	0
Manglietia grandis	0	1	1	0	0	0	0	0	0	1	1	0	0	8	4	4	0	1	0	0
Manglietia hookeri	0	2	1	0	0	0	0	0	0	1	0	0	0	8	3	4	1	0	1	0
Manglietia utilis	0	1	0	1	1	0	0	0	0	0	0	0	0	9	5	2	0	1	0	0
Manglietia caveana	0	1	1	1	0	0	0	0	0	0	0	0	0	6	3	2	2	2	0	0
Manglietia decidua (SWU)	0	0	0	2	1	0	0	0	0	0	1	0	0	7	3	4	2	0	0	0
Manglietia decidua (IBSC)	0	0	0	1	2	0	0	0	0	0	1	0	0	7	3	4	2	0	0	0
Magnolia officinalis	0	1	1	0	0	0	0	0	0	0	0	0	0	9	4	4	1	1	0	0
Magnolia obovata	0	0	0	1	0	0	0	0	0	0	0	0	0	8	5	3	0	2	0	0
Magnolia tripetala	0	2	0	1	0	0	0	0	1	0	0	0	0	8	4	1	3	0	0	0
Magnolia globosa	0	1	0	0	1	0	0	0	0	0	0	0	0	9	6	4	3	2	0	0
Magnolia wilsonii	1	0	1	0	2	0	0	0	0	0	0	0	0	6	3	4	4	0	0	0
Magnolia sieboldii subsp. *sinensis*	0	0	0	0	2	0	0	0	0	0	0	1	0	6	7	5	2	2	1	0
Magnolia sieboldii	0	0	0	0	1	0	0	1	1	1	0	0	0	6	6	6	2	2	2	0

Appendix 2. (Continued)

sci. name	(AT)^5	(AT)^6	(AT)^7	(CT)^5	(CT)^6	(CT)^7	(CT)^8	(AAAT)^3	(AAAT)^4	(AAAT)^5	(AATC)^3	(AATG)^3	(AATT)^3	(ACAT)^3	(CATT)^3	(AAAGT)^3	(AAATAG)^3	sum
Manglietia glauca (IBSC)	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	47
Manglietia glauca (L)	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	47
Manglietia chevalieri	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia fordiana	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	50
Manglietia forrestii	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	50
Manglietia chingii	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	49
Manglietia guangzhouensis	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	50
Manglietia longipedunculata	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	51
Manglietia ovoidea (SWU)	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	50
Manglietia ovoidea (IBSC)	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	50

Manglietia patungensis	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	49
Manglietia kwangtungensis	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	50
Manglietia yuyuanensis	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	49
Manglietia hainanensis	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	49
Manglietia ventii	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	48
Manglietia garrettii	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	48
Manglietia megaphylla	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	51
Manglietia rufibarbata	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	51
Manglietia dandyi	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	51
Manglietia longirostrata	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	51
Manglietia crassipes	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	51
Manglietia calcarea	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	47
Manglietia lucida (KUN)	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	49
Manglietia lucida (IBSC)	4	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	48
Manglietia miechangensis	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	43
Manglietia maguanica	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia sapaensis	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	47
Manglietia conifera	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia insignis	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia aromatica	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	44
Manglietia kaifui	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia duclouxii	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia guangnanica	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia szechuanica	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	45
Manglietia grandis	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	47
Manglietia hookeri	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	47
Manglietia utilis	3	1	0	1	0	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia caveana	3	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	46
Manglietia decidua (SWU)	3	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	44
Manglietia decidua (IBSC)	3	1	0	0	1	0	0	2	1	0	1	1	1	1	1	0	0	44
Magnolia officinalis	3	1	0	0	0	2	0	2	0	0	1	1	1	1	1	0	0	48
Magnolia obovata	3	1	0	0	0	2	0	2	0	0	1	1	1	1	1	0	0	44
Magnolia tripetala	3	1	0	0	0	1	0	2	0	0	1	1	1	1	1	0	0	48
Magnolia globosa	3	1	0	1	0	0	0	2	0	1	1	1	1	1	1	0	1	58
Magnolia wilsonii	3	0	1	0	0	1	1	1	1	0	1	1	1	1	1	1	0	57
Magnolia sieboldii subsp. *sinensis*	3	1	0	0	0	2	0	2	0	1	1	1	1	1	1	0	0	58
Magnolia sieboldii	3	1	0	0	0	1	1	2	0	1	1	1	1	1	1	0	0	59


LSC
IRb
SSC
Manglietia glauca (IBSC)
Manglietia glauca (L)
Manglietia chevalieri
Manglietia fordiana
Manglietia forrestii
Manglietia chingii
Manglietia guangchouensis
Manglietia longipedunculata
Manglietia ovoidea (SWU)
Manglietia ovoidea (IBSC)
Manglietia patungensis
Manglietia kwangtungensis
Manglietia yuyuanensis
Manglietia hainanensis
Manglietia ventii
Manglietia garrettii
Manglietia megaphylla
Manglietia rufibarbata
Manglietia dandyi
Manglietia longirostrata
Manglietia crassipes
Manglietia calcarea
Manglietia lucida (KUN)
Manglietia lucida (IBSC)
Manglietia miechangensis
Manglietia maguanica
Manglietia sapaensis
Manglietia conifera
Manglietia insignis
Manglietia aromatica
Manglietia kaifui
Manglietia duclouxii
Manglietia guangnanica
Manglietia szechuanica
Manglietia grandis
Manglietia hookeri
Manglietia utilis
Manglietia caveana
Manglietia decidua (SWU)
Manglietia decidua (IBSC)

Appendix 3 MAUVE alignments of 47 taxa chloroplast genomes including outgroup taxa. The *Manglietia glauca* was shown at the top as the reference. Within each of the alignment, local collinear blocks are represented by blocks of the same color connected by lines. The order was arranged based on the phylogenetic tree.

Appendices for Chapter 3

Appendix 4. Taxa and voucher information included in phylogenetic study of Magnoliaceae based on chloroplast genomes.

Appendix 5. Summary of the sequencing results for the chloroplast genome study of Magnoliaceae

Appendix 6. Summary of features of the Magnoliaceae chloroplast genomes.

Appendix 7. Comparison of the large single copy (LSC), small single copy (SSC), and inverted repeat (IR) border regions among the Magnoliaceae chloroplast genomes.

Appendix 8. Comparison of the number of repeats of an 18 bp (TATTCTGATCATTATTGG) repeating units with six bp short direct repeat sequences (TATTGG) on both sides of the repeat in the 3' end portion of the *ycf1* gene in the SSC region in the Magnoliaceae chloroplast genomes.

Appendix 9. Long repeats comparison of the chloroplast genome of Magnoliaceae.

Appendix 10. SSRs comparison of the chloroplast genome of Magnoliaceae.

Appendix 11. The type and frequency of repeated sequences and simple sequence repeats (SSRs) in the chloroplast genomes of Magnoliaceae.

Appendix 12-22. Small inversions in *trnH-psbA*, *matK*, *petN-psbM*, *petA-psbJ*, *rpl32-trnL*, *ccsA-ndhD*, and *rps15-ycf1*.

Appendix 23. MAUVE alignment of 125 Magnoliaceae chloroplast genomes (124 taxa).

Appendix 24. Comparative analysis of the nucleotide variability (Pi) values of Magnoliaceae and of Magnolioideae.

Appendix 25. Phylogenetic tree of Magnoliaceae using Maximum likelihood (ML) based on chloroplast genomes, in which the small inversions were substituted for their reverse complement sequences.

Appendix 4. Taxa and voucher information included in phylogenetic study of Magnoliaceae based on chloroplast genomes. Classification followed Nooteboom (1985).

Taxa	Voucher, herbarium	The same materials used in *ndhF* study (Kim et al., 2001)	The same materials used in ten cp regions study (Kim and Suh,2013)	Accession Number
Family Magnoliaceae				
Subfamily Magnolioideae				
Tribes Magnolieae				
Genus *Magnolia*				
Subgenus *Magnolia*				
Section *Magnolia*				
Magnolia virginiana	*S. Kim 1027*, NPRI	v	v	MT682840
Section *Gwillimia*				
Magnolia albosericea	*S. Kim 1068*, NPRI	v		MT682773
Magnolia championii	*S. Kim 1057*, NPRI	v		MT682774
Magnolia coco	*S. Kim 1005*, NPRI	v	v	MT682853
Magnolia delavayi	*S. Kim 1009*, NPRI	v		MT682851
Magnolia henryi	*S. Kim 2017-0216*, SWU			MT682799
Magnolia phanerophlebia	*S. Kim 2015-0013*, SWU			MT682787
Section *Lirianthe*				
Magnolia pterocarpa	*M. W. Chase 1304*, K	v	v	MT682824
Section *Rytidospermum*				
Magnolia dealbata	*S. Kim 1008*, NPRI	v	v	JX280393
Magnolia fraseri	*S. Kim 1111*, NPRI	v	v	MT682783
Magnolia fraseri var. *pyrimidata*	*S. Kim 1100*, NPRI	v	v	MT682775
Magnolia macrophylla	*S. Kim 1015*, NPRI	v	v	MT682848
Magnolia macrophylla var. *ashei*	*S. Kim 1016*, NPRI	v		MT682847
Magnolia obovata	*S. Kim 1046*, NPRI	v		MT682850
Magnolia officinalis	*S. Kim 1018*, NPRI	v	v	MT682845
Magnolia tripetala	*S. Kim 1025*, NPRI	v	v	MT682841
Section *Oyama*				
Magnolia globosa	*S. Kim 1101*, NPRI	v		MT682834
Magnolia sieboldii	*S. Kim 1047*, NPRI	v	v	MT682836
Magnolia sieboldii subsp. *sinensis*	*S. Kim 1022*, NPRI	v		MT682843
Magnolia wilsonii	*S. Kim 1028*, NPRI	v	v	MT682839
Section *Theorhodon*				
Magnolia cubensis	*A.Gentry & M.Lavin 50992*, MO			MT682782
Magnolia grandiflora	*Soltis and Miles 2764*			MT682795
Magnolia guatemalensis	*Collection #72.0658*, JEPS	v	v	MT682827
Magnolia iltisiana	*A. Gentry & E. Jardel 73514*, MO	v		MT682780
Magnolia panamensis	*G. McPherson 15882*, MO	v	v	MT682784
Magnolia poasana	*H. Haber 9830*, MO	v		MT682781
Magnolia portoricensis	*C.M.Taylor & J. Bithorn 11817*, MO	v		MT682785
Magnolia schiedeana	*S. Kim 1021*, NPRI	v		MT682844
Magnolia sharpii	*Collection #80.0066*, JEPS	v		MT682826
Magnolia splendens	*S. Kim 1108*, NPRI	v	v	MT682779
Magnolia tamaulipana	*S. Kim 1026*, NPRI	v	v	MT682842
Section *Gynopodium*				
Magnolia kachirachirai	*S.Kim 20140830*, SWU			MT682786
Magnolia nitida	*S. Kim 1017*, NPRI	v	v	MT682846
Magnolia nitida var. *lotungensis*	*S. Kim 1051*, NPRI	v		MT682837
Section *Maingola*				
Magnolia carsonii	*J. H. Beaman 7912*, L			MT682829
Magnolia griffithii	*S. Kim 1113*, NPRI	v		MT682772
Section *Alcimandra*				
Magnolia cathcartii	*S. Kim 1091*, NPRI	v	v	JX280392
Subgenus *Yulania*				
Section *Yulania*				
Magnolia amoena	*S. Kim 1002*, NPRI	v		MT682856
Magnolia campbellii	*S. Kim 1004*, NPRI	v	v	MT682854
Magnolia dawsoniana	Vally garden HIL 82041			MT682835
Magnolia denudata	*S. Kim 1010*, NPRI	v	v	JX280394
Magnolia sargentiana	*S. Kim 1102*, NPRI	v		MT682832
Magnolia sprengeri	*S. Kim 1023*, NPRI	v		JX280401
Magnolia zenii	*S. Kim 1029*, NPRI	v		MT682838
Section *Buergeria*				
Magnolia biondii	*S. Kim 1003*, NPRI	v	v	MT682855
Magnolia cylindrica	*S. Kim 1006*, NPRI	v	v	MT682852
Magnolia kobus	*S. Kim 1013*, NPRI	v	v	MT682849
Magnolia salicifolia	*S. Kim 1019*, NPRI	v		MT682884
Magnolia sinostellata	*S. Kim 2017-0213*, SWU			MT682798

Magnolia stellata	*S. Kim 1103*, NPRI	v		MT682833
Section *Tulipastrum*				
Magnolia acuminata	*S. Kim 1001*, NPRI	v	v	JX280391
Magnolia acuminata var. *subcordata*	*B. K. Boom 5453*, L			MT682831
Magnolia liliiflora	*S. Kim 1014*, NPRI	v		JX280397
Subgenus *Talauma*				
Section *Talauma*				
Magnolia bankardiorum	*S. Kim 2015-0114*, SWU			MT682791
Magnolia dodecapetala	*S. Kim 1106*, NPRI	v	v	MT682776
Magnolia equatorialis	*S. Kim 2015-0118*, SWU			MT682793
Magnolia hodgsonii	*Shui Yu-Min et Chen wen-Hong 13801*, PE			MT682794
Magnolia kichuana	*S. Kim 2015-0112*, SWU			MT682789
Magnolia mercedesiarum	*R.Efren Merino-Santi, D. Yajaira Malucin-Andrade & Alex Dahua-Machoa s.n.*, ECUAMZ			MT682797
Magnolia mexicana	*Thien & Azuma s.n.*, TI	v	v	MT682778
Magnolia mindoensis	*Alex & Luis Dahua-Machoa s. n.*, ECUAMZ			MT682796
Magnolia ovata	*G.T. Prance & N.T.Silva s. n.*, K			MT682825
Magnolia pastazaensis	*S. Kim 2015-0113*, SWU			MT682790
Magnolia striatifolia	*S.Kim 1109*, NPRI			MT682777
Magnolia zamorana	*S. Kim 2015-0115*, SWU			MT682792
Section *Blumiana*				
Magnolia liliifera	*M. W. Chase 2108*, K	v	v	MT682771
Section *Aromadendron*				
Magnolia borneensis	*L 964.202-331*, L			MT682830
Magnolia elegans	*N. Balgry 2259*, L			MT682828
Section *Manglietiastrum*				
Magnolia sinica	*S.Kim 2015-0002*, SWU			MT682788
Genus *Manglietia*				
Manglietia aromatica	*S. Kim 2017-0208*, SWU			MT682870
Manglietia caveana	*s.n. 03730*, PE			MT682883
Manglietia conifera	*S. Kim 1030*, NPRI	v	v	MT682800
Manglietia decidua	*S. Kim 2015-0014*, SWU			MT682823
Manglietia duclouxii	*S. Kim 1092*, NPRI	v		MT682811
Manglietia fordiana	*S. Kim 1031*, NPRI	v		MT682801
Manglietia garrettii	*S.Kim 20141027*, SWU			MT682821
Manglietia glauca	*L 530810*, L			MT682807
Manglietia grandis	*S. Kim 2015-0031*, SWU			MT682864
Manglietia hookeri	*S. Kim 2015-0029*, SWU			MT682863
Manglietia insignis	*S. Kim 1032*, NPRI	v		MT682802
Manglietia kwangtungensis	*S. Kim 1033*, NPRI	v		MT682803
Manglietia lucida	*DZL 3142A*, KUN			MT682867
Manglietia megaphylla	*S. Kim 1056*, NPRI	v		MT682812
Manglietia ovoidea	*S. Kim 2015-0036*, SWU			MT682865
Manglietia pachyphylla	*S. Kim 2017-0204*, SWU			MT682868
Manglietia rufibarbata	*S. Kim 2015-0005*, SWU			MT682822
Manglietia szechuanica	*S. Kim 2017-0201*, SWU			MT682874
Manglietia utilis	*H. P. Nooteboom 6137*, L	v		MT682820
Manglietia ventii	*S.Kim 2015-0004*, SWU			MT682881
Genus *Pachylarnax*				
Pachylarnax praecalva	*W.Meijer 3173*, L			MT682876
Genus *Kmeria*				
Kmeria duperreana	*Smitinand 11692*, L	v	v	MT682809
Kmeria septentrionalis	*S. Kim 1053*, NPRI	v	v	MT682810
Tribes Michelieae				
Genus *Elmerrillia*				
Elmerrillia ovalis	*A. H. G. Alston 15973*, L			MT682806
Genus *Michelia*				
Michelia baillonii	*S. Kim 1064*, NPRI	v	v	MT682813
Michelia balansae	*S. Kim 1060*, NPRI	v		MT682814
Michelia cavaleriei	*S. Kim 2015-0022*, SWU			MT682859
Michelia chapensis	*S. Kim 1065*, NPRI	v		MT682815
Michelia chapensis	*S. Kim 2015-0019*, SWU			MT674812
Michelia compressa	*S. Kim 2015-0108*, SWU			MT682882
Michelia coriacea	*S. Kim 2015-0010*, SWU			MT674809
Michelia doltsopa	*S. Kim 2015-0023*, SWU			MT682860
Michelia figo	*S. Kim 1039*, NPRI	v	v	MT682804
Michelia floribunda	*S. Kim 1095*, NPRI	v		MT682816
Michelia foveolata	*S. Kim 2015-0021*, SWU			MT682858
Michelia guangdongensis	*S. Kim 2015-0037*, SWU			MT682866
Michelia guangxiensis	*S. Kim 2017-0218*, SWU			MT682872
Michelia hypolampra	*S. Kim 2015-0016*, SWU			MT674811
Michelia ingrata	*S. Kim 2015-0007*, SWU			MT674808
Michelia lacei	*S. Kim 1096*, NPRI	v		MT682817
Michelia macclurei	*S. Kim 2015-0028*, SWU			MT682862
Michelia martini	*S. Kim 1048*, NPRI	v		MT682805
Michelia masticata	*S. Kim 1097*, NPRI	v		MT682875
Michelia maudiae	*S. Kim 2015-0027*, SWU			MT682861
Michelia montana	*H. P. Nooteboom 6138*, L	v		MT682819
Michelia odora	*S. Kim 2015-0020*, SWU			MT682857
Michelia salicifolia	*L 908.125-1336*, L			MT682808
Michelia shiluensis	*S. Kim 1063*, NPRI	v		MT682818
Michelia sirindhorniae	*S. Kim 2017-0220*, SWU			MT682873
Michelia sphaerantha	*S. Kim 2017-0205*, SWU			MT682869
Michelia velutina	*S. Kim 1040*, NPRI	v		MT682880
Michelia viridipetala	*S. Kim 2017-0215*, SWU			MT682871

Michelia wilsonii	*S. Kim 2015-0012*, SWU			MT674810
Subfamily Liriodendroideae				
Genus *Liriodendron*				
Liriodendron chinense	*S. Kim 1044*, NPRI	v	v	MT682877
Liriodendron tulipifera	*S. Kim 1045*, NPRI	v	v	MT682878
Liriodendron chinense x *Liriodendron tulipifera*	*S. Kim 2015-0009*, SWU			MT682879

Note: ECUAMZ, Universidad Estatal Amazónica, Pastaza, Ecuador; JEPS, University of California, California, U.S.A.; K, Royal Botanic Gardens, Kew, U.K. England; KUN, Kunming Institute of Botany, Yunnan, China; L, Naturalis, Leiden, Netherlands; MO, Missouri Botanical Garden, Missouri, U.S.A.; NPRI, Seoul National University, Seoul, Republic of Korea; PE, Institute of Botany, Beijing, China; SWU, Sungshin Women's University, Seoul, Republic of Korea; TI, University of Tokyo, Tokyo, Japan.

Appendix 5. Summary of the sequencing results for the chloroplast genome study of Magnoliaceae.

Sci. name	Read length	N. of rawreads	N. of rawreads mapped on chloroplast	% of reads mapped on cp	Depth (N. cp reads x read length / 160 kb)	No of trimmed reads (read length from 30 to 101 or 151)	% of trimmed reads
Michelia macclurei	101	2,768,072	1,539,677	55.6	971.92	2,659,035	96.1
Michelia cavaleriei	101	1,944,690	649,201	33.4	409.81	1,868,468	96.1
Michelia guangdongensis	101	951,936	307,291	32.3	193.98	917,430	96.4
Michelia maudiae	101	822,108	154,776	18.8	97.70	786,800	95.7
Michelia coriacea	101	2,623,454	1,191,501	45.4	752.14	2,510,984	95.7
Michelia hypolampra	101	3,458,374	2,322,361	67.2	1465.99	3,327,842	96.2
Michelia chapensis	101	1,957,472	1,064,275	54.4	671.82	1,887,132	96.4
Michelia chapensis	101	2,443,844	1,112,116	45.5	702.02	2,361,476	96.6
Michelia martini	101	3,707,080	2,465,998	66.5	1556.66	3,558,713	96.0
Michelia wilsonii	101	4,781,836	3,073,441	64.3	1940.11	4,592,269	96.0
Michelia balansae	101	2,448,860	1,270,970	51.9	802.30	2,367,607	96.7
Michelia viridipetala	151	2,429,888	1,259,876	51.8	1189.01	2,282,742	93.9
Michelia montana	101	6,536,176	4,635,548	70.9	2926.19	6,322,827	96.7
Michelia velutina	151	6,589,984	4,299,326	65.2	4057.49	6,291,630	95.5
Magnolia griffithii	151	1,161,780	352,003	30.3	332.20	1,098,256	94.5
Michelia sirindhorniae	151	7,850,744	5,181,568	66.0	4890.10	7,517,183	95.8
Michelia baillonii	101	2,057,256	1,092,759	53.1	689.80	1,984,995	96.5
Elmerrillia ovalis	151	3,090,400	2,012,840	65.1	1899.62	2,991,654	96.8
Michelia floribunda	101	2,188,516	1,112,710	50.8	702.40	2,115,684	96.7
Michelia ingrata	101	2,677,064	1,401,589	52.4	884.75	2,572,156	96.1
Michelia salicifolia	151	3,572,244	2,034,737	57.0	1920.28	3,455,826	96.7
Michelia lacei	101	3,453,998	2,044,134	59.2	1290.36	3,319,294	96.1
Michelia doltsopa	101	4,380,414	2,615,487	59.7	1651.03	4,205,485	96.0
Michelia sphaerantha	101	5,544,276	3,959,060	71.4	2499.16	5,344,889	96.4
Michelia masticata	101	2,512,964	1,542,904	61.4	973.96	2,415,194	96.1
Michelia odora	101	2,621,048	1,651,614	63.0	1042.58	2,537,692	96.8
Michelia foveolata	101	1,483,352	651,131	43.9	411.03	1,424,007	96.0
Michelia guangxiensis	151	4,121,450	2,212,668	53.7	2088.21	3,936,104	95.5
Michelia shiluensis	101	2,417,462	1,408,541	58.3	889.14	2,333,996	96.5
Michelia figo	101	4,386,288	3,127,793	71.3	1974.42	4,211,682	96.0
Michelia compressa	101	1,088,268	310,200	28.5	195.81	1,047,199	96.2

Magnolia elegans	151	1,887,488	846,252	44.8	798.65	1,815,345	96.2
Magnolia borneensis	151	1,438,278	888,581	61.8	838.60	1,325,177	92.1
Magnolia carsonii	151	1,893,708	844,110	44.6	796.63	1,828,702	96.6
Magnolia cathcartii	101	2,094,106	1,232,705	58.9	778.15	2,024,587	96.7
Magnolia amoena	101	2,536,580	1,582,313	62.4	998.84	2,462,083	97.1
Magnolia zenii	101	2,605,082	1,733,775	66.6	1094.45	2,527,817	97.0
Magnolia biondii	101	1,057,246	559,152	52.9	352.96	1,015,029	96.0
Magnolia sinostellata	101	3,886,866	2,494,580	64.2	1574.70	3,662,865	94.2
Magnolia kobus	101	2,135,188	1,346,500	63.1	849.98	2,072,581	97.1
Magnolia stellata	101	6,380,028	4,525,380	70.9	2856.65	6,167,883	96.7
Magnolia salicifolia	101	1,869,894	1,008,389	53.9	636.55	1,784,994	95.5
Magnolia dawsoniana	101	2,490,374	1,501,800	60.3	948.01	2,409,322	96.7
Magnolia sargentiana	101	5,319,460	3,975,556	74.7	2509.57	5,123,408	96.3
Magnolia campbellii	101	1,762,056	963,583	54.7	608.26	1,709,763	97.0
Magnolia sprengeri	101	2,435,386	1,593,722	65.4	1006.04	2,340,211	96.1
Magnolia cylindrica	101	1,874,494	1,181,311	63.0	745.70	1,820,665	97.1
Magnolia denudata	101	2,676,792	1,785,435	66.7	1127.06	2,617,461	97.8
Magnolia liliiflora	101	1,558,200	913,160	58.6	576.43	1,504,450	96.6
Magnolia acuminata	101	2,244,126	1,390,232	61.9	877.58	2,153,550	96.0
Magnolia acuminata var. *subcordata*	151	1,373,214	351,376	25.6	331.61	1,330,052	96.9
Magnolia kachirachirai	101	5,136,632	3,780,651	73.6	2386.54	4,938,158	96.1
Magnolia nitida var. *lotungensis*	101	6,507,520	5,028,810	77.3	3174.44	6,297,108	96.8
Magnolia nitida	101	2,055,004	1,267,793	61.7	800.29	1,970,866	95.9
Pachylarnax praecalva	151	392,612	206,738	52.7	195.11	350,808	89.4
Magnolia sinica	101	1,956,320	897,597	45.9	566.61	1,878,249	96.0
Kmeria duperreana	151	2,533,940	1,213,446	47.9	1145.19	2,434,592	96.1
Kmeria septentrionalis	101	1,976,088	1,148,035	58.1	724.70	1,914,149	96.9
Manglietia ovoidea	101	1,628,506	695,331	42.7	438.93	1,577,670	96.9
Manglietia kwangtungensis	101	3,941,260	2,551,325	64.7	1610.52	3,783,862	96.0
Manglietia garrettii	101	2,517,148	1,285,385	51.1	811.40	2,427,018	96.4
Manglietia ventii	101	1,511,296	630,055	41.7	397.72	1,464,744	96.9
Manglietia lucida	151	2,157,130	742,666	34.4	700.89	2,074,175	96.2
Manglietia rufibarbata	101	1,306,976	332,572	25.4	209.94	1,260,279	96.4
Manglietia megaphylla	101	1,336,734	502,766	37.6	317.37	1,280,785	95.8
Manglietia glauca	151	1,093,136	228,056	20.9	215.23	1,054,905	96.5
Manglietia fordiana	101	3,678,952	2,628,851	71.5	1659.46	3,559,818	96.8
Manglietia pachyphylla	101	2,310,710	1,334,262	57.7	842.25	2,234,960	96.7
Manglietia insignis	101	4,131,476	2,764,118	66.9	1744.85	3,965,715	96.0
Manglietia conifera	101	2,991,278	2,080,921	69.6	1313.58	2,893,318	96.7
Manglietia hookeri	101	1,402,836	495,349	35.3	312.69	1,355,652	96.6
Manglietia duclouxii	101	2,087,722	1,260,168	60.4	795.48	2,013,619	96.5
Manglietia grandis	101	3,132,312	1,674,883	53.5	1057.27	3,016,692	96.3
Manglietia szechuanica	151	2,163,596	937,438	43.3	884.71	2,070,518	95.7
Manglietia aromatica	101	2,407,308	1,404,181	58.3	886.39	2,261,852	94.0
Manglietia utilis	101	1,566,842	733,948	46.8	463.30	1,507,021	96.2
Manglietia caveana	151	1,355,994	370,767	27.3	349.91	1,310,192	96.6
Manglietia decidua	101	2,904,754	1,667,694	57.4	1052.73	2,799,425	96.4
Magnolia obovata	101	2,270,852	1,290,572	56.8	814.67	2,195,788	96.7
Magnolia officinalis	101	2,137,418	1,359,268	63.6	858.04	2,045,622	95.7
Magnolia tripetala	101	3,259,248	1,879,926	57.7	1186.70	3,115,105	95.6
Magnolia globosa	101	11,068,824	8,733,359	78.9	5512.93	10,647,972	96.2
Magnolia sieboldii	101	4,493,858	3,234,059	72.0	2041.50	4,353,794	96.9
Magnolia sieboldii subsp. *sinensis*	101	6,010,834	4,526,952	75.3	2857.64	5,840,853	97.2
Magnolia wilsonii	101	5,814,396	4,610,218	79.3	2910.20	5,597,913	96.3
Magnolia panamensis	101	6,289,586	4,183,244	66.5	2640.67	6,083,382	96.7
Magnolia poasana	151	4,795,550	3,029,269	63.2	2858.87	4,605,165	96.0
Magnolia sharpii	101	7,213,622	5,075,975	70.4	3204.21	6,981,328	96.8
Magnolia guatemalensis	151	7,593,872	4,970,436	65.5	4690.85	7,329,910	96.5
Magnolia virginiana	101	4,921,564	3,796,481	77.1	2396.53	4,741,280	96.3
Magnolia iltisiana	151	4,121,684	2,588,557	62.8	2442.95	3,955,734	96.0
Magnolia grandiflora	151	6,847,774	3,930,954	57.4	3709.84	6,591,704	96.3
Magnolia striatifolia	151	2,707,550	1,227,335	45.3	1158.30	2,614,588	96.6
Magnolia schiedeana	101	1,623,934	692,556	42.6	437.18	1,536,764	94.6
Magnolia tamaulipana	101	1,437,298	743,784	51.7	469.51	1,388,779	96.6
Magnolia macrophylla var. *ashei*	151	2,258,114	1,184,902	52.5	1118.25	2,146,901	95.1
Magnolia macrophylla	101	3,366,054	2,321,735	69.0	1465.60	3,251,273	96.6
Magnolia dealbata	101	3,799,480	2,872,363	75.6	1813.18	3,690,428	97.1
Magnolia fraseri var. *pyrimidata*	101	2,032,846	1,116,762	54.9	704.96	1,958,514	96.3
Magnolia fraseri	101	5,456,094	3,875,484	71.0	2446.40	5,259,406	96.4
Magnolia coco	101	7,354,400	6,146,863	83.6	3880.21	7,176,071	97.6
Magnolia championii	101	3,790,728	2,265,082	59.8	1429.83	3,664,354	96.7
Magnolia albosericea	101	657,362	148,271	22.6	93.60	634,297	96.5
Magnolia phanerophlebia	101	2,302,618	1,400,518	60.8	884.08	2,217,025	96.3
Magnolia henryi	151	4,528,180	2,637,830	58.3	2489.45	4,321,798	95.4
Magnolia hodgsonii	151	2,027,254	763,610	37.7	720.66	1,954,342	96.4
Magnolia pterocarpa	101	3,215,752	1,127,980	35.1	712.04	3,095,273	96.3
Magnolia liliifera	101	4,850,682	3,230,337	66.6	2039.15	4,665,789	96.2
Magnolia delavayi	151	2,749,284	880,454	32.0	830.93	2,640,778	96.1
Magnolia mercedesiarum	151	2,374,924	1,299,775	54.7	1226.66	2,283,666	96.2
Magnolia dodecapetala	151	5,138,238	3,208,439	62.4	3027.96	4,934,853	96.0
Magnolia ovata	151	3,194,150	1,924,489	60.3	1816.24	3,089,478	96.7
Magnolia equatorialis	151	2,559,730	1,362,110	53.2	1285.49	2,399,149	93.7
Magnolia pastazaensis	101	2,129,812	1,275,213	59.9	804.98	2,063,181	96.9
Magnolia zamorana	101	4,238,404	3,144,811	74.2	1985.16	4,103,235	96.8
Magnolia kichuana	101	1,846,986	1,011,124	54.7	638.27	1,788,065	96.8

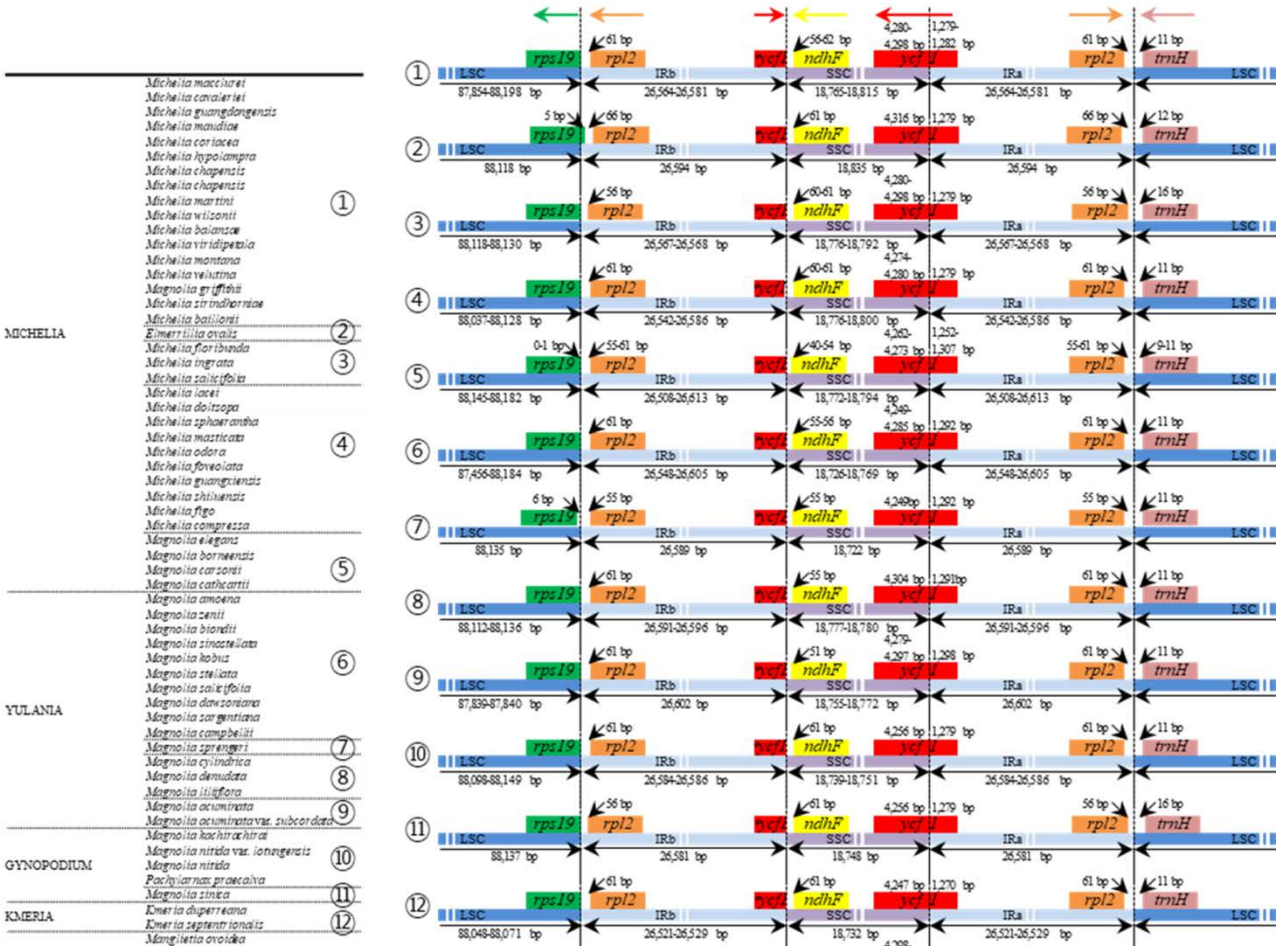
Magnolia mindoensis	151	1,786,818	615,834	34.5	581.19	1,718,540	96.2
Magnolia mexicana	151	3,281,198	2,012,385	61.3	1899.19	3,151,110	96.0
Magnolia splendens	101	2,438,296	1,485,102	60.9	937.47	2,341,407	96.0
Magnolia portoricensis	101	2,604,152	1,545,348	59.3	975.50	2,511,880	96.5
Magnolia cubensis	151	2,325,078	1,210,652	52.1	1142.55	2,246,189	96.6
Magnolia bankardiorum	101	2,396,968	1,105,395	46.1	697.78	2,320,725	96.8
Liriodendron tulipifera	101	6,673,698	5,136,328	77.0	3242.31	6,413,814	96.1
Liriodendron chinense x *Liriodendron tulipifera*	101	5,768,500	4,444,788	77.1	2805.77	5,594,752	97.0
Liriodendron chinense	101	3,973,422	2,885,569	72.6	1821.52	3,812,294	95.9
Minimum value		392,612	148,271	18.8	93.60	350,808	89.4
Maximum value		11,068,824	8,733,359	83.6	5512.93	10,647,972	97.8
Average		3,180,008	1,969,218	56.4	1385.14	3,061,701	96.2

Appendix 6 Summary of features of the Magnoliaceae chloroplast genomes.

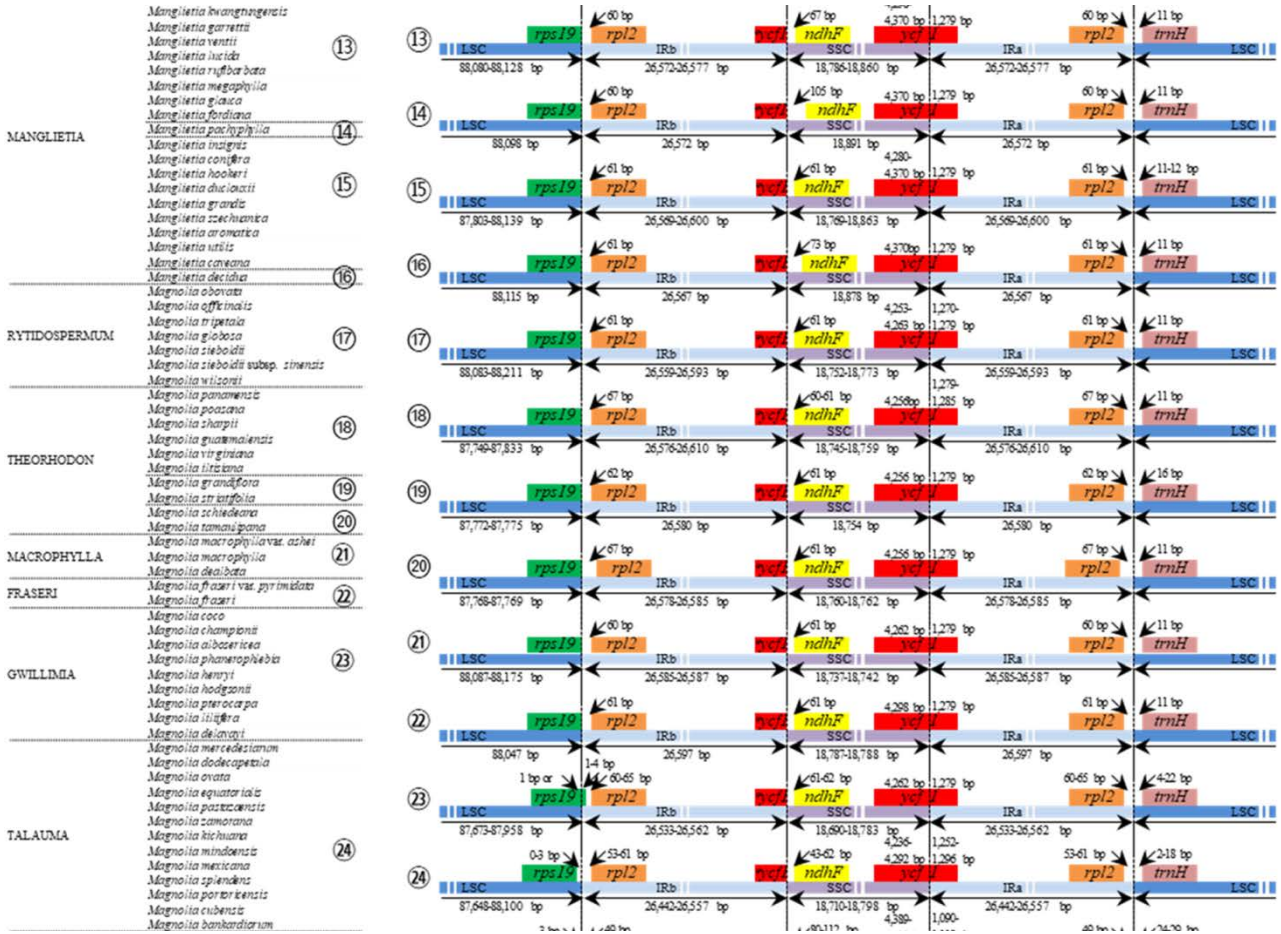
Clade names in a phylogenetic tree	Species	Sequence Length (bp)	GC content (%)	LSC (bp)	IRb (bp)	SSC (bp)	total genes	protein encoding genes	tRNA genes	rRNA genes	genes duplicated in IR (incl. rps12)
MICHELIA	*Michelia macclurei*	160,097	39.20	88,179	26,575	18,768	113	79	30	4	18
MICHELIA	*Michelia cavaleriei*	160,069	39.30	88,144	26,575	18,775	113	79	30	4	18
MICHELIA	*Michelia guangdongensis*	160,049	39.30	88,127	26,575	18,772	113	79	30	4	18
MICHELIA	*Michelia maudiae*	160,072	39.30	88,155	26,575	18,767	113	79	30	4	18
MICHELIA	*Michelia coriacea*	160,065	39.20	88,147	26,575	18,768	113	79	30	4	18
MICHELIA	*Michelia hypolampra*	160,126	39.20	88,198	26,575	18,778	113	79	30	4	18
MICHELIA	*Michelia chapensis*	160,042	39.20	88,122	26,575	18,770	113	79	30	4	18
MICHELIA	*Michelia chapensis*	160,063	39.20	88,143	26,575	18,770	113	79	30	4	18
MICHELIA	*Michelia martini*	160,076	39.20	88,150	26,578	18,770	113	79	30	4	18
MICHELIA	*Michelia wilsonii*	159,769	39.30	87,854	26,575	18,765	113	79	30	4	18
MICHELIA	*Michelia balansae*	160,083	39.20	88,160	26,564	18,795	113	79	30	4	18
MICHELIA	*Michelia viridipetala*	160,080	39.20	88,157	26,564	18,795	113	79	30	4	18
MICHELIA	*Michelia montana*	160,054	39.30	88,106	26,575	18,798	113	79	30	4	18
MICHELIA	*Michelia velutina*	160,088	39.20	88,143	26,574	18,797	113	79	30	4	18
MICHELIA	*Magnolia griffithii*	160,091	39.20	88,162	26,564	18,801	113	79	30	4	18
MICHELIA	*Michelia sirindhorniae*	160,149	39.20	88,172	26,581	18,815	113	79	30	4	18
MICHELIA	*Michelia baillonii*	160,069	39.30	88,126	26,574	18,795	113	79	30	4	18
MICHELIA	*Elmerrillia ovalis*	160,141	39.20	88,118	26,594	18,835	113	79	30	4	18
MICHELIA	*Michelia floribunda*	160,030	39.20	88,118	26,568	18,776	113	79	30	4	18
MICHELIA	*Michelia ingrata*	160,041	39.20	88,130	26,567	18,777	113	79	30	4	18
MICHELIA	*Michelia salicifolia*	160,057	39.30	88,129	26,568	18,792	113	79	30	4	18
MICHELIA	*Michelia lacei*	159,986	39.20	88,037	26,586	18,777	113	79	30	4	18
MICHELIA	*Michelia doltsopa*	159,987	39.20	88,039	26,586	18,776	113	79	30	4	18
MICHELIA	*Michelia sphaerantha*	160,022	39.30	88,079	26,581	18,780	113	79	30	4	18
MICHELIA	*Michelia masticata*	160,020	39.30	88,081	26,581	18,777	113	79	30	4	18
MICHELIA	*Michelia odora*	160,088	39.30	88,116	26,586	18,800	113	79	30	4	18
MICHELIA	*Michelia foveolata*	160,070	39.30	88,100	26,586	18,798	113	79	30	4	18
MICHELIA	*Michelia guangxiensis*	160,080	39.30	88,114	26,586	18,794	113	79	30	4	18
MICHELIA	*Michelia shiluensis*	160,074	39.30	88,102	26,586	18,800	113	79	30	4	18
MICHELIA	*Michelia figo*	160,002	39.20	88,123	26,542	18,795	113	79	30	4	18
MICHELIA	*Michelia compressa*	160,074	39.20	88,128	26,581	18,784	113	79	30	4	18
MICHELIA	*Magnolia elegans*	160,110	39.20	88,145	26,592	18,781	113	79	30	4	18
MICHELIA	*Magnolia borneensis*	160,161	39.20	88,163	26,613	18,772	113	79	30	4	18
MICHELIA	*Magnolia carsonii*	160,186	39.20	88,182	26,605	18,794	113	79	30	4	18
MICHELIA	*Magnolia cathcartii*	159,956	39.20	88,149	26,508	18,791	113	79	30	4	18
YULANIA	*Magnolia amoena*	159,987	39.20	88,128	26,548	18,763	113	79	30	4	18
YULANIA	*Magnolia zenii*	160,075	39.20	88,125	26,596	18,758	113	79	30	4	18
YULANIA	*Magnolia biondii*	160,043	39.20	88,104	26,590	18,759	113	79	30	4	18
YULANIA	*Magnolia sinostellata*	160,076	39.20	88,140	26,589	18,758	113	79	30	4	18
YULANIA	*Magnolia kobus*	159,408	39.30	87,471	26,587	18,763	113	79	30	4	18
YULANIA	*Magnolia stellata*	159,403	39.30	87,456	26,590	18,767	113	79	30	4	18
YULANIA	*Magnolia salicifolia*	160,091	39.30	88,140	26,591	18,769	113	79	30	4	18
YULANIA	*Magnolia dawsoniana*	159,908	39.30	87,956	26,605	18,742	113	79	30	4	18
YULANIA	*Magnolia sargentiana*	160,118	39.20	88,184	26,604	18,726	113	79	30	4	18
YULANIA	*Magnolia campbellii*	160,102	39.30	88,164	26,603	18,732	113	79	30	4	18
YULANIA	*Magnolia sprengeri*	160,035	39.20	88,135	26,589	18,722	113	79	30	4	18
YULANIA	*Magnolia cylindrica*	160,074	39.20	88,112	26,591	18,780	113	79	30	4	18
YULANIA	*Magnolia denudata*	160,091	39.20	88,129	26,591	18,780	113	79	30	4	18
YULANIA	*Magnolia liliiflora*	160,105	39.20	88,136	26,596	18,777	113	79	30	4	18
YULANIA	*Magnolia acuminata*	159,815	39.30	87,839	26,602	18,772	113	79	30	4	18
YULANIA	*Magnolia acuminata* var. *subcordata*	159,799	39.30	87,840	26,602	18,755	113	79	30	4	18
GYNOPODIUM	*Magnolia kachirachirai*	160,042	39.30	88,131	26,586	18,739	113	79	30	4	18
GYNOPODIUM	*Magnolia nitida var. lotungensis*	160,046	39.30	88,131	26,585	18,745	113	79	30	4	18
GYNOPODIUM	*Magnolia nitida*	160,019	39.30	88,098	26,585	18,751	113	79	30	4	18
GYNOPODIUM	*Pachylarnax praecalva*	160,061	39.30	88,149	26,584	18,744	113	79	30	4	18

GYNOPODIUM	*Magnolia sinica*	160,046	39.30	88,137	26,581	18,748	113	79	30	4	18
KMERIA	*Kmeria duperreana*	159,845	39.30	88,071	26,521	18,732	113	79	30	4	18
KMERIA	*Kmeria septentrionalis*	159,838	39.30	88,048	26,529	18,732	113	79	30	4	18
MANGLIETIA	*Manglietia ovoidea*	160,112	39.30	88,108	26,572	18,860	113	79	30	4	18
MANGLIETIA	*Manglietia kwangtungensis*	160,110	39.30	88,107	26,572	18,859	113	79	30	4	18
MANGLIETIA	*Manglietia garrettii*	160,020	39.30	88,080	26,577	18,786	113	79	30	4	18
MANGLIETIA	*Manglietia ventii*	160,113	39.30	88,113	26,572	18,856	113	79	30	4	18
MANGLIETIA	*Manglietia lucida*	160,109	39.30	88,109	26,572	18,856	113	79	30	4	18
MANGLIETIA	*Manglietia rufibarbata*	160,092	39.30	88,092	26,572	18,856	113	79	30	4	18
MANGLIETIA	*Manglietia megaphylla*	160,093	39.30	88,094	26,572	18,855	113	79	30	4	18
MANGLIETIA	*Manglietia glauca*	160,101	39.30	88,098	26,572	18,859	113	79	30	4	18
MANGLIETIA	*Manglietia fordiana*	160,058	39.30	88,128	26,572	18,786	113	79	30	4	18
MANGLIETIA	*Manglietia pachyphylla*	160,133	39.30	88,098	26,572	18,891	113	79	30	4	18
MANGLIETIA	*Manglietia insignis*	160,087	39.30	88,139	26,583	18,782	113	79	30	4	18
MANGLIETIA	*Manglietia conifera*	160,087	39.30	88,139	26,583	18,782	113	79	30	4	18
MANGLIETIA	*Manglietia hookeri*	160,066	39.30	88,124	26,583	18,776	113	79	30	4	18
MANGLIETIA	*Manglietia duclouxii*	160,035	39.30	88,098	26,576	18,785	113	79	30	4	18
MANGLIETIA	*Manglietia grandis*	160,047	39.30	88,110	26,576	18,785	113	79	30	4	18
MANGLIETIA	*Manglietia szechuanica*	160,120	39.30	88,105	26,576	18,863	113	79	30	4	18
MANGLIETIA	*Manglietia aromatica*	160,110	39.30	88,107	26,575	18,853	113	79	30	4	18
MANGLIETIA	*Manglietia utilis*	160,066	39.30	88,097	26,600	18,769	113	79	30	4	18
MANGLIETIA	*Manglietia caveana*	159,733	39.30	87,803	26,569	18,792	113	79	30	4	18
MANGLIETIA	*Manglietia decidua*	160,127	39.30	88,115	26,567	18,878	113	79	30	4	18
RYTIDOSPERMUM	*Magnolia obovata*	160,087	39.20	88,190	26,562	18,773	113	79	30	4	18
RYTIDOSPERMUM	*Magnolia officinalis*	160,055	39.20	88,161	26,562	18,770	113	79	30	4	18
RYTIDOSPERMUM	*Magnolia tripetala*	160,043	39.30	88,147	26,572	18,752	113	79	30	4	18
RYTIDOSPERMUM	*Magnolia globosa*	159,969	39.20	88,083	26,559	18,768	113	79	30	4	18
RYTIDOSPERMUM	*Magnolia sieboldii*	160,151	39.20	88,209	26,588	18,766	113	79	30	4	18
RYTIDOSPERMUM	*Magnolia sieboldii* subsp. *sinensis*	160,146	39.30	88,211	26,587	18,761	113	79	30	4	18
RYTIDOSPERMUM	*Magnolia wilsonii*	160,131	39.20	88,191	26,593	18,754	113	79	30	4	18
THEORHODON	*Magnolia panamensis*	159,721	39.30	87,798	26,583	18,757	113	79	30	4	18
THEORHODON	*Magnolia poasana*	159,732	39.30	87,805	26,584	18,759	113	79	30	4	18
THEORHODON	*Magnolia sharpii*	159,730	39.30	87,817	26,584	18,745	113	79	30	4	18
THEORHODON	*Magnolia guatemalensis*	159,748	39.30	87,833	26,585	18,745	113	79	30	4	18
THEORHODON	*Magnolia virginiana*	159,793	39.30	87,814	26,610	18,759	113	79	30	4	18
THEORHODON	*Magnolia iltisiana*	159,658	39.30	87,749	26,576	18,757	113	79	30	4	18
THEORHODON	*Magnolia grandiflora*	159,689	39.30	87,775	26,580	18,754	113	79	30	4	18
THEORHODON	*Magnolia striatifolia*	159,686	39.30	87,772	26,580	18,754	113	79	30	4	18
THEORHODON	*Magnolia schiedeana*	159,686	39.30	87,768	26,578	18,762	113	79	30	4	18
THEORHODON	*Magnolia tamaulipana*	159,699	39.30	87,769	26,585	18,760	113	79	30	4	18
MACROPHYLLA	*Magnolia macrophylla* var. *ashei*	160,002	39.20	88,092	26,585	18,740	113	79	30	4	18
MACROPHYLLA	*Magnolia macrophylla*	160,087	39.20	88,175	26,585	18,742	113	79	30	4	18
MACROPHYLLA	*Magnolia dealbata*	159,998	39.20	88,087	26,587	18,737	113	79	30	4	18
FRASERI	*Magnolia fraseri* var. *pyrimidata*	160,029	39.20	88,047	26,597	18,788	113	79	30	4	18
FRASERI	*Magnolia fraseri*	160,028	39.20	88,047	26,597	18,787	113	79	30	4	18
GWILLIMIA	*Magnolia coco*	159,828	39.30	87,958	26,555	18,760	113	79	30	4	18
GWILLIMIA	*Magnolia championii*	159,828	39.30	87,958	26,555	18,760	113	79	30	4	18
GWILLIMIA	*Magnolia albosericea*	159,792	39.30	87,921	26,562	18,747	113	79	30	4	18
GWILLIMIA	*Magnolia phanerophlebia*	159,572	39.30	87,673	26,558	18,783	113	79	30	4	18
GWILLIMIA	*Magnolia henryi*	159,760	39.30	87,887	26,557	18,759	113	79	30	4	18
GWILLIMIA	*Magnolia hodgsonii*	159,687	39.30	87,837	26,554	18,742	113	79	30	4	18
GWILLIMIA	*Magnolia pterocarpa*	159,722	39.30	87,873	26,552	18,745	113	79	30	4	18
GWILLIMIA	*Magnolia liliifera*	159,736	39.30	87,930	26,558	18,690	113	79	30	4	18
GWILLIMIA	*Magnolia delavayi*	159,714	39.30	87,887	26,533	18,760	113	79	30	4	18
TALAUMA	*Magnolia mercedesiarum*	159,896	39.30	88,023	26,557	18,759	113	79	30	4	18
TALAUMA	*Magnolia dodecapetala*	159,828	39.30	88,004	26,537	18,750	113	79	30	4	18
TALAUMA	*Magnolia ovata*	159,787	39.30	87,987	26,529	18,743	113	79	30	4	18
TALAUMA	*Magnolia equatorialis*	159,806	39.30	87,988	26,539	18,740	113	79	30	4	18
TALAUMA	*Magnolia pastazaensis*	159,790	39.30	87,981	26,530	18,749	113	79	30	4	18
TALAUMA	*Magnolia zamorana*	159,734	39.30	87,922	26,551	18,710	113	79	30	4	18
TALAUMA	*Magnolia kichuana*	159,864	39.30	88,005	26,550	18,759	113	79	30	4	18
TALAUMA	*Magnolia mindoensis*	159,800	39.30	88,027	26,507	18,759	113	79	30	4	18
TALAUMA	*Magnolia mexicana*	159,787	39.30	87,984	26,530	18,743	113	79	30	4	18
TALAUMA	*Magnolia splendens*	159,926	39.30	88,030	26,550	18,796	113	79	30	4	18
TALAUMA	*Magnolia portoricensis*	159,919	39.30	88,021	26,550	18,798	113	79	30	4	18
TALAUMA	*Magnolia cubensis*	159,917	39.30	88,100	26,541	18,735	113	79	30	4	18
TALAUMA	*Magnolia bankardiorum*	159,269	39.30	87,648	26,442	18,737	113	79	30	4	18
OUTGROUP	*Liriodendron tulipifera*	159,886	39.20	88,148	26,386	18,966	113	79	30	4	18
OUTGROUP	*Liriodendron chinense* x *Liriodendron tulipifera*	159,397	39.20	87,734	26,333	18,997	113	79	30	4	18
OUTGROUP	Liriodendron chinense	159,427	39.20	87,764	26,333	18,997	113	79	30	4	18

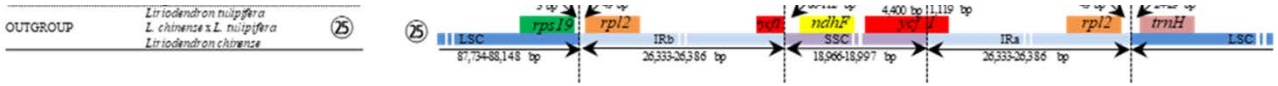
Note: LSC, large single-copy; SSC, Small single-copy; IR, inverted repeats; tRNA, transfer RNA; rRNA, ribosomal RNA.



Appendix 7. (Continued)



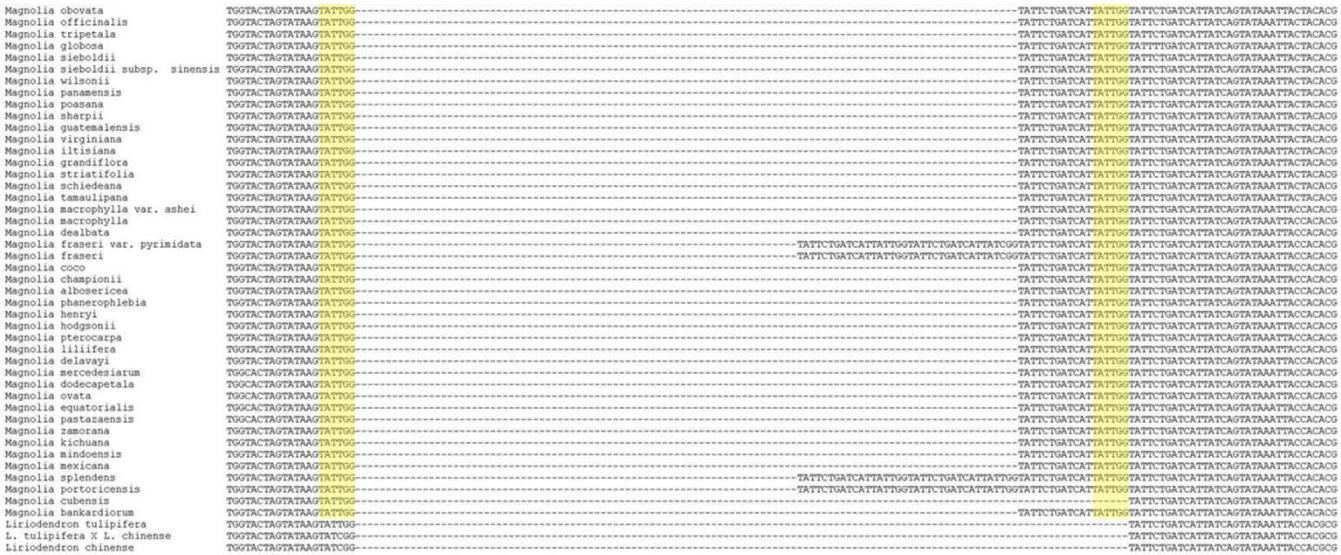
Appendix 7. (Continued)



Appendix 7. Comparison of the large single copy (LSC), small single copy (SSC), and inverted repeat (IR) border regions among the Magnoliaceae chloroplast genomes. The order was arranged based on the phylogenetic tree. φ means pseudogene.



Appendix 8. (Continued)



Appendix 8. Comparison of the number of repeats of an 18 bp (TATTCTGATCATTATTGG) repeating units with six bp short direct repeat sequences (TATTGG) on both sides of the repeat in the 3' end portion of the *ycf1* gene in the SSC region in the Magnoliaceae chloroplast genomes. A black box indicates the repeating unit, and yellow shadows mark the short direct repeats.

Appendix 9. Long repeats comparison of the chloroplast genome of Magnoliaceae.

Clade name	Sci. name	Repeat types				Total	Repeat legnth (bp)																																		
		Forward	Reverse	Palindrome	Complement		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	51	53	57	61	62	75	93	111	129						
MICHELIA	*Michelia macclurei*	14	0	16	0	30	10	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia cavaleriei*	13	0	16	0	29	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia guangdongensis*	13	0	16	0	29	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia maudiae*	14	0	15	0	29	10	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia coriacea*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia hypolampra*	15	0	15	0	30	11	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia chapensis*	13	0	16	0	29	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia chapensis*	14	0	16	0	30	10	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia martini*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia wilsonii*	14	0	16	0	30	10	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia balansae*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia viridipetala*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia montana*	13	0	16	0	29	9	2	1	6	0	0	0	0	0	3	0	1	5	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia velutina*	13	0	14	0	27	9	2	1	6	0	0	0	0	0	3	0	1	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Magnolia griffithii*	15	1	16	0	32	11	2	1	7	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0						
MICHELIA	*Michelia sirindhorniae*	15	0	15	0	30	9	2	1	6	1	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0						
MICHELIA	*Michelia baillonii*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Elmerrillia ovalis*	17	0	20	0	37	9	4	3	7	0	1	0	0	0	3	0	1	5	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0						
MICHELIA	*Michelia floribunda*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia ingrata*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia salicifolia*	14	0	15	0	29	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0						
MICHELIA	*Michelia lacei*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia doltsopa*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia sphaerantha*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia masticata*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia odora*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia foveolata*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia guangxiensis*	13	0	16	0	29	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia shiluensis*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia figo*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Michelia compressa*	13	0	15	0	28	9	2	1	6	0	0	0	0	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Magnolia elegans*	13	0	15	0	28	9	2	2	5	0	0	0	1	0	3	0	1	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Magnolia borneensis*	13	0	15	0	28	8	2	1	6	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0						
MICHELIA	*Magnolia carsonii*	13	0	15	0	28	9	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
MICHELIA	*Magnolia cathcartii*	9	0	12	0	21	3	2	1	5	0	0	0	1	0	2	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0						
YULANIA	*Magnolia amoena*	11	0	14	0	25	4	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0						
YULANIA	*Magnolia zenii*	13	0	15	0	28	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0						
YULANIA	*Magnolia biondii*	15	0	15	0	30	9	2	2	5	0	0	0	1	0	2	0	1	5	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0						
YULANIA	*Magnolia sinostellata*	13	0	15	0	28	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0						
YULANIA	*Magnolia kobus*	16	0	15	0	31	8	3	3	5	0	0	0	1	0	3	0	1	6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0						
YULANIA	*Magnolia stellata*	13	0	15	0	28	8	2	1	5	0	0	0	1	0	3	0	1	5	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0						
YULANIA	*Magnolia salicifolia*	14	0	14	0	28	8	3	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0						
YULANIA	*Magnolia dawsoniana*	12	0	15	0	27	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0						
YULANIA	*Magnolia sargentiana*	11	0	15	0	26	8	2	1	5	0	0	0	1	0	2	0	1	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0						
YULANIA	*Magnolia campbellii*	12	1	14	0	27	8	3	2	5	0	0	0	1	0	2	0	1	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0						
YULANIA	*Magnolia sprengeri*	11	0	14	0	25	8	2	1	5	0	0	0	1	0	2	0	1	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0						
YULANIA	*Magnolia cylindrica*	18	0	15	0	33	9	3	1	5	0	0	0	1	0	4	0	1	5	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0						
YULANIA	*Magnolia denudata*	18	0	15	0	33	9	3	1	5	0	0	0	1	0	4	0	1	5	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0						

YULANIA	*Magnolia liliiflora*	16	0	14	0	30	9	2	1	5	0	0	0	1	0	3	0	1	6	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
YULANIA	*Magnolia acuminata*	15	1	17	0	33	11	2	1	5	1	0	0	1	0	3	0	2	5	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
YULANIA	*Magnolia acuminata* var. *subcordata*	14	1	16	0	31	11	2	1	5	1	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
GYNOPODIUM	*Magnolia kachirachirai*	12	1	15	0	28	10	2	1	5	0	0	0	1	1	2	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Magnolia nitida* var. *lotungensis*	12	1	14	0	27	9	2	1	5	0	0	0	1	1	2	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Magnolia nitida*	12	1	15	0	28	10	2	1	5	0	0	0	1	1	2	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Pachylarnax praecalva*	12	1	16	0	29	11	2	1	5	0	0	0	1	1	2	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Magnolia sinica*	11	1	14	0	26	8	2	1	5	0	0	0	1	1	2	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KMERIA	*Kmeria duperreana*	13	1	14	0	28	9	3	1	5	0	0	0	1	1	2	0	1	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
KMERIA	*Kmeria septentrionalis*	11	1	14	0	26	8	2	1	5	0	0	0	1	1	2	0	1	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia ovoidea*	17	0	14	0	31	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia kwangtungensis*	17	0	14	0	31	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia garrettii*	13	0	14	0	27	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia ventii*	17	0	14	0	31	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia lucida*	17	0	15	0	32	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia rufibarbata*	17	0	13	0	30	8	2	1	5	0	0	0	1	0	3	0	1	4	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia megaphylla*	17	0	13	0	30	8	2	1	5	0	0	0	1	0	3	0	1	4	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia glauca*	17	0	14	0	31	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia fordiana*	13	0	14	0	27	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia pachyphylla*	18	0	14	0	32	9	2	0	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia insignis*	13	0	16	0	29	8	3	1	6	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia conifera*	13	0	16	0	29	8	3	1	6	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia hookeri*	13	0	16	0	29	8	3	1	6	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia duclouxii*	13	0	14	0	27	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia grandis*	13	0	16	0	29	8	3	1	6	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia szechuanica*	17	0	16	0	33	8	3	1	6	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia aromatica*	17	0	14	0	31	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
MANGLIETIA	*Manglietia utilis*	12	0	15	0	27	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia caveana*	12	0	17	0	29	9	2	2	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia decidua*	17	0	14	0	31	8	2	1	5	0	0	0	1	0	3	0	1	5	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
RYTIDOSPERMUM	*Magnolia obovata*	11	1	15	0	27	8	2	1	5	0	0	0	1	0	2	1	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia officinalis*	11	1	15	0	27	8	2	1	5	0	0	0	1	0	2	1	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia tripetala*	12	1	14	0	27	9	2	1	5	0	0	0	1	0	2	1	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia globosa*	11	0	14	0	25	8	2	1	5	0	0	0	1	0	2	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia sieboldii*	14	1	14	0	29	9	3	1	4	0	0	0	1	2	2	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia sieboldii* subsp. *sinensis*	13	1	14	0	28	9	2	1	4	0	0	0	1	2	2	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia wilsonii*	12	3	17	0	32	9	2	3	6	0	1	0	1	1	2	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia panamensis*	11	0	15	0	26	8	2	1	5	0	0	0	1	0	2	0	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia poasana*	12	0	15	0	27	8	2	1	5	0	0	0	1	0	2	1	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia sharpii*	10	0	13	0	23	6	2	1	5	0	0	0	1	0	2	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia guatemalensis*	10	0	14	0	24	6	2	1	5	0	0	0	1	0	2	0	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia virginiana*	11	0	15	0	26	8	2	1	5	0	0	0	1	0	2	0	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia iltisiana*	11	0	15	0	26	8	2	1	5	0	0	0	1	0	2	0	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia grandiflora*	11	0	15	0	26	8	2	1	5	0	0	0	1	0	2	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia striatifolia*	11	0	15	0	26	8	2	1	5	0	0	0	1	0	2	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia schiedeana*	12	0	15	0	27	9	2	1	5	0	0	0	1	0	2	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia tamaulipana*	11	0	15	0	26	8	2	1	5	0	0	0	1	0	2	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MACROPHYLLA	*Magnolia macrophylla* var. *ashei*	11	1	15	0	27	8	2	1	5	0	0	0	1	1	2	0	1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MACROPHYLLA	*Magnolia macrophylla*	11	1	15	0	27	8	2	1	5	0	0	0	1	1	2	0	1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MACROPHYLLA	*Magnolia dealbata*	11	1	15	0	27	8	2	1	5	0	0	0	1	1	2	0	1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRASERI	*Magnolia fraseri* var.	16	0	14	0	30	7	2	1	5	0	1	0	1	0	3	0	1	5	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0

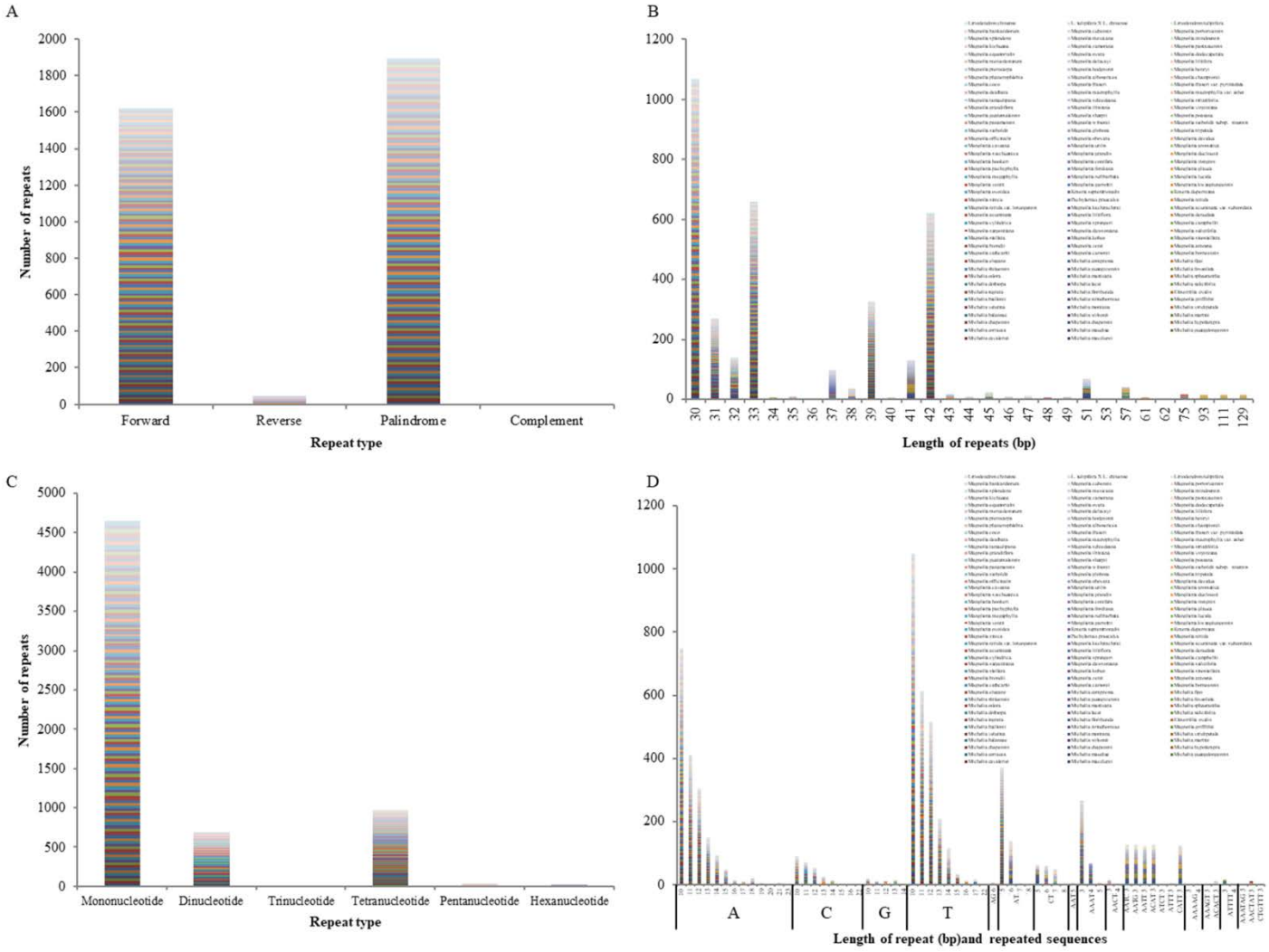
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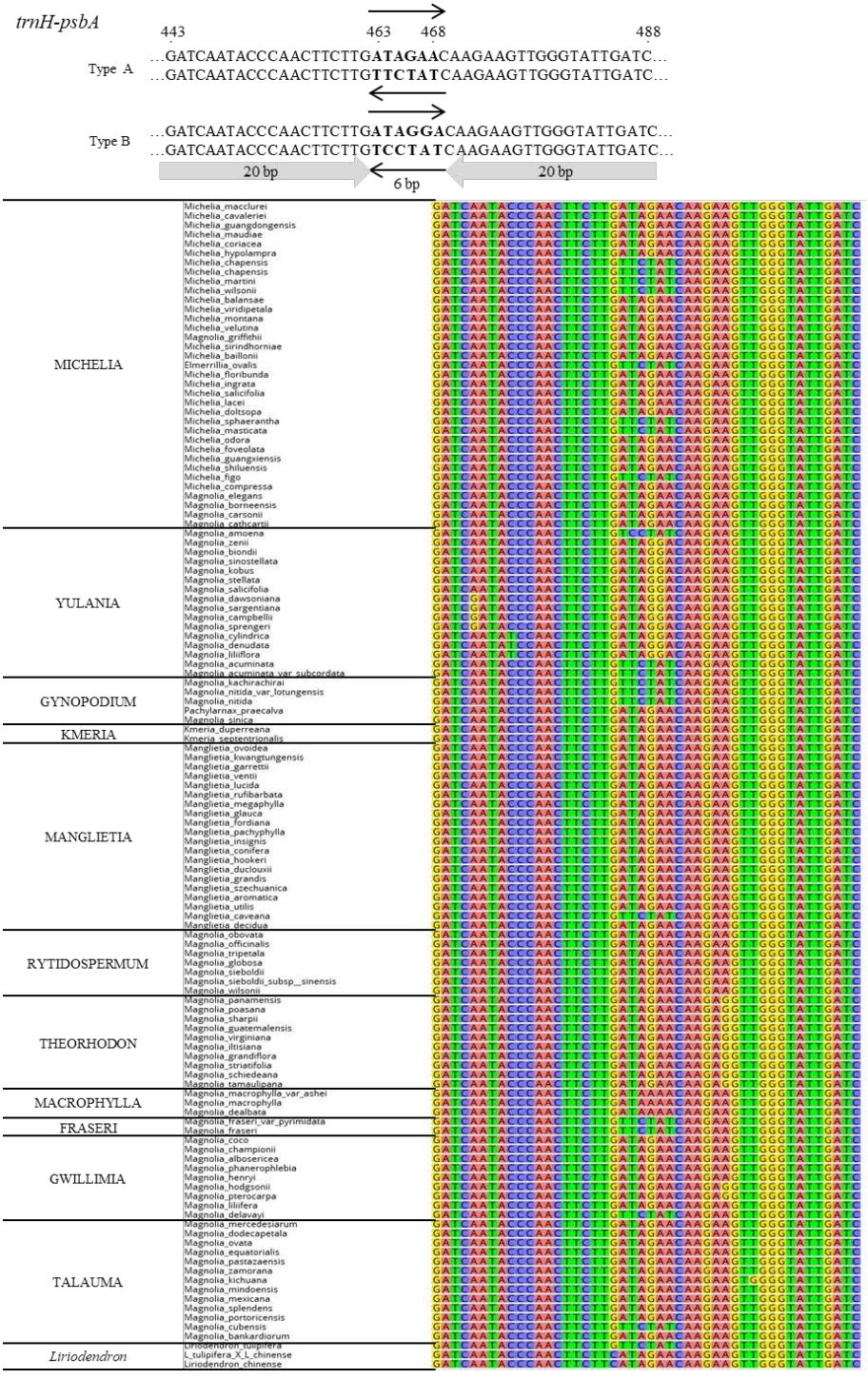
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MICHELIA	*Magnolia griffithii*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia sirindhorniae*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia baillonii*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Elmerrillia ovalis*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia floribunda*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia ingrata*	0	3	1	0	0	0	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia salicifolia*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia lacei*	0	3	1	0	0	1	0	0	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia doltsopa*	0	3	1	0	0	1	0	0	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia sphaerantha*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia masticata*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia odora*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia foveolata*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia guangxiensis*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia shiluensis*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia figo*	0	3	1	0	0	1	0	0	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Michelia compressa*	0	3	1	0	0	0	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Magnolia elegans*	0	4	0	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Magnolia borneensis*	0	4	0	0	0	1	0	0	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Magnolia carsonii*	0	4	1	0	0	1	0	0	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MICHELIA	*Magnolia cathcartii*	0	3	1	0	0	1	0	0	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0
YULANIA	*Magnolia amoena*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0
YULANIA	*Magnolia zenii*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0
YULANIA	*Magnolia biondii*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0
YULANIA	*Magnolia sinostellata*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0
YULANIA	*Magnolia kobus*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
YULANIA	*Magnolia stellata*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
YULANIA	*Magnolia salicifolia*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0
YULANIA	*Magnolia dawsoniana*	0	3	1	0	0	0	1	0	0	0	2	1	0	1	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0
YULANIA	*Magnolia sargentiana*	0	3	1	0	0	0	1	0	0	0	2	1	0	1	0	1	1	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0
YULANIA	*Magnolia campbellii*	0	3	1	0	0	0	0	1	0	0	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1
YULANIA	*Magnolia sprengeri*	0	3	1	0	0	0	1	0	0	0	2	1	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0
YULANIA	*Magnolia cylindrica*	0	4	0	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
YULANIA	*Magnolia denudata*	0	3	0	1	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
YULANIA	*Magnolia liliiflora*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
YULANIA	*Magnolia acuminata*	0	3	1	0	0	1	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YULANIA	*Magnolia acuminata* var. *subcordata*	0	3	1	0	0	1	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Magnolia kachirachirai*	0	3	1	0	0	0	1	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Magnolia nitida* var. *lotungensis*	0	3	1	0	0	0	1	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Magnolia nitida*	0	3	1	0	0	0	1	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Pachylarnax praecalva*	0	3	1	0	0	0	1	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
GYNOPODIUM	*Magnolia sinica*	0	3	1	0	0	0	1	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
KMERIA	*Kmeria duperreana*	0	2	1	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
KMERIA	*Kmeria septentrionalis*	0	2	1	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia ovoidea*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia kwangtungensis*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia garrettii*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia ventii*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia lucida*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia rufibarbata*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia megaphylla*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia glauca*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia fordiana*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia pachyphylla*	0	4	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia insignis*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia conifera*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia hookeri*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia duclouxii*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia grandis*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
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MANGLIETIA	*Manglietia aromatica*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia utilis*	0	3	1	0	0	1	0	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia caveana*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MANGLIETIA	*Manglietia decidua*	0	3	1	0	0	0	1	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia obovata*	0	3	1	0	0	0	0	2	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia officinalis*	0	3	1	0	0	0	0	2	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia tripetala*	0	3	1	0	0	0	0	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0

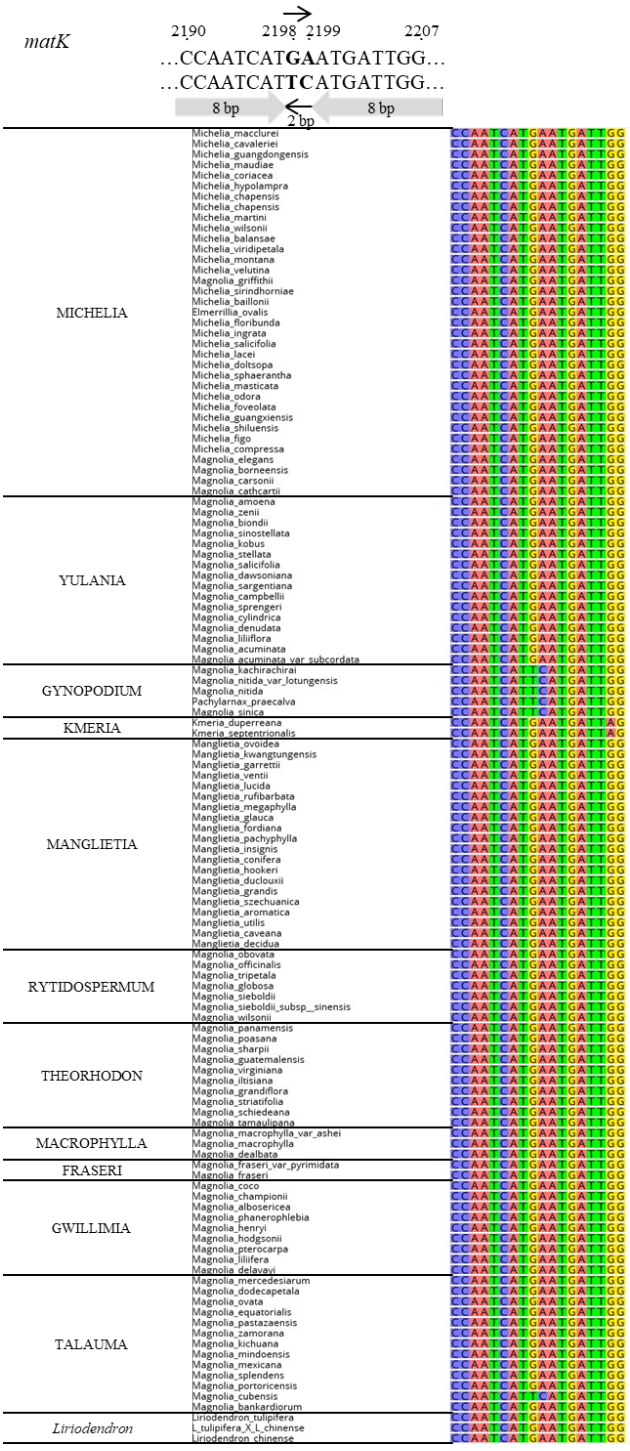
RYTIDOSPERMUM	*Magnolia globosa*	0	3	1	0	0	1	0	0	0	0	2	0	1	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	1	0	0
RYTIDOSPERMUM	*Magnolia sieboldii*	0	3	1	0	0	0	0	1	1	0	2	0	1	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia sieboldii* subsp. *sinensis*	0	3	1	0	0	0	0	2	0	0	2	0	1	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
RYTIDOSPERMUM	*Magnolia wilsonii*	0	3	0	1	0	0	0	1	1	0	1	1	0	0	0	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0
THEORHODON	*Magnolia panamensis*	0	3	1	0	0	0	1	0	0	0	2	0	0	1	0	1	1	2	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia poasana*	0	3	1	0	0	0	1	0	0	0	2	0	0	1	0	1	1	2	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia sharpii*	0	3	1	0	0	0	1	1	0	0	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia guatemalensis*	0	3	1	0	0	0	1	1	0	0	2	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia virginiana*	0	3	1	0	0	0	1	1	0	0	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia iltisiana*	0	3	1	0	0	0	1	1	0	0	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia grandiflora*	0	3	1	0	0	0	1	1	0	0	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia striatifolia*	0	3	1	0	0	0	1	1	0	0	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia schiedeana*	0	3	1	0	0	0	1	1	0	0	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
THEORHODON	*Magnolia tamaulipana*	0	3	1	0	0	0	1	1	0	0	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
MACROPHYLLA	*Magnolia macrophylla* var. *ashei*	1	3	1	0	0	1	0	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
MACROPHYLLA	*Magnolia macrophylla*	1	3	1	0	0	1	0	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
MACROPHYLLA	*Magnolia dealbata*	1	3	1	0	0	1	0	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
FRASERI	*Magnolia fraseri* var. *pyrimidata*	0	3	1	0	0	0	2	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
FRASERI	*Magnolia fraseri*	0	3	1	0	0	0	2	0	0	0	2	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
GWILLIMIA	*Magnolia coco*	0	3	1	0	0	1	0	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0
GWILLIMIA	*Magnolia championii*	0	3	1	0	0	1	0	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0
GWILLIMIA	*Magnolia albosericea*	0	3	1	0	0	0	0	0	0	0	3	0	0	0	0	1	1	1	1	1	0	1	0	0	0	1	0	0	0	0	0
GWILLIMIA	*Magnolia phanerophlebia*	0	3	1	0	0	1	0	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0
GWILLIMIA	*Magnolia henryi*	0	3	1	0	0	1	0	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0
GWILLIMIA	*Magnolia hodgsonii*	0	3	1	0	0	1	0	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0
GWILLIMIA	*Magnolia pterocarpa*	0	3	1	0	0	1	0	1	0	0	3	0	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0
GWILLIMIA	*Magnolia liliifera*	0	3	1	0	0	1	0	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0
GWILLIMIA	*Magnolia delavayi*	0	3	1	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0
TALAUMA	*Magnolia mercedesiarum*	0	2	2	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia dodecapetala*	0	2	2	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia ovata*	0	2	2	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia equatorialis*	0	2	2	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia pastazaensis*	0	2	2	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia zamorana*	0	2	2	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia kichuana*	0	2	2	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia mindoensis*	0	2	2	0	0	0	1	1	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia mexicana*	0	2	2	0	0	0	0	2	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0
TALAUMA	*Magnolia splendens*	0	2	2	0	0	0	1	0	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia portoricensis*	0	2	2	0	0	0	1	0	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia cubensis*	0	2	2	0	0	0	1	0	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
TALAUMA	*Magnolia bankardiorum*	0	2	2	0	0	0	1	0	0	0	2	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
OUTGROUP	*Liriodendron tulipifera*	0	2	3	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0
OUTGROUP	*L. tulipifera* X *L. chinense*	0	2	1	1	1	1	0	0	0	1	1	0	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0
OUTGROUP	*Liriodendron chinense*	0	2	1	1	1	1	0	0	0	1	1	0	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0


A
Number of repeats
Forward
Reverse
Palindrome
Complement
Repeat type
B
Length of repeats (bp)
C
Number of repeats
Mononucleotide
Dinucleotide
Trinucleotide
Tetranucleotide
Pentanucleotide
Hexanucleotide
Repeat type
D
A
C
G
T
Length of repeat (bp)and repeated sequences

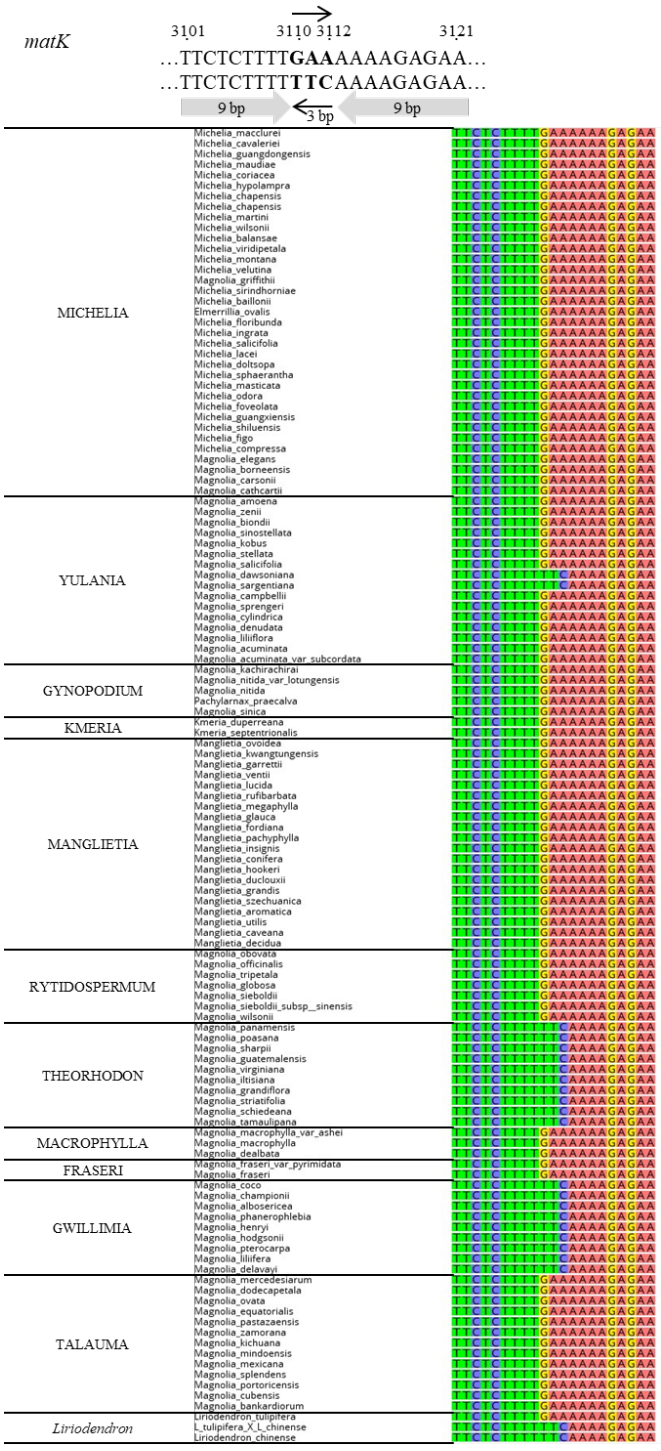
Appendix 11. The type and frequency of repeated sequences and simple sequence repeats (SSRs) in the chloroplast genomes of Magnoliaceae. (A) Frequency of repeats by types, (B) Frequency of repeats by repeat length, (C) Frequency of SSRs by six types, (D) Frequency of identified SSRs by motifs and repeat length.



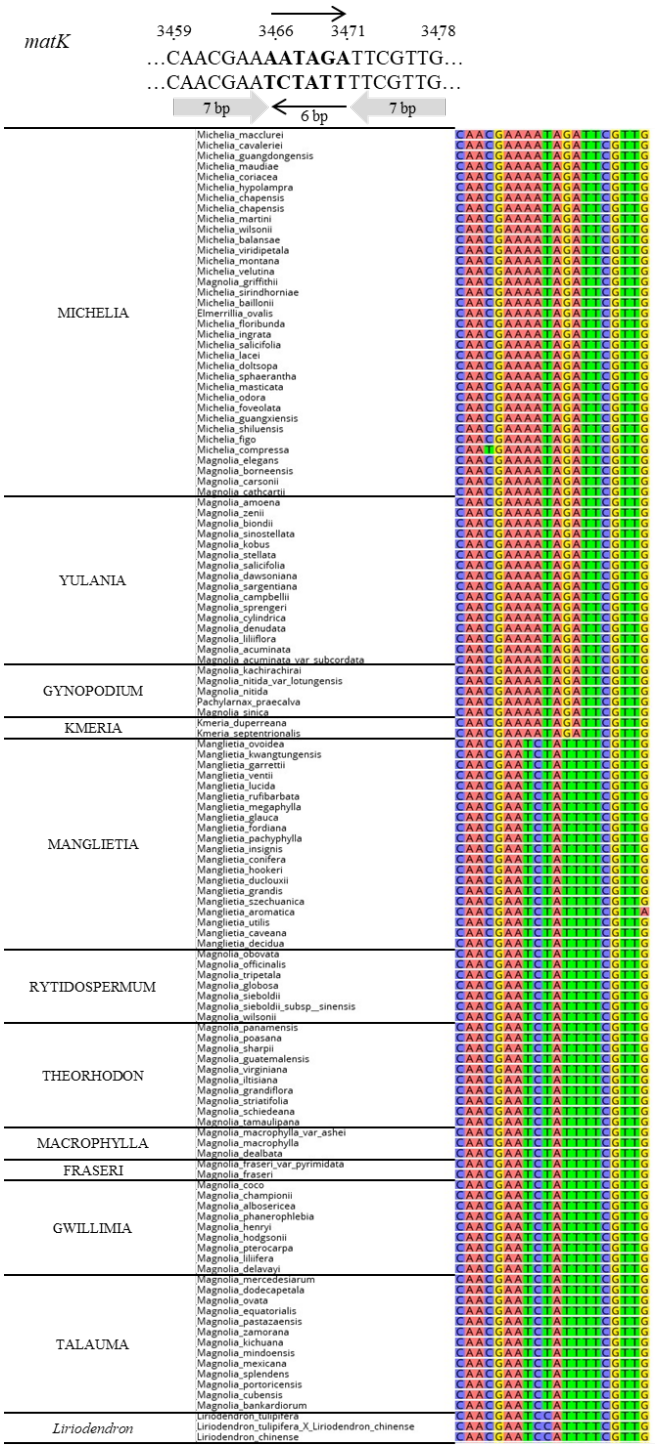
Appendix 12. Small inversion in *trnH-psbA*.



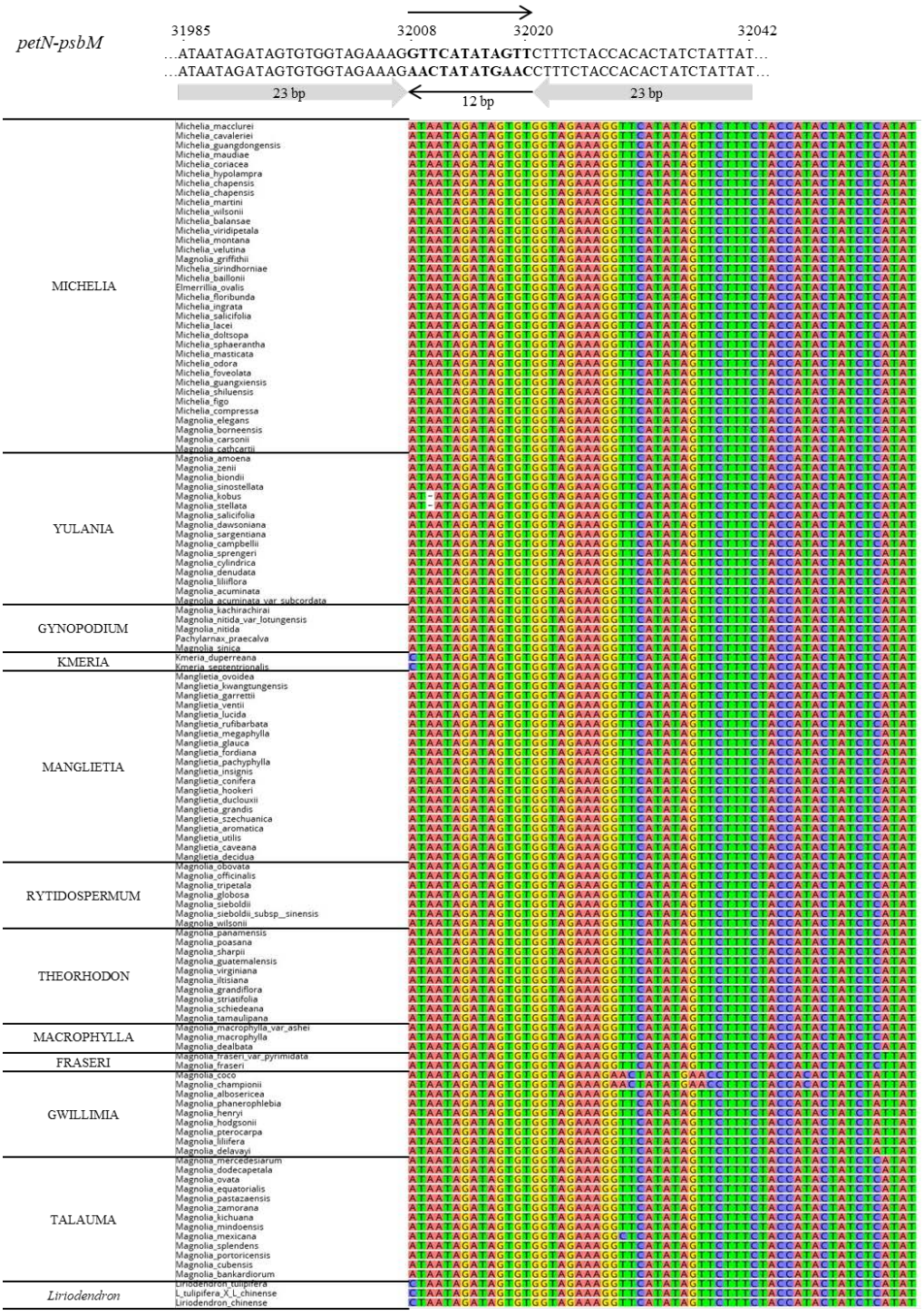
Appendix 13. Small inversion in *matK* (one).



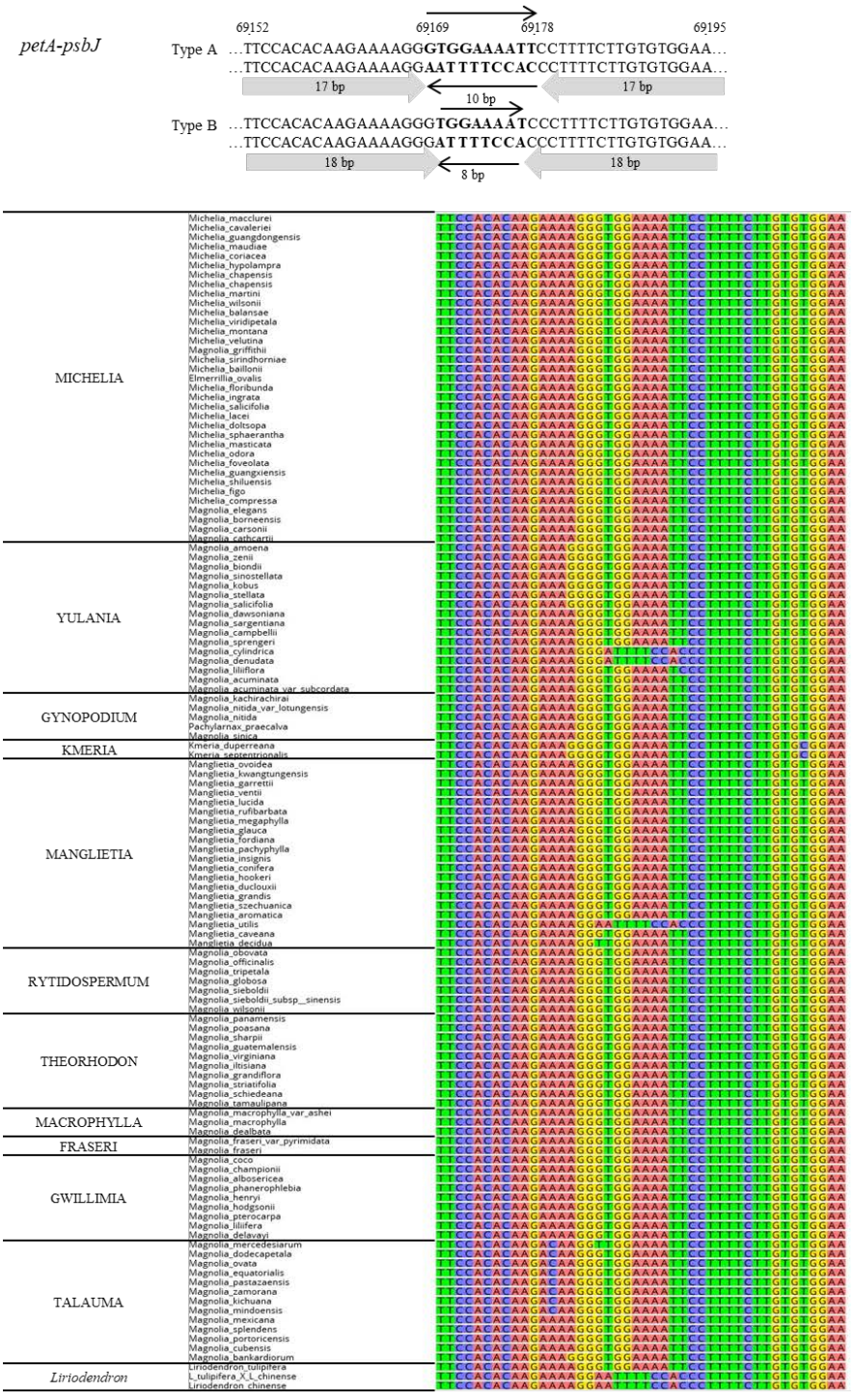
Appendix 14. Small inversion in *matK* (two).



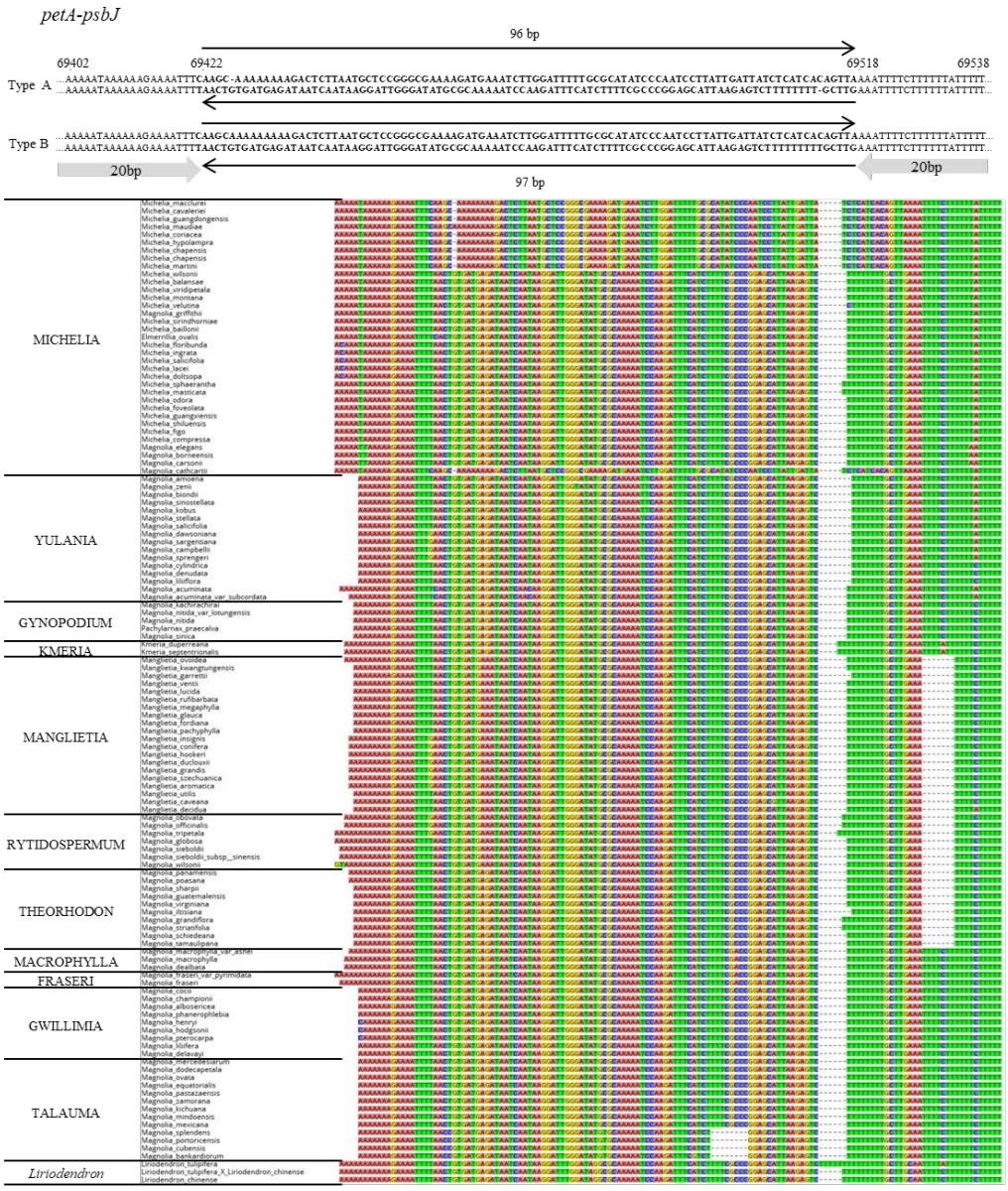
Appendix 15. Small inversion in *matK* (three).



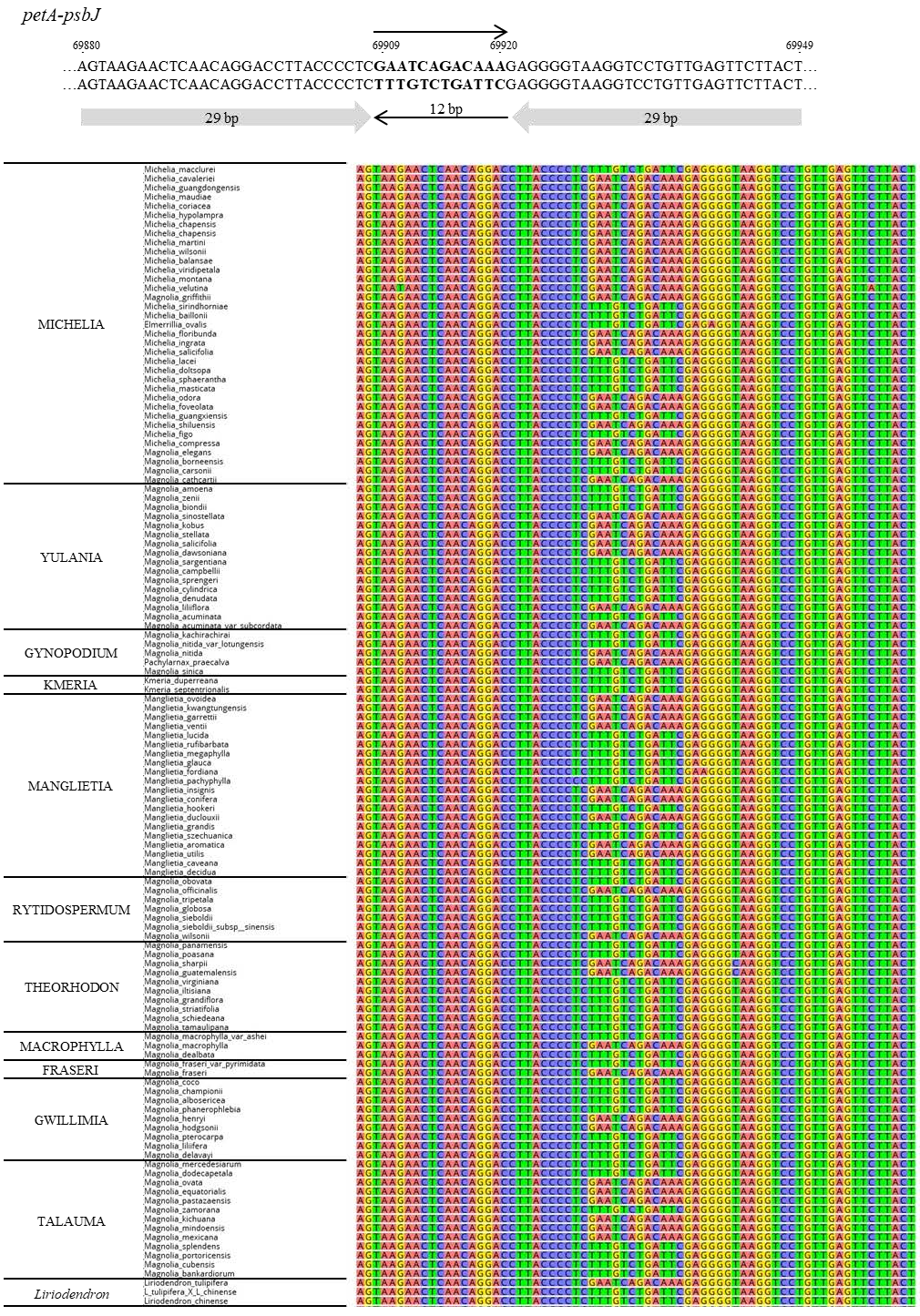
Appendix 16. Small inversion in *petN-psbM.*



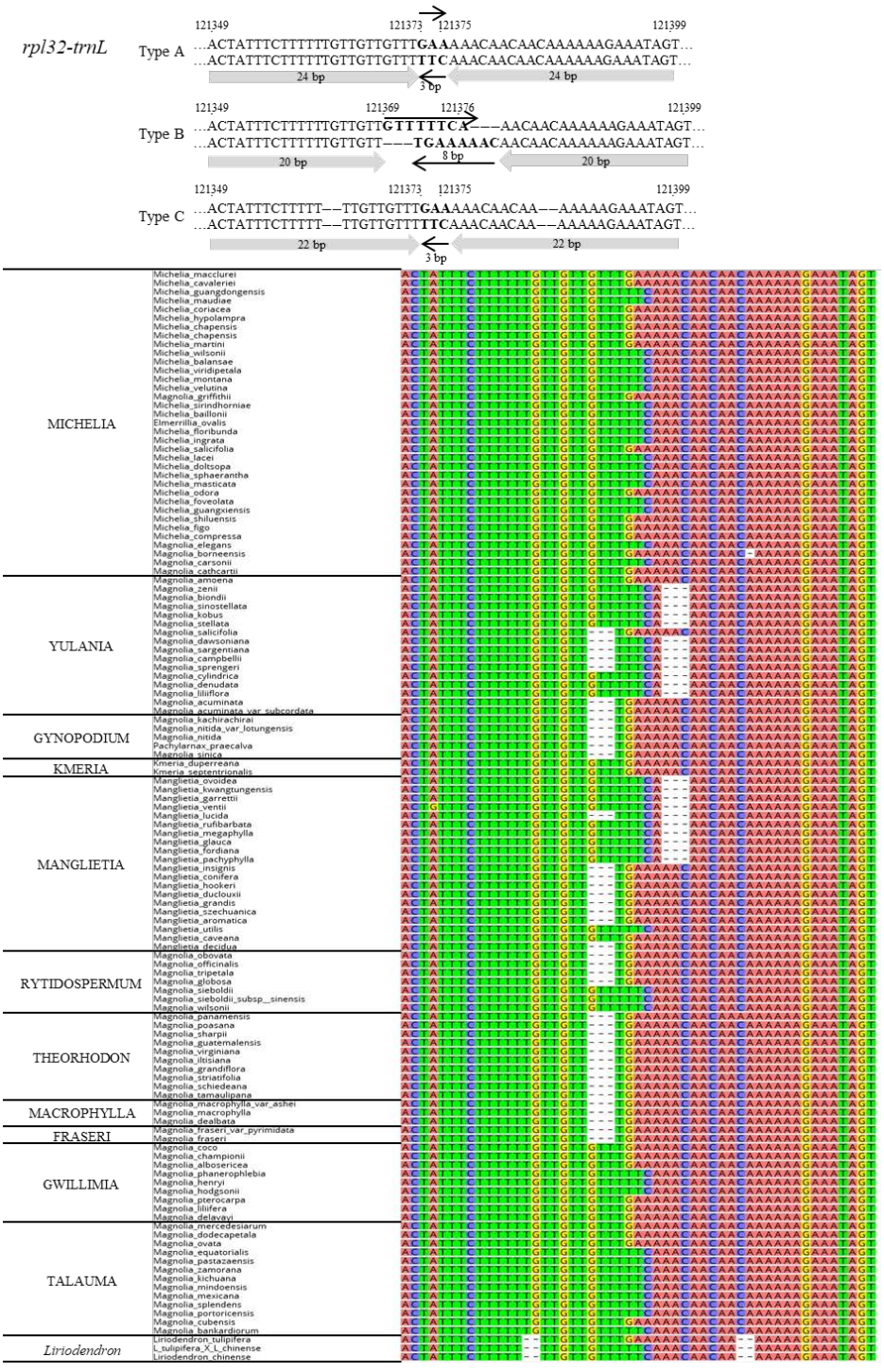
Appendix 17. Small inversion in *petA-psbJ* (one).



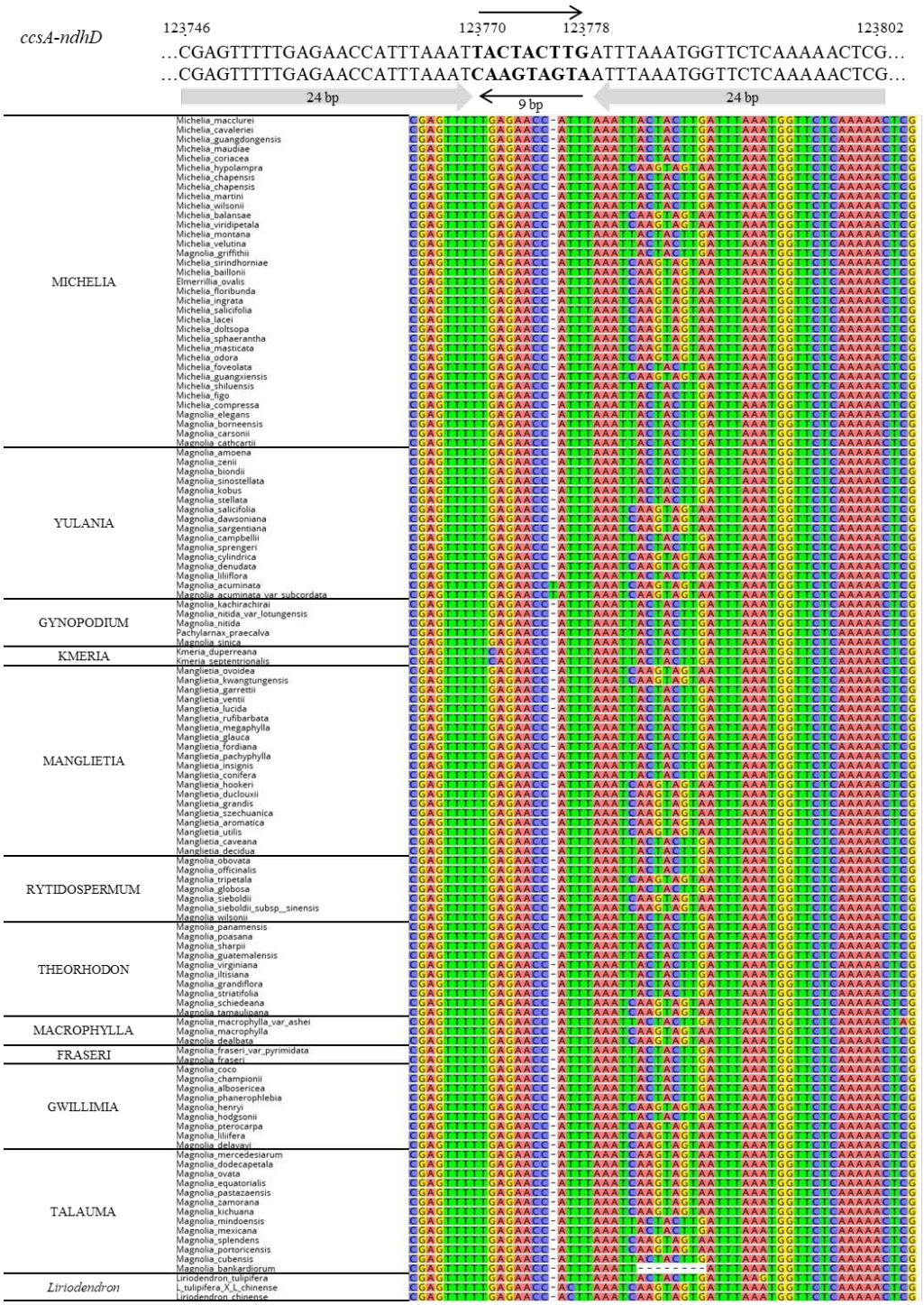
Appendix 18. Small inversion in *petA-psbJ* (two).



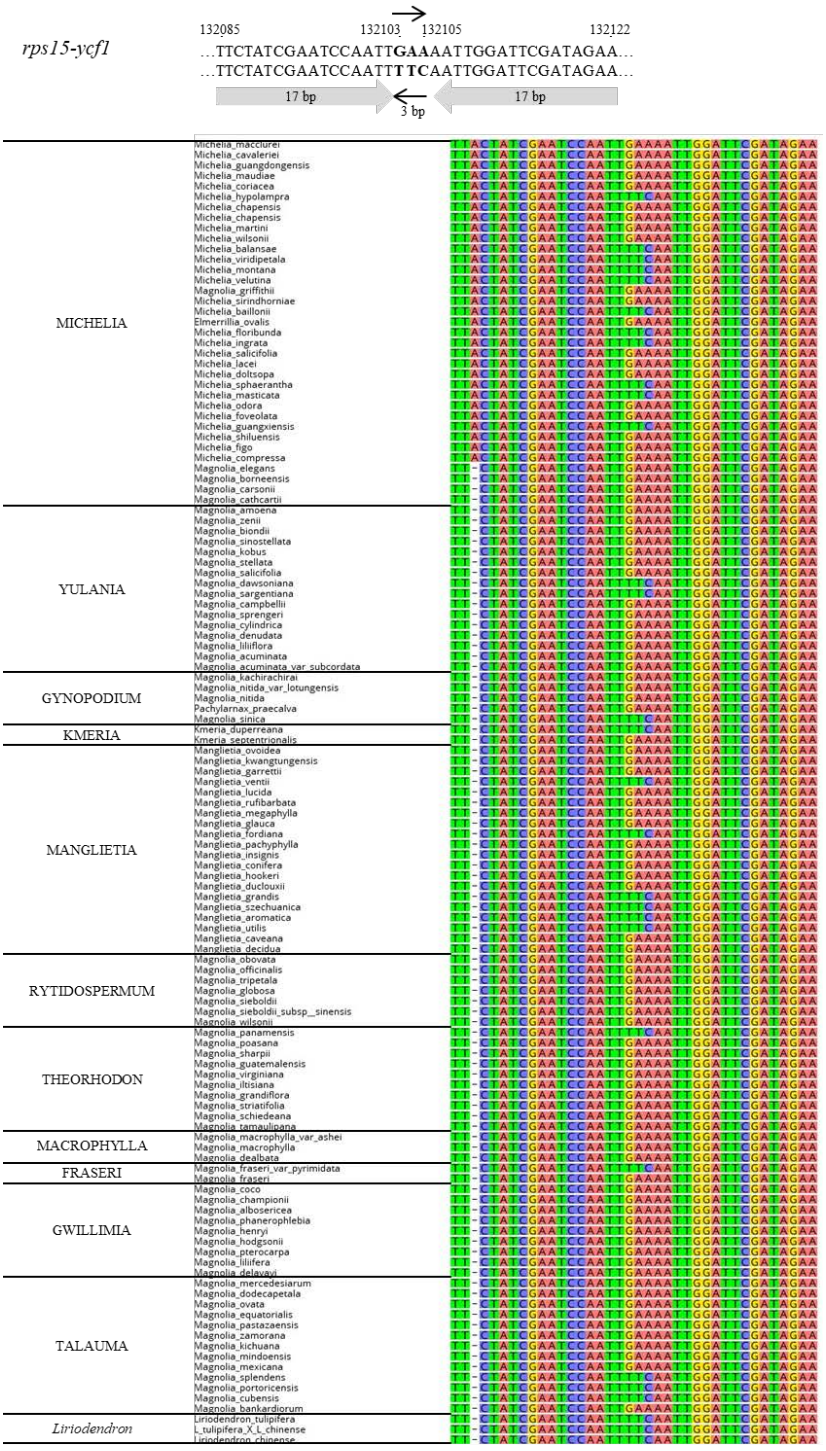
Appendix 19. Small inversion in *petA-psbJ* (three).



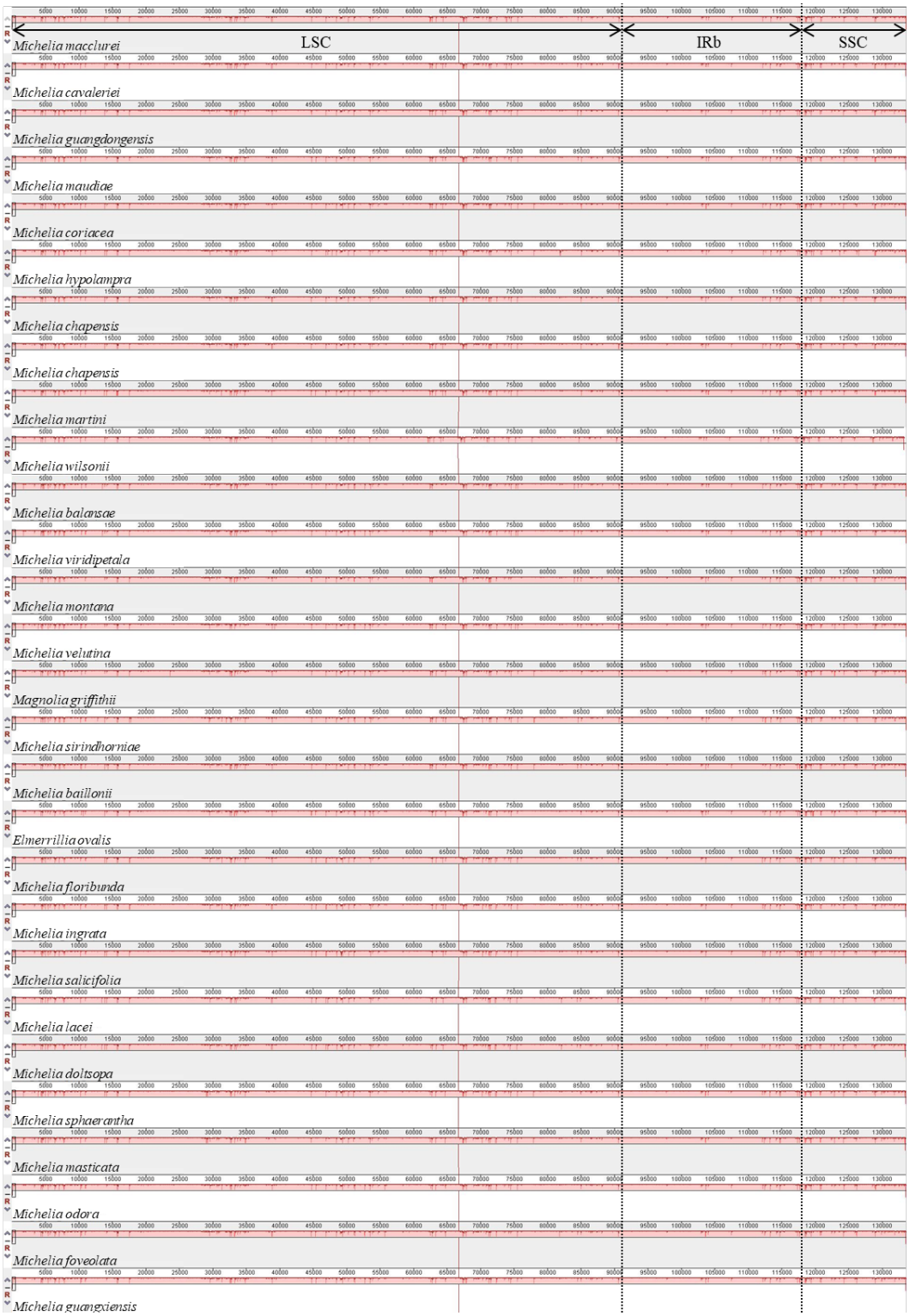
Appendix 20. Small inversion in *rpl32-trnL.*

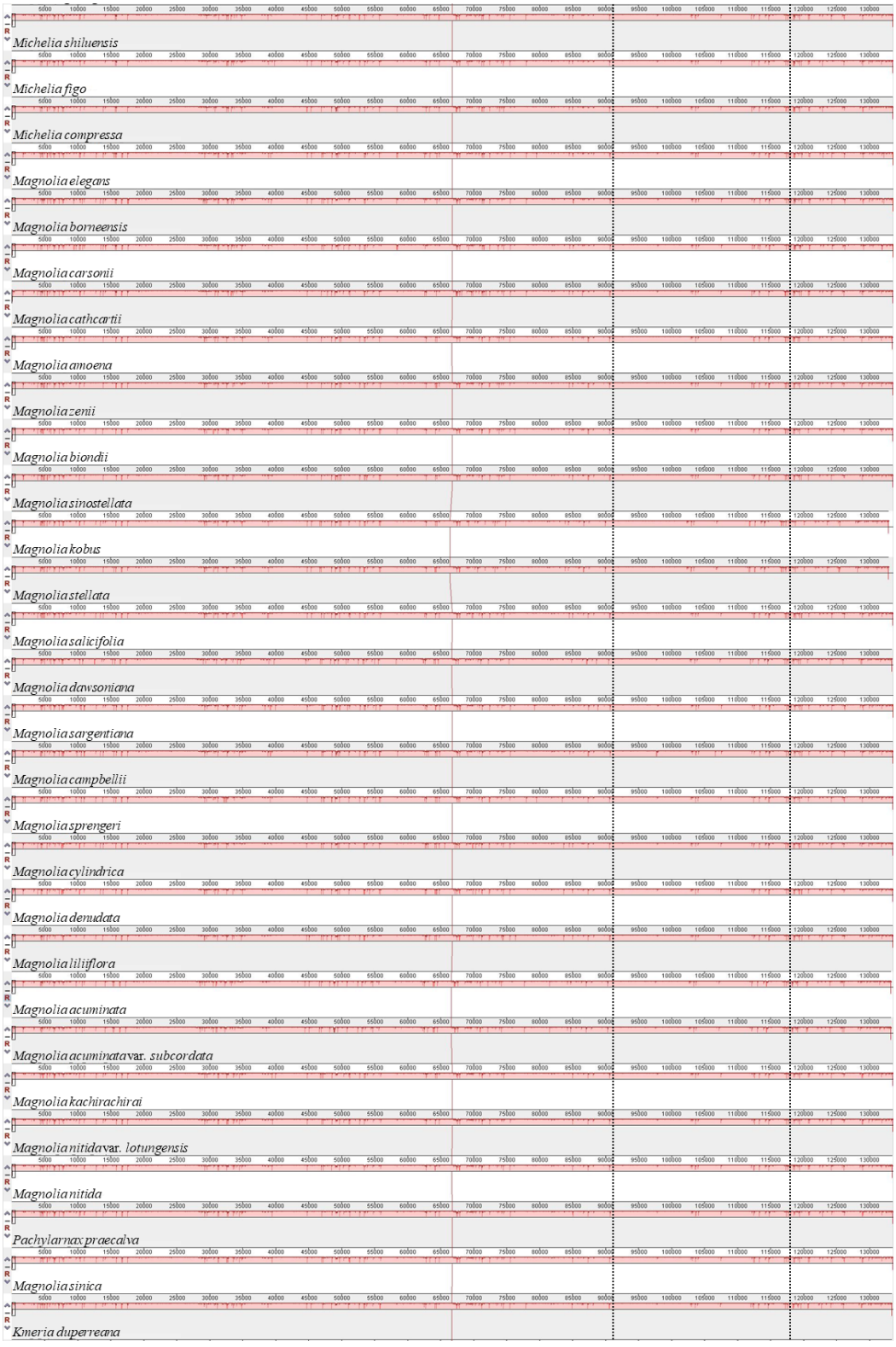


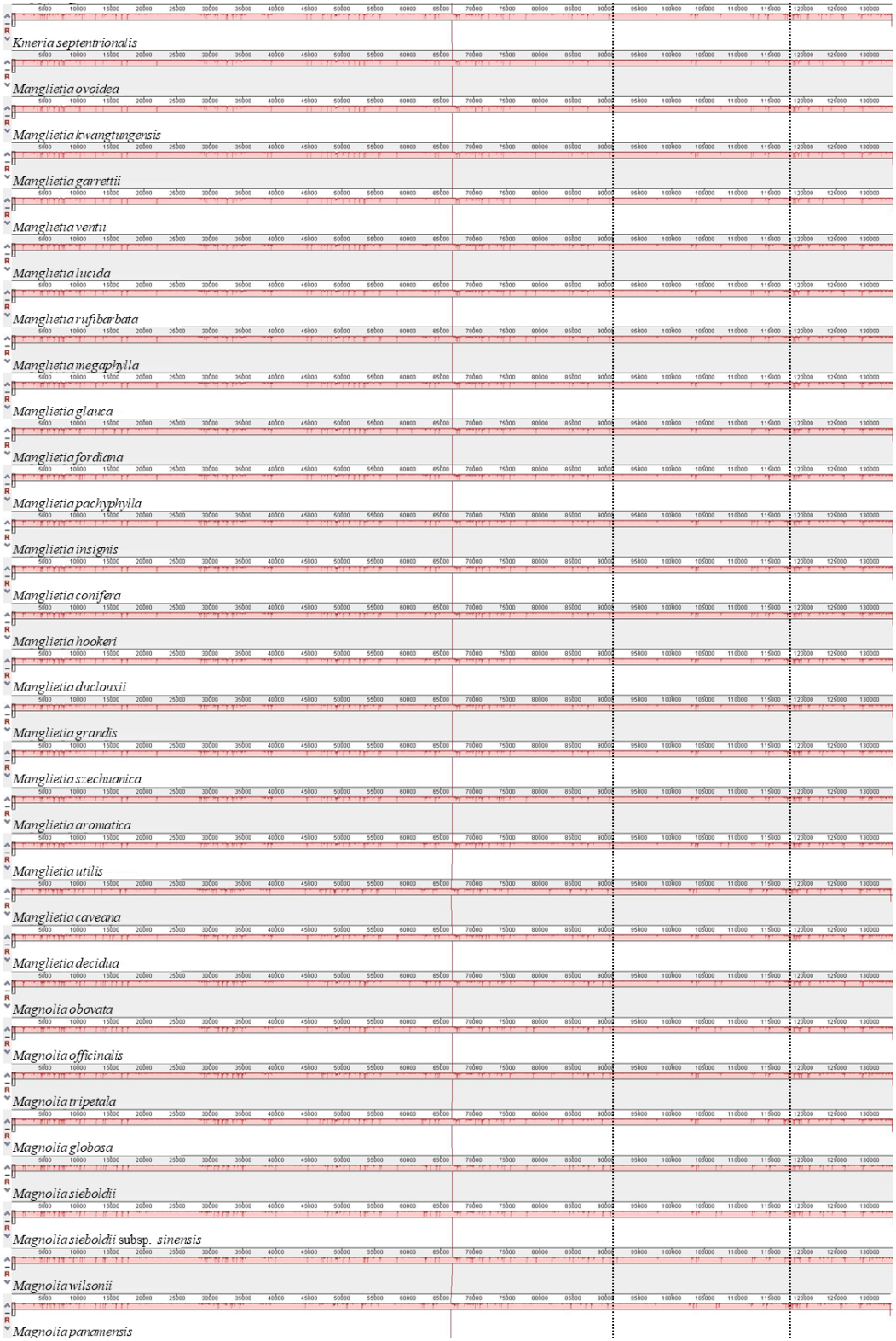
Appendix 21. Small inversion in *ccsA-ndhD.*

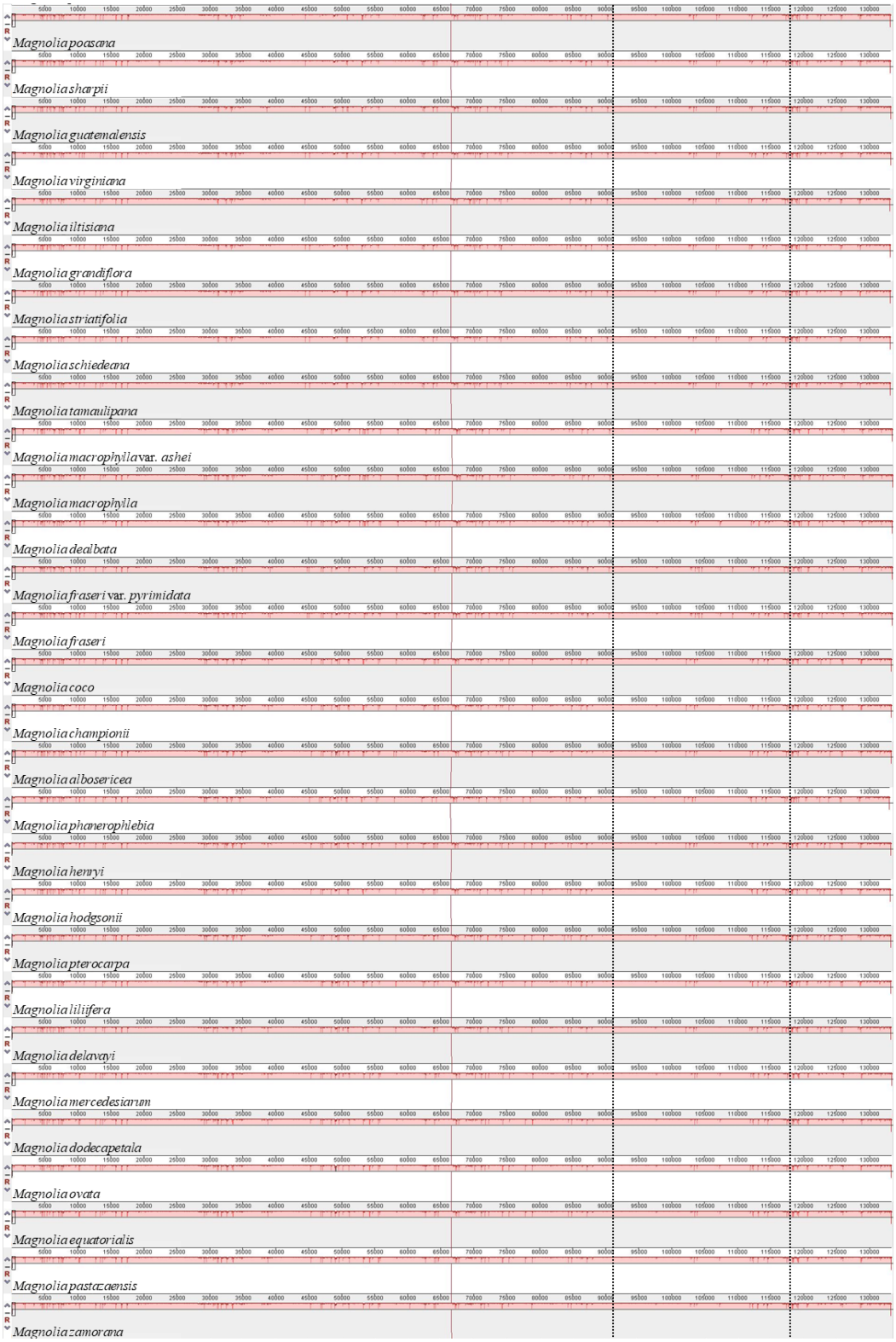


Appendix 22. Small inversion in *rps15-ycf1.*


LSC
IRb
SSC
Michelia macclurei
Michelia cavaleriei
Michelia guangdongensis
Michelia maudiae
Michelia coriacea
Michelia hypolampra
Michelia chapensis
Michelia chapensis
Michelia martini
Michelia wilsonii
Michelia balansae
Michelia viridipetala
Michelia montana
Michelia velutina
Magnolia griffithii
Michelia sirindhorniae
Michelia baillonii
Elmerrillia ovalis
Michelia floribunda
Michelia ingrata
Michelia salicifolia
Michelia lacei
Michelia doltsopa
Michelia sphaerantha
Michelia masticata
Michelia odora
Michelia foveolata
Michelia guangxiensis

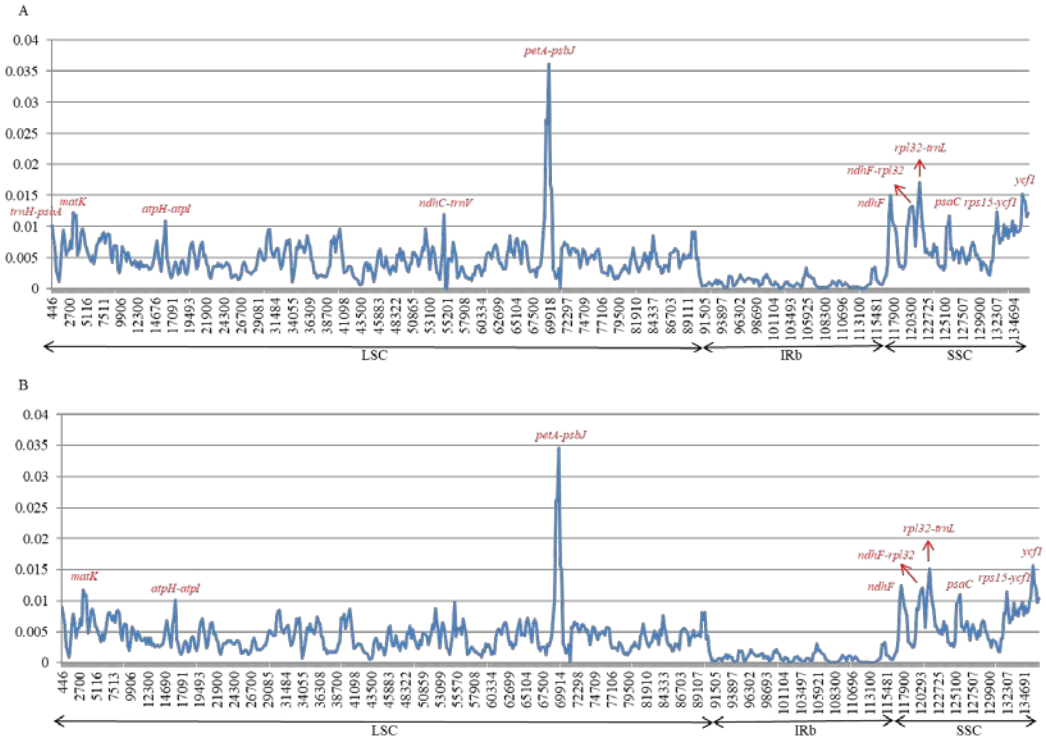

Michelia shiluensis
Michelia figo
Michelia compressa
Magnolia elegans
Magnolia borneensis
Magnolia carsonii
Magnolia cathcartii
Magnolia amoena
Magnolia zenii
Magnolia biondii
Magnolia sinostellata
Magnolia kobus
Magnolia stellata
Magnolia salicifolia
Magnolia dawsoniana
Magnolia sargentiana
Magnolia campbellii
Magnolia sprengeri
Magnolia cylindrica
Magnolia denudata
Magnolia liliiflora
Magnolia acuminata
Magnolia acuminata var. subcordata
Magnolia kachirachirai
Magnolia nitida var. lotungensis
Magnolia nitida
Pachylarnax praecalva
Magnolia sinica
Kmeria duperreana


Kmeria septentrionalis
Manglietia ovoidea
Manglietia kwangtungensis
Manglietia garrettii
Manglietia ventii
Manglietia lucida
Manglietia rufibarbata
Manglietia megaphylla
Manglietia glauca
Manglietia fordiana
Manglietia pachyphylla
Manglietia insignis
Manglietia conifera
Manglietia hookeri
Manglietia duclouxii
Manglietia grandis
Manglietia szechuanica
Manglietia aromatica
Manglietia utilis
Manglietia caveana
Manglietia decidua
Magnolia obovata
Magnolia officinalis
Magnolia tripetala
Magnolia globosa
Magnolia sieboldii
Magnolia sieboldii subsp. sinensis
Magnolia wilsonii
Magnolia panamensis

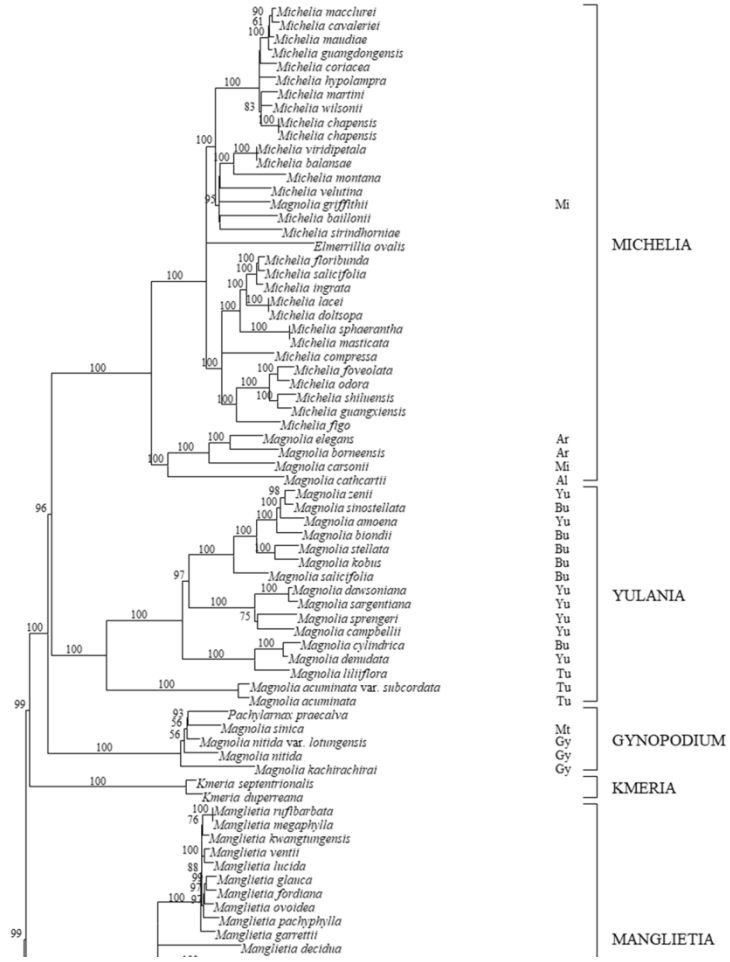

Magnolia poasana
Magnolia sharpii
Magnolia guatemalensis
Magnolia virginiana
Magnolia iltisiana
Magnolia grandiflora
Magnolia striatifolia
Magnolia schiedeana
Magnolia tamaulipana
Magnolia macrophylla var. ashei
Magnolia macrophylla
Magnolia dealbata
Magnolia fraseri var. pyrimidata
Magnolia fraseri
Magnolia coco
Magnolia championii
Magnolia albosericea
Magnolia phanerophlebia
Magnolia henryi
Magnolia hodgsonii
Magnolia pterocarpa
Magnolia liliifera
Magnolia delavayi
Magnolia mercedesiarum
Magnolia dodecapetala
Magnolia ovata
Magnolia equatorialis
Magnolia pastazaensis
Magnolia zamorana



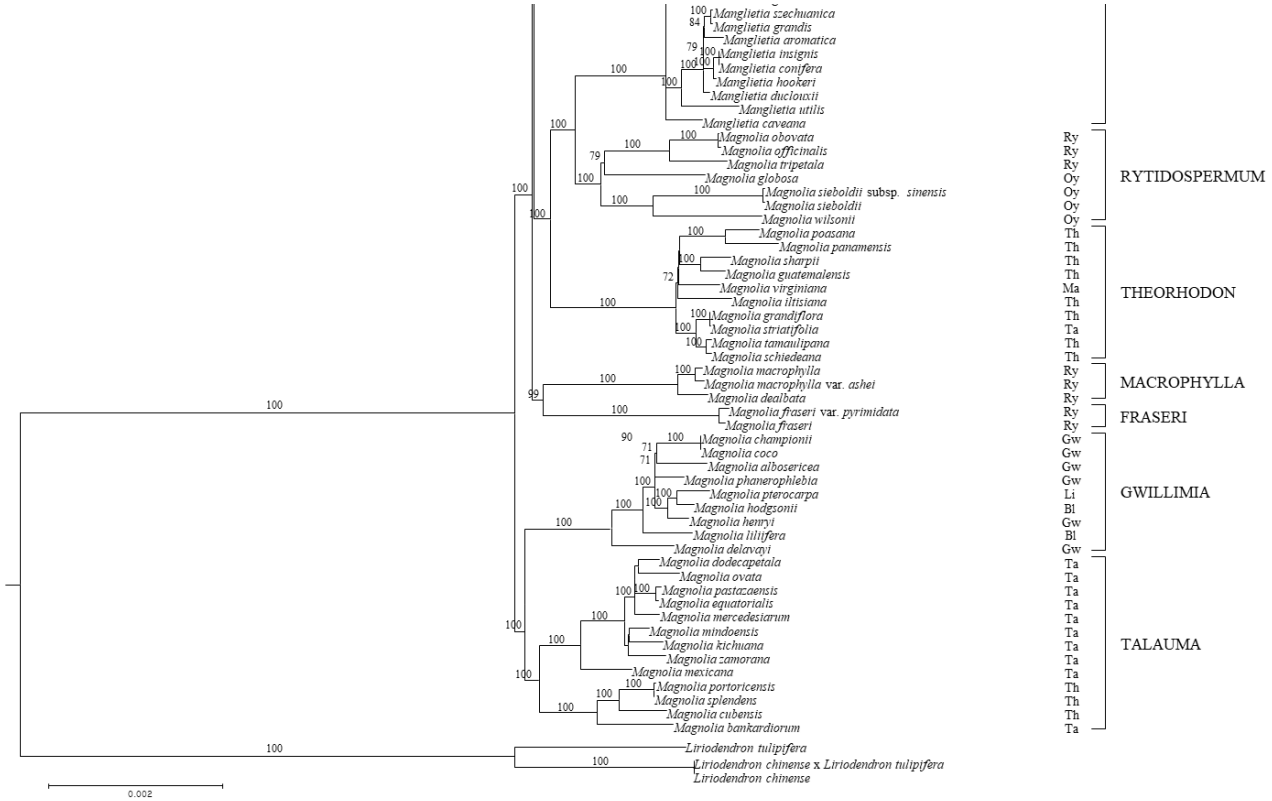
Appendix 23. MAUVE alignment of 125 Magnoliaceae chloroplast genomes (124 taxa). Within each of the alignment, local collinear blocks are represented by blocks of the same color connected by lines. The *Magnolia acuminata* was used as the reference. The order of the alignments is arranged based on the phylogenetic tree reconstructed in this study.



Appendix 24. Comparative analysis of the nucleotide variability (Pi) values of Magnoliaceae (A) and of Magnolioideae (excluding *Liriodendron* taxa) (B). X-axis: position of the midpoint of a window. Y-axis: nucleotide diversity of each window.



Appendix 25. (Continued)



Appendix 25. Phylogenetic tree of Magnoliaceae using Maximum likelihood (ML) based on chloroplast genomes, in which the small inversions were substituted for their reverse complement sequences.

Appendices for Chapter 4

Appendix 26. Venn diagram on the composition of 504 targets.

Appendix 27. List of 504 targeted genes used in this study.

Appendix 28. Summary of the sequencing results and HybPiper statistics for assembly. The order listed is based on the concatenated ML tree order.

Appendix 29. Summary of the lengths recovered by the HybPiper for each sample against of coding sequences of 504 genes selected to design probes. The order listed is based on the concatenated ML tree order

Appendix 30. Information and statistics of the 400 nuclear supercontigs (including exon and intron) used in the phylogenetic analyses out of 504 targeted genes in this study.

Appendix 31. Maximum likelihood tree of Magnoliaceae reconstructed by Raxml based on the supermatrix concatenated with 400 supercontigs obtained by HybPiper.

Appendix 32. Phylogenetic tree inferred under the coalescence approach using ASTRAL-Ⅲ.

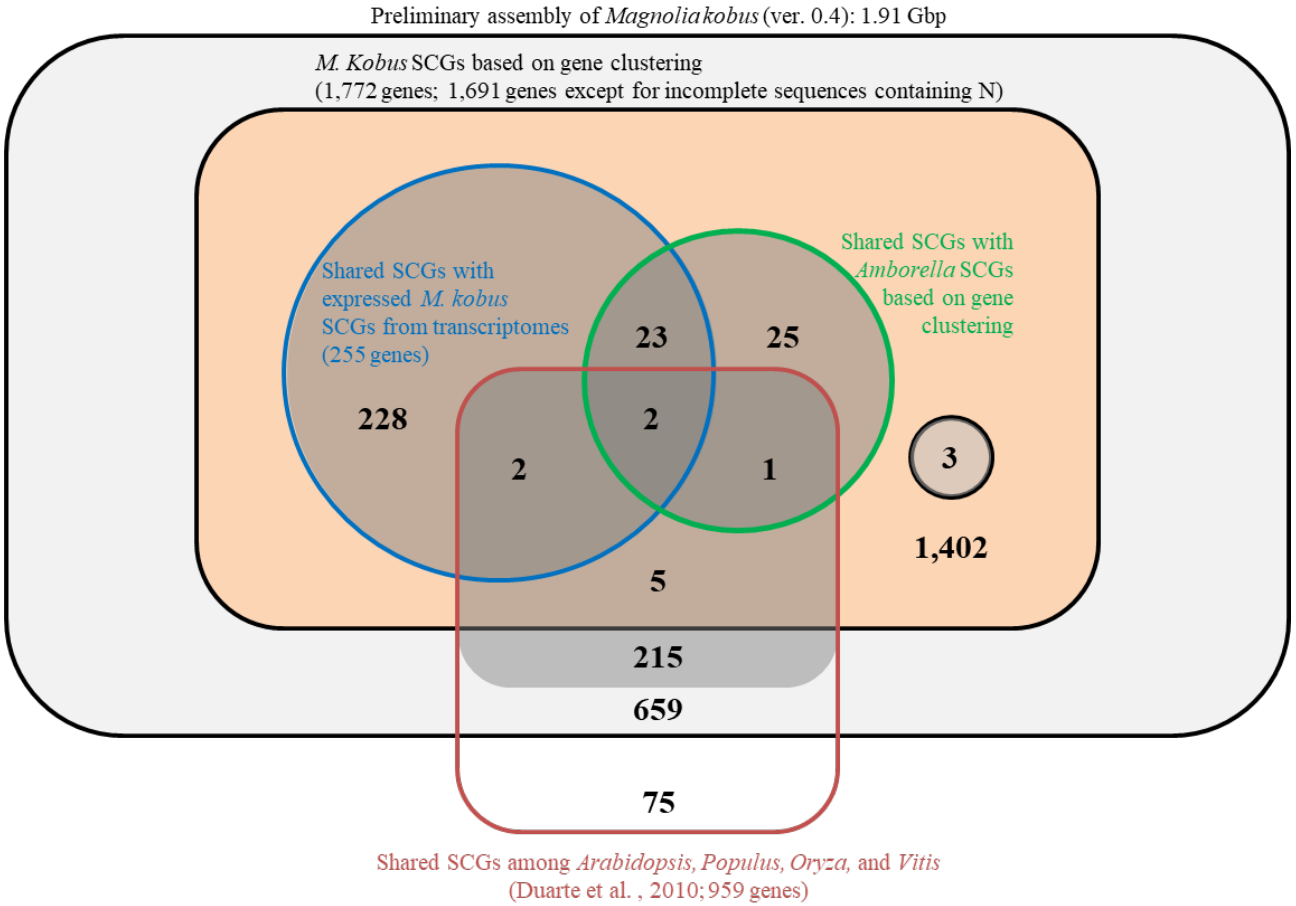
Appendix 33. Tanglegram of trees inferred under the concatenation approach (left, IQ-TREE) and the coalescent approach (right, ASTRAL-Ⅲ).

Appendix 34. gene tree conflict at each node relative to the coalescent ASTRAL tree as estimated by phyparts.

Appendix 35. The number and the percentage of shared quartets with the concatenated ML tree (IQtree) for entire topologies and within each five sub-clade.

Appendix 36. Chronogram of Magnoliaceae estimated by treePL.

Appendix 37. Divergence times and their 95% confidence intervals of subfamilies, major clades, deep nodes of the backbone, and temperate disjunction for Magnoliaceae estimated by treePL



Appendix 26. Venn diagram on the composition of 504 targets.

Appendix 27. List of 504 targeted genes used in this study.

Loci_ID	Arabidopsis_ID	Description	*M. kobus* SCGs	Expressed *M. kobus* SCGs	Shared SCGs among APOV	*M. kobus* SCGs shared with *Amborella* SCGs	Length (bp)
MKT001844_1_4_APOV	AT2G48120.2	pale cress protein (PAC)			v		1419
MKT002001_1_4_APOV	AT4G09010.2	ascorbate peroxidase 4			v		909
MKT004172_1_4	AT3G04150.2	RmlC-like cupins superfamily protein	v	v			441
MKT004737_1_4	AT3G05850.1	MuDR family transposase	v	v		v	834
MKT004964_1_4	AT3G19615.1	beta-1, 4-xylosidase	v	v			309
MKT005032_1_4	AT2G20635.1	protein kinase and Mad3-BUB1-I domain-containing protein	v	v			342
MKT005035_1_4_APOV	AT2G20635.1	protein kinase and Mad3-BUB1-I domain-containing protein			v		906
MKT005265_1_4	AT3G08010.1	RNA binding protein	v	v			282
MKT006060_1_4_APOV	AT1G49380.1	cytochrome c biogenesis protein family			v		1500
MKT006261_1_4	AT3G42170.2	BED zinc finger and hAT dimerization domain-containing protein DAYSLEEPER	v	v			597
MKT007960_1_4	AT3G61790.1	Protein with RING/U-box and TRAF-like domain	v	v			195
MKT008026_1_4_APOV	AT3G56040.1	UDP-glucose pyrophosphorylase 3			v		1518
MKT012393_1_4_APOV	AT3G13940.1	DNA binding / DNA-directed RNA polymerase			v		1572
MKT012543_1_4	AT4G29570.1	Cytidine/deoxycytidylate deaminase family protein	v	v			885
MKT012837_1_4_APOV	AT5G10920.1	L-Aspartase-like family protein			v		927
MKT013138_1_4	AT4G18600.3	SCAR family protein	v	v			870
MKT014126_1_4	AT3G26680.3	DNA repair metallo-beta-lactamase family protein	v	v			465
MKT014169_1_4_APOV	AT5G45170.1	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein			v		1266
MKT014423_1_4_APOV	AT5G17290.1	autophagy protein Apg5 family			v		1014
MKT014504_1_4_APOV	AT3G26710.1	cofactor assembly of complex C			v		1029
MKT014815_1_4	AT5G61030.2	glycine-rich RNA-binding protein 3	v	v		v	744
MKT014829_1_4	AT3G14890.1	phosphoesterase	v	v			402
MKT015133_1_4	AT4G32010.2	HSI2-like 1	v			v	303
MKT017247_1_4	AT2G44660.1	ALG6, ALG8 glycosyltransferase family	v		v		1146
MKT017888_1_4	AT5G23060.1	calcium sensing receptor			v		612
MKT018003_1_4	AT5G58760.2	damaged DNA binding 2	v			v	561
MKT018104_1_4	AT5G58330.3	lactate/malate dehydrogenase family protein			v		762
MKT018636_1_4_APOV	AT4G35560.2	Transducin/WD40 repeat-like superfamily protein			v		1557
MKT021441_1_4	AT3G30200.1	Plant transposase (Ptta/En/Spm family)	v	v			423
MKT021766_1_4_APOV	AT3G52905.1	Polynucleotidyl transferase, ribonuclease H-like superfamily protein			v		960
MKT021934_1_4_APOV	AT2G24830.1	zinc finger (CCCH-type) family protein / D111/G-patch domain-containing protein			v		1050
MKT023081_1_4_APOV	AT1G53710.1	Calcineurin-like metallo-phosphoesterase superfamily protein			v		912
MKT023139_1_4	AT5G11700.1	ephrin type-B receptor	v	v			867
MKT024581_1_4	AT5G11100.1	Calcium-dependent lipid-binding (CaLB domain) family protein	v	v			282
MKT024877_1_4	AT2G13440.1	glucose-inhibited division family A protein	v	v			891
MKT025491_1_4_APOV	AT5G64250.2	Aldolase-type TIM barrel family protein			v		1206
MKT025734_1_4	AT1G21610.1	wound-responsive family protein	v	v		v	1014
MKT025845_1_4	AT5G04070.1	NAD(P)-binding Rossmann-fold superfamily protein	v	v			1242
MKT026990_1_4_APOV	AT1G78010.1	tRNA modification GTPase			v		1101
MKT027074_1_4	AT3G26900.3	shikimate kinase like 1	v	v			492
MKT027421_1_4_APOV	AT1G10830.1	15-cis-zeta-carotene isomerase			v		909
MKT028511_1_4_APOV	AT1G07910.1	RNAligase			v		1689
MKT030637_1_4	AT1G27310.1	nuclear transport factor 2A	v	v			375
MKT033363_1_4	AT1G27595.1	symplekin	v	v			1110
MKT033924_1_4_APOV	AT3G16760.1	Tetratricopeptide repeat (TPR)-like superfamily protein			v		1023
MKT035091_1_4	AT3G53320.1	mediator of RNA polymerase II transcription subunit-like protein	v	v		v	1137
MKT035534_1_4	AT4G18370.2	DEGP protease 5	v	v			519

MKT035542_1_4	AT2G37240.1	Thioredoxin superfamily protein	v	v			750
MKT037336_1_4_APOV	AT4G04880.1	adenosine/AMP deaminase family protein			v		1290
MKT039288_1_4	ATMG00860.1	DNA/RNA polymerases superfamily protein	v	v			432
MKT040158_1_4_APOV	AT5G54855.1	Pollen Ole e 1 allergen and extensin family protein			v		1095
MKT041541_1_4_APOV	AT2G43400.2	electron-transfer flavoprotein:ubiquinone oxidoreductase			v		1557
MKT041966_1_4	AT3G09720.2	P-loop containing nucleoside triphosphate hydrolases superfamily protein	v	v			261
MKT042175_1_4	AT1G23400.1	RNA-binding CRS1 / YhbY (CRM) domain-containing protein	v	v			675
MKT042873_1_4	AT1G33360.1	ATP-dependent Clp protease	v	v		v	1353
MKT043000_1_4	AT4G24670.2	tryptophan aminotransferase related 2	v	v			579
MKT043157_1_4	AT1G11390.1	Protein kinase superfamily protein	v	v			240
MKT043957_1_4_APOV	AT5G49530.1	SIN-like family protein			v		963
MKT044207_1_4_APOV	AT5G25770.1	alpha/beta-Hydrolases superfamily protein			v		1137
MKT044398_1_4	AT4G11560.1	bromo-adjacent homology (BAH) domain-containing protein	v			v	330
MKT044450_1_4	AT5G47800.4	Phototropic-responsive NPH3 family protein	v	v		v	2178
MKT044548_1_4	AT1G51440.1	alpha/beta-Hydrolases superfamily protein	v	v			921
MKT046452_1_4	AT3G52850.1	vacuolar sorting receptor homolog 1	v	v			732
MKT047515_1_4	AT3G43600.1	aldehyde oxidase 2	v	v			213
MKT048020_1_4_APOV	AT4G17760.2	PCNA domain-containing protein			v		1524
MKT049010_1_4_APOV	AT5G41480.1	Folylpolyglutamate synthetase family protein			v		1086
MKT049457_1_4	AT2G14820.2	Phototropic-responsive NPH3 family protein	v			v	2682
MKT049651_1_4_APOV	AT5G02250.1	Ribonuclease II/R family protein			v		1143
MKT049743_1_4	AT1G23000.1	Heavy metal transport/detoxification superfamily protein	v			v	1332
MKT049745_1_4	AT1G78550.2	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	v	v		v	840
MKT049974_1_4_APOV	AT5G10320.6	ATP synthase subunit B			v		1101
MKT050498_1_4_APOV	AT1G74640.1	alpha/beta-Hydrolases superfamily protein			v		1086
MKT052244_1_4_APOV	AT2G35610.1	xyloglucanase 113			v		1317
MKT052493_1_4	AT4G26100.1	casein kinase 1	v	v			2007
MKT052654_1_4	AT1G57765.1	transmembrane protein	v	v			297
MKT054033_1_4_APOV	AT4G10030.1	alpha/beta-Hydrolases superfamily protein			v		963
MKT054141_1_4_APOV	AT2G30410.3	tubulin folding cofactor A (KIESEL)			v		1659
MKT054153_1_4	AT5G66100.1	winged-helix DNA-binding transcription factor family protein	v	v			666
MKT054712_1_4	AT4G10720.2	Ankyrin repeat family protein	v	v			297
MKT055672_1_4_APOV	AT5G50230.1	Transducin/WD40 repeat-like superfamily protein			v		1002
MKT055769_1_4	AT4G10695.2	CDC68-like protein	v	v			240
MKT056344_1_4	AT4G18760.1	receptor like protein 51	v	v			645
MKT058473_1_4_APOV	AT5G63200.1	tetratricopeptide repeat (TPR)-containing protein			v		924
MKT058531_1_4	AT1G47290.1	3beta-hydroxysteroid-dehydrogenase/decarboxylase isoform 1	v	v			579
MKT059069_1_4_APOV	AT5G19940.2	Plastid-lipid associated protein PAP / fibrillin family protein			v		984
MKT059496_1_4_APOV	AT5G23395.1	Cox19-like CHCH family protein			v		1068
MKT061112_1_4	AT1G29740.1	Leucine-rich repeat transmembrane protein kinase	v	v			639
MKT062212_1_4	AT1G02410.3	cytochrome c oxidase assembly protein CtaG / Cox11 family	v	v			1344
MKT062415_1_4_APOV	AT5G10070.2	RNase L inhibitor protein-like protein			v		960
MKT062775_1_4	AT3G51080.1	GATA transcription factor 6	v	v			204
MKT063487_1_4	AT2G21550.2	Bifunctional dihydrofolate reductase/thymidylate synthase	v	v			633
MKT063650_1_4_APOV	AT3G07060.1	NHL domain-containing protein			v		1053
MKT064181_1_4_APOV	AT3G32930.2	6, 7-dimethyl-8-ribityllumazine synthase			v		1362
MKT065092_1_4_APOV	AT5G18660.1	NAD(P)-binding Rossmann-fold superfamily protein			v		1335
MKT065135_1_4_APOV	AT2G42080.1	Chaperone DnaJ-domain superfamily protein			v		1188
MKT065481_1_4_APOV	AT1G72440.1	CCAAT-binding factor			v		1128
MKT066774_1_4	AT1G43760.1	DNAse I-like superfamily protein	v	v			348
MKT071108_1_4_APOV	AT5G09530.1	hydroxyproline-rich glycoprotein family protein			v		984
MKT072919_1_4_APOV	AT3G59650.2	mitochondrial ribosomal protein L51/S25/CI-B8 family protein			v		1017
MKT074080_1_4_APOV	AT1G75200.1	flavodoxin family protein / radical SAM domain-containing protein			v		1335
MKT074616_1_4	AT5G04040.2	Patatin-like phospholipase family protein	v	v		v	1431
MKT074911_1_4	AT4G01550.1	NAC domain containing protein 69	v	v			465
MKT075332_1_4	AT3G51360.8	Eukaryotic aspartyl protease family protein	v	v			480
MKT075417_1_4_APOV	AT2G42770.1	Peroxisomal membrane 22 kDa (Mpv17/PMP22) family protein			v		1068

MKT075942_1_4_APOV	AT2G05320.1	beta-1, 2-N-acetylglucosaminyltransferase II			v		1503
MKT076221_1_4	AT5G54930.1	AT hook motif-containing protein	v	v			393
MKT076335_1_4_APOV	AT2G43370.2	RNA-binding (RRM/RBD/RNP motifs) family protein			v		1065
MKT077005_1_4_APOV	AT3G24320.2	MUTL protein homolog 1			v		1191
MKT077409_1_4_APOV	AT5G58760.2	damaged DNA binding 2			v		1029
MKT077685_1_4	AT5G51340.1	Tetratricopeptide repeat (TPR)-like superfamily protein	v	v			531
MKT077735_1_4	AT4G28230.1	hypothetical protein	v	v			390
MKT079447_1_4_APOV	AT4G02790.1	GTP-binding family protein			v		1404
MKT080632_1_4	AT3G04500.3	RNA-binding (RRM/RBD/RNP motifs) family protein	v	v			1554
MKT081437_1_4_APOV	AT5G27560.4	DUF1995 domain protein, putative (DUF1995)			v		1131
MKT082329_1_4	AT4G24620.2	phosphoglucose isomerase 1	v			v	327
MKT083137_1_4	AT5G42400.8	SET domain protein 25	v	v			291
MKT083367_1_4_APOV	AT3G25470.1	bacterial hemolysin-like protein			v		1404
MKT083464_1_4_APOV	AT3G24200.2	FAD/NAD(P)-binding oxidoreductase family protein			v		1173
MKT084780_1_4_APOV	AT3G01920.1	DHBP synthase RibB-like alpha/beta domain-containing protein			v		1302
MKT085635_1_4	AT5G20570.1	RING-box 1	v	v			786
MKT086183_1_4	AT4G11290.1	Peroxidase superfamily protein	v	v		v	357
MKT086766_1_4_APOV	AT1G59990.2	DEA(D/H)-box RNA helicase family protein			v		1296
MKT087337_1_4	AT1G07510.1	FTSH protease 10	v	v			1659
MKT087636_1_4_APOV	AT5G63040.1	transmembrane protein			v		951
MKT088403_1_4	AT3G57940.2	GNAT acetyltransferase (DUF699)	v	v			531
MKT089525_1_4_APOV	AT3G14910.1	Rab3 GTPase-activating protein non-catalytic subunit			v		1134
MKT093344_1_4	AT5G61500.2	autophagy 3 (APG3)	v				303
MKT094099_1_4	AT4G05530.1	indole-3-butyric acid response 1	v	v			384
MKT095133_1_4_APOV	AT2G22370.1	mediator of RNA polymerase II transcription subunit			v		1086
MKT095310_1_4	ATMG00860.1	DNA/RNA polymerases superfamily protein	v	v			768
MKT095730_1_4_APOV	AT1G77090.1	thylakoid lumenal protein (Mog1/PsbP/DUF1795-like photosystem II reaction center PsbP family protein)			v		1212
MKT097806_1_4	No_hit	No_hit	v	v			228
MKT097815_1_4_APOV	AT4G03200.1	catalytics			v		948
MKT099172_1_4_APOV	AT3G16270.3	ENTH/VHS family protein			v		1452
MKT099267_1_4	AT4G09680.3	conserved telomere maintenance component 1	v	v			501
MKT099416_1_4_APOV	AT4G33030.1	sulfoquinovosyldiacylglycerol 1			v		1371
MKT100456_1_4	AT1G04210.1	Leucine-rich repeat protein kinase family protein	v	v			378
MKT102093_1_4_APOV	AT5G48470.1	hypothetical protein			v		996
MKT102398_1_4	AT1G72790.1	hydroxyproline-rich glycoprotein family protein	v	v		v	1590
MKT102617_1_4_APOV	ATMG00520.1	Intron maturase, type II family protein			v		1017
MKT102671_1_4	AT5G51980.2	Transducin/WD40 repeat-like superfamily protein	v	v			444
MKT103416_1_4	AT2G24270.2	aldehyde dehydrogenase 11A3	v	v			588
MKT103490_1_4	AT4G35830.2	aconitase 1	v	v			1017
MKT103531_1_4_APOV	AT1G55880.1	Pyridoxal-5'-phosphate-dependent enzyme family protein			v		1218
MKT103582_1_4	AT2G46225.1	ABI-1-like 1	v	v			756
MKT104268_1_4	AT5G61450.1	P-loop containing nucleoside triphosphate hydrolases superfamily protein	v	v			216
MKT104669_1_4	AT3G48110.1	glycine-tRNA ligase	v			v	165
MKT105275_1_4	AT2G25710.2	holocarboxylase synthase 1	v	v			234
MKT106281_1_4	AT3G17360.1	phragmoplast orienting kinesin 1	v	v			255
MKT106488_1_4	AT2G20000.2	CDC27 family protein	v			v	351
MKT107466_1_4	ATMG00860.1	DNA/RNA polymerases superfamily protein	v	v			708
MKT108799_1_4_APOV	AT2G19270.1	mitotic checkpoint protein PRCC-carboxy-term protein			v		942
MKT109897_1_4	AT1G43760.1	DNAse I-like superfamily protein	v	v			504
MKT110241_1_4_APOV	AT3G07670.1	Rubisco methyltransferase family protein			v		912
MKT110690_1_4	AT1G78780.2	pathogenesis-related family protein	v	v			516
MKT110961_1_4	AT5G03980.1	SGNH hydrolase-type esterase superfamily protein	v				273
MKT111153_1_4_APOV	AT5G51220.2	ubiquinol-cytochrome C chaperone family protein			v		1263
MKT111535_1_4_APOV	AT5G16850.2	telomerase reverse transcriptase			v		1041
MKT111570_1_4_APOV	AT2G21710.2	Mitochondrial transcription termination factor family protein			v		1242
MKT111920_1_4	AT5G66060.2	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	v	v			582
MKT113256_1_4_APOV	AT3G52180.3	dual specificity protein phosphatase (DsPTP1) family protein			v		951

MKT114467_1_4	AT1G43760.1	DNAse I-like superfamily protein	v	v			744
MKT115451_1_4_APOV	AT5G63060.1	Sec14p-like phosphatidylinositol transfer family protein			v		906
MKT115640_1_4	AT1G03910.1	cactus-binding carboxy-terminal, actin	v	v			339
MKT115677_1_4_APOV	AT5G22820.3	ARM repeat superfamily protein			v		1278
MKT116135_1_4	AT4G33700.3	CBS domain protein (DUF21)	v	v			804
MKT116442_1_4_APOV	AT1G31780.1	oligomeric golgi complex subunit			v		1377
MKT116443_1_4	AT2G35920.3	RNA helicase family protein	v	v			288
MKT117656_1_4_APOV	AT3G27110.2	Peptidase family M48 family protein			v		1110
MKT117762_1_4	AT1G14390.1	Leucine-rich repeat protein kinase family protein	v	v			1242
MKT118146_1_4	AT1G66030.1	cytochrome P450, family 96, subfamily A, polypeptide 14 pseudogene	v	v			531
MKT120073_1_4_APOV	AT1G05410.2	CDPK adapter, putative (DUF1423)			v		903
MKT120644_1_4	AT2G03670.1	cell division cycle 48B	v	v			261
MKT120725_1_4	AT5G39890.1	2-aminoethanethiol dioxygenase, putative (DUF1637)	v	v			771
MKT121246_1_4	AT3G58660.1	Ribosomal protein L1p/L10e family	v	v			516
MKT122427_1_4_APOV	AT2G20210.1	RNI-like superfamily protein			v		1218
MKT124409_1_4_APOV	AT5G42765.1	plasma membrane fusion protein			v		1038
MKT124578_1_4_APOV	AT3G20480.5	tetraacyldisaccharide 4'-kinase family protein			v		1116
MKT125069_1_4	AT5G14910.2	Heavy metal transport/detoxification superfamily protein	v		v		180
MKT125774_1_4_APOV	AT3G18480.1	CCAAT-displacement protein alternatively spliced product			v		1371
MKT125823_1_4	AT5G58090.1	O-Glycosyl hydrolases family 17 protein	v	v			591
MKT126189_1_4	AT1G09290.1	hypothetical protein	v	v			1086
MKT126260_1_4_APOV	AT5G64630.1	Transducin/WD40 repeat-like superfamily protein			v		1233
MKT126264_1_4	AT2G25600.1	Shaker pollen inward K+ channel	v	v			393
MKT126492_1_4	ATMG00860.1	DNA/RNA polymerases superfamily protein	v	v			924
MKT126679_1_4	AT5G05170.1	Cellulose synthase family protein	v	v			714
MKT127097_1_4_APOV	AT2G28450.2	zinc finger (CCCH-type) family protein			v		1062
MKT127492_1_4_APOV	AT2G40316.3	autophagy-like protein			v		924
MKT127979_1_4	AT3G56140.3	DUF399 family protein, putative (DUF399 and DUF3411)	v	v			654
MKT129330_1_4_APOV	AT1G26840.1	origin recognition complex protein 6			v		951
MKT129653_1_4_APOV	AT5G52180.1	transmembrane protein 161AB protein			v		1059
MKT130843_1_4_APOV	AT2G26340.1	hypothetical protein			v		1179
MKT130987_1_4_APOV	AT4G13670.1	plastid transcriptionally active 5			v		1245
MKT131170_1_4	AT3G42170.2	BED zinc finger and hAT dimerization domain-containing protein DAYSLEEPER	v	v			1281
MKT131604_1_4_APOV	AT5G16690.2	origin recognition complex subunit 3			v		981
MKT131706_1_4	AT4G33410.1	SIGNAL PEPTIDE PEPTIDASE-LIKE 1	v			v	210
MKT131785_1_4	AT2G31335.1	hypothetical protein	v	v			441
MKT132265_1_4	AT3G49160.1	pyruvate kinase family protein	v	v			363
MKT132814_1_4	AT1G21950.1	transmembrane protein	v	v			438
MKT136353_1_4	AT3G51800.3	metallopeptidase M24 family protein	v	v			579
MKT136846_1_4	AT3G26270.1	cytochrome P450, family 71, subfamily B, polypeptide 25	v	v			222
MKT137064_1_4	AT4G35170.1	Late embryogenesis abundant (LEA) hydroxyproline-rich glycoprotein family	v	v			285
MKT137339_1_4	AT2G40730.1	kinase family with ARM repeat domain-containing protein	v			v	489
MKT137622_1_4_APOV	AT5G46680.1	Pentatricopeptide repeat (PPR-like) superfamily protein			v		1068
MKT138013_1_4	AT4G17610.1	tRNA/rRNA methyltransferase (SpoU) family protein	v			v	1206
MKT138505_1_4	AT3G24255.5	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	v	v			501
MKT138586_1_4	AT3G50420.2	Pentatricopeptide repeat (PPR) superfamily protein	v	v			696
MKT138835_1_4	AT5G45990.1	crooked neck protein, putative / cell cycle protein	v	v			228
MKT138928_1_4	AT1G52590.1	Putative thiol-disulfide oxidoreductase DCC	v	v	v		408
MKT139741_1_4_APOV	AT4G37510.1	Ribonuclease III family protein			v		1143
MKT139751_1_4	AT2G02650.1	Ribonuclease H-like superfamily protein	v	v			546
MKT143784_1_4	AT2G02070.2	indeterminate(ID)-domain 5	v	v			510
MKT145856_1_4	AT2G04842.2	threonyl-tRNA synthetase, putative / threonine-tRNA ligase	v	v			465
MKT146240_1_4_APOV	AT3G17712.3	hypothetical protein			v		918
MKT147857_1_4	ATMG00900.1	cytochrome C biogenesis 256	v	v		v	960
MKT148312_1_4	AT2G31260.1	autophagy 9 (APG9)	v	v			879
MKT149396_1_4_APOV	AT3G17040.2	high chlorophyll fluorescent 107			v		1194
MKT149614_1_4_APOV	AT1G56090.1	Tetratricopeptide repeat (TPR)-like superfamily protein			v		1401

MKT152047_1_4_APOV	AT1G72640.1	NAD(P)-binding Rossmann-fold superfamily protein			v		1044
MKT153301_1_4	AT2G02650.1	Ribonuclease H-like superfamily protein	v	v			1113
MKT153988_1_4	AT1G55250.4	histone mono-ubiquitination 2	v	v			1056
MKT154349_1_4_APOV	AT1G63680.3	ALBINO OR PALE-GREEN 13			v		1161
MKT154711_1_4_APOV	AT2G44420.3	protein N-terminal asparagine amidohydrolase family protein			v		1272
MKT155109_1_4	AT3G47420.3	putative glycerol-3-phosphate transporter 1	v	v			900
MKT155265_1_4	AT5G13240.1	transcription regulator	v	v	v	v	852
MKT155305_1_4	AT5G01881.1	transmembrane protein	v	v			453
MKT157257_1_4_APOV	AT5G25070.1	neurofilament light protein			v		1476
MKT157285_1_4_APOV	AT1G77320.2	transcription coactivator			v		1461
MKT157286_1_4_APOV	AT1G77290.3	Glutathione S-transferase family protein			v		1071
MKT159057_1_4	AT5G35360.3	acetyl Co-enzyme a carboxylase biotin carboxylase subunit	v	v			519
MKT160185_1_4_APOV	AT4G26980.1	RNI-like superfamily protein			v		1176
MKT160703_1_4_APOV	AT1G34770.3	melanoma-associated antigen G1-like protein			v		1035
MKT160851_1_4_APOV	AT5G55760.1	sirtuin 1			v		1092
MKT161286_1_4	AT3G61182.1	low-molecular-weight cysteine-rich 54	v	v			393
MKT161705_1_4_APOV	AT5G41190.1	RNA-binding NOB1-like protein			v		1245
MKT162606_1_4_APOV	AT4G30580.1	Phospholipid/glycerol acyltransferase family protein			v		1110
MKT164012_1_4_APOV	AT5G06430.1	Thioredoxin superfamily protein			v		1110
MKT164029_1_4	AT5G49430.2	WD40/YVTN repeat and Bromo-WDR9-I-like domain-containing protein	v	v		v	351
MKT164244_1_4	AT4G37200.1	Thioredoxin superfamily protein	v	v			648
MKT164313_1_4	AT5G04230.2	phenyl alanine ammonia-lyase 3	v	v			291
MKT164391_1_4	AT1G27180.7	disease resistance protein (TIR-NBS-LRR class)	v	v			279
MKT165315_1_4	AT4G13620.1	Integrase-type DNA-binding superfamily protein	v	v		v	1305
MKT165734_1_4_APOV	AT5G25500.1	exosome complex exonuclease			v		1275
MKT166824_1_4	AT1G73660.1	protein tyrosine kinase family protein	v	v			1149
MKT167910_1_4_APOV	AT5G49570.1	peptide-N-glycanase 1			v		1161
MKT168213_1_4	AT2G28470.5	beta-galactosidase 8	v	v			1641
MKT169758_1_4_APOV	AT5G24850.1	cryptochrome 3			v		1188
MKT169891_1_4	AT4G24380.2	dihydrofolate reductase	v			v	861
MKT170456_1_4	AT3G16000.1	MAR binding filament-like protein 1	v			v	1110
MKT175152_1_4_APOV	AT2G20495.2	Serine/Threonine-kinase			v		1056
MKT176042_1_4	AT1G64760.2	O-Glycosyl hydrolases family 17 protein	v	v			960
MKT176331_1_4	AT3G16110.1	PDI-like 1-6	v			v	1263
MKT177392_1_4_APOV	AT2G42780.2	transcription elongation factor B polypeptide			v		996
MKT182812_1_4	AT1G50830.1	Aminotransferase-like, plant mobile domain family protein	v	v			996
MKT182888_1_4_APOV	AT1G09010.1	glycoside hydrolase family 2 protein			v		1005
MKT184400_1_4_APOV	AT2G20790.2	clathrin adaptor complexes medium subunit family protein			v		1434
MKT185663_1_4_APOV	AT5G17670.1	alpha/beta-Hydrolases superfamily protein			v		936
MKT185666_1_4_APOV	AT5G45360.1	F-box family protein			v		1635
MKT186190_1_4_APOV	AT4G26410.1	chromosome-associated kinesin			v		1074
MKT187982_1_4	AT3G45690.1	Major facilitator superfamily protein	v	v			438
MKT188496_1_4_APOV	AT5G01310.1	APRATAXIN-like protein			v		1113
MKT190086_1_4_APOV	AT1G53860.1	Remorin family protein			v		1299
MKT190355_1_4	AT4G32150.1	vesicle-associated membrane protein 711	v	v			222
MKT191419_1_4	AT4G30810.1	serine carboxypeptidase-like 29	v	v			378
MKT192708_1_4	AT2G02148.5	PPR containing protein	v	v			216
MKT192907_1_4	AT1G63670.4	hypothetical protein (DUF3741)	v	v			258
MKT193152_1_4	AT5G01260.3	Carbohydrate-binding-like fold	v	v			1056
MKT193254_1_4	AT4G02070.2	MUTS homolog 6	v	v			432
MKT193786_1_4_APOV	AT5G04910.1	DNA repair REX1-B protein			v		1167
MKT194050_1_4_APOV	AT5G05490.1	Rad21/Rec8-like family protein			v		918
MKT194086_1_4_APOV	AT5G43600.1	ureidoglycolate amidohydrolase			v		993
MKT196134_1_4_APOV	AT4G38090.2	ribosomal protein S5 domain protein			v		1377
MKT196157_1_4_APOV	AT1G17760.1	Tetratricopeptide repeat (TPR)-like superfamily protein			v		975
MKT197215_1_4	AT3G10230.1	lycopene cyclase	v	v			1659
MKT198187_1_4	AT3G54290.1	hemerythrin HHE cation-binding domain protein	v	v			708

MKT198387_1_4_APOV	AT5G08320.1	E2F-associated phosphoprotein			v		1140
MKT198537_1_4	AT5G40410.1	Tetratricopeptide repeat (TPR)-like superfamily protein	v	v			474
MKT198585_1_4	AT4G04650.1	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	v	v			1125
MKT199319_1_4	AT3G18030.1	HAL3-like protein A	v	v			441
MKT199612_1_4	AT5G64460.5	Phosphoglycerate mutase family protein	v	v			930
MKT200802_1_4	AT1G08510.1	fatty acyl-ACP thioesterases B	v	v		v	534
MKT201180_1_4	AT2G05915.1	hypothetical protein	v	v			606
MKT202602_1_4_APOV	AT4G11060.1	mitochondrially targeted single-stranded DNA binding protein			v		1116
MKT202963_1_4	AT3G26820.2	Esterase/lipase/thioesterase family protein	v	v			354
MKT203107_1_4	AT2G17200.1	ubiquitin family protein	v			v	723
MKT203205_1_4_APOV	AT3G58530.1	RNI-like superfamily protein			v		1485
MKT203672_1_4	AT3G55080.4	SET domain-containing protein	v	v			747
MKT204768_1_4	AT1G12430.2	armadillo repeat kinesin 3	v	v			399
MKT204875_1_4	AT4G39290.1	Galactose oxidase/kelch repeat superfamily protein	v	v			1206
MKT205092_1_4_APOV	AT2G34640.1	plastid transcriptionally active 12			v		966
MKT205230_1_4	AT4G04640.1	ATPase, F1 complex, gamma subunit protein	v	v			378
MKT206098_1_4_APOV	AT3G10970.3	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein			v		939
MKT206466_1_4_APOV	AT2G43110.1	U3 containing 90S pre-ribosomal complex subunit			v		1044
MKT206470_1_4	AT1G67500.4	recovery protein 3	v	v			495
MKT208284_1_4_APOV	AT3G43540.2	initiation factor 4F subunit (DUF1350)			v		1233
MKT208916_1_4	AT4G18930.1	RNA ligase/cyclic nucleotide phosphodiesterase family protein	v	v			375
MKT208959_1_4	AT1G52680.1	late embryogenesis abundant protein-related / LEA protein-like protein	v			v	399
MKT210113_1_4_APOV	AT3G59490.4	hypothetical protein			v		1410
MKT210707_1_4_APOV	AT4G01860.2	Transducin family protein / WD-40 repeat family protein			v		1620
MKT210746_1_4	AT4G17030.1	expansin-like B1	v	v			213
MKT211758_1_4_APOV	AT4G15420.2	Ubiquitin fusion degradation UFD1 family protein			v		1680
MKT212863_1_4_APOV	AT2G35500.1	shikimate kinase like 2			v		990
MKT213884_1_4	AT1G13060.1	20S proteasome beta subunit E1	v	v			267
MKT214027_1_4	AT1G07890.8	ascorbate peroxidase 1	v	v			366
MKT214507_1_4	AT3G54650.1	RNI-like superfamily protein	v	v			210
MKT216653_1_4	AT2G16630.1	Pollen Ole e 1 allergen and extensin family protein	v				222
MKT217609_1_4	AT2G39670.1	Radical SAM superfamily protein	v	v			354
MKT217917_1_4	AT5G18350.1	Disease resistance protein (TIR-NBS-LRR class) family	v	v			261
MKT221190_1_4	AT3G17440.2	Putative plant snare 13	v	v			273
MKT223188_1_4_APOV	AT2G34860.2	DnaJ/Hsp40 cysteine-rich domain superfamily protein			v		969
MKT223227_1_4	AT2G02410.12	yacP-like NYN domain protein	v		v		1068
MKT223537_1_4	AT4G35300.5	tonoplast monosaccharide transporter2	v	v			711
MKT225133_1_4	AT2G03330.1	transmembrane protein	v	v			381
MKT225962_1_4_APOV	AT3G21820.1	histone-lysine N-methyltransferase ATXR2			v		921
MKT227293_1_4_APOV	AT2G31840.2	Thioredoxin superfamily protein			v		987
MKT228111_1_4	AT2G19490.1	recA DNA recombination family protein	v	v			1284
MKT228199_1_4	AT3G14770.1	Nodulin MtN3 family protein	v	v			669
MKT228412_1_4	AT4G25830.1	Uncharacterized protein family (UPF0497)	v	v			441
MKT228574_1_4	AT1G74920.1	aldehyde dehydrogenase 10A8	v	v			234
MKT228912_1_4	AT3G29785.1	Pol-like polyprotein/retrotransposon	v	v			1344
MKT229513_1_4	AT4G20380.9	LSD1 zinc finger family protein	v	v			447
MKT229926_1_4_APOV	AT3G62940.4	Cysteine proteinases superfamily protein			v		1221
MKT231174_1_4	AT1G43760.1	DNAse I-like superfamily protein	v	v			885
MKT231614_1_4	AT5G08550.1	GC-rich sequence DNA-binding factor-like protein	v	v			462
MKT232553_1_4	AT5G61380.1	CCT motif -containing response regulator protein	v	v		v	1485
MKT232584_1_4_APOV	AT2G15020.1	hypothetical protein			v		1017
MKT232706_1_4_APOV	AT4G00560.1	NAD(P)-binding Rossmann-fold superfamily protein			v		1338
MKT233179_1_4	AT5G20420.1	chromatin remodeling 42	v	v			1347
MKT233393_1_4	AT3G06530.3	ARM repeat superfamily protein	v	v		v	444
MKT233399_1_4_APOV	AT3G06530.2	ARM repeat superfamily protein			v		1272
MKT234475_1_4_APOV	AT1G76450.1	Photosystem II reaction center PsbP family protein			v		1368
MKT235083_1_4	AT4G21470.1	riboflavin kinase/FMN hydrolase	v	v			777

MKT235691_1_4	AT1G25290.2	RHOMBOID-like protein 10	v		v		297
MKT235890_1_4	AT1G50480.1	10-formyltetrahydrofolate synthetase	v	v			489
MKT236372_1_4_APOV	AT3G53900.1	uracil phosphoribosyltransferase			v		1398
MKT238438_1_4	AT3G61170.1	Tetratricopeptide repeat (TPR)-like superfamily protein	v	v			468
MKT239674_1_4	AT1G21280.1	Copia-like polyprotein/retrotransposon	v	v			327
MKT239819_1_4_APOV	AT3G45900.1	Ribonuclease P protein subunit P38-like protein			v		1116
MKT240204_1_4	AT2G26990.1	proteasome family protein	v	v			405
MKT240662_1_4_APOV	AT5G24710.1	Transducin/WD40 repeat-like superfamily protein			v		1479
MKT241357_1_4_APOV	AT5G66810.2	Ran-binding protein in the microtubule-organising centre protein			v		939
MKT241546_1_4	AT3G01880.1	vacuolar sorting-associated protein (DUF946)	v	v			849
MKT242726_1_4_APOV	AT1G48175.6	Cytidine/deoxycytidylate deaminase family protein			v		1071
MKT242935_1_4	AT5G64370.1	beta-ureidopropionase	v			v	846
MKT243378_1_4	AT3G44690.1	hypothetical protein	v	v			243
MKT244181_1_4	AT1G49340.4	Phosphatidylinositol 3- and 4-kinase family protein	v	v			723
MKT244595_1_4	AT2G34970.1	Trimeric LpxA-like enzyme	v	v			342
MKT245813_1_4_APOV	AT3G49070.2	transmembrane protein, putative (DUF677)			v		1014
MKT246045_1_4	AT3G15110.1	transmembrane protein	v	v	v	v	570
MKT246079_1_4_APOV	AT2G17900.1	SET domain group 37			v		1098
MKT246461_1_4_APOV	AT3G24560.2	Adenine nucleotide alpha hydrolases-like superfamily protein			v		1275
MKT248146_1_4	AT2G31660.1	ARM repeat superfamily protein	v	v		v	657
MKT248631_1_4_APOV	AT1G73440.1	calmodulin-like protein			v		1311
MKT248845_1_4	AT1G54210.2	Ubiquitin-like superfamily protein	v	v			516
MKT249328_1_4_APOV	AT1G50000.1	methyltransferase			v		1401
MKT249944_1_4	AT2G23070.1	Protein kinase superfamily protein	v			v	306
MKT250009_1_4_APOV	AT3G15090.1	GroES-like zinc-binding alcohol dehydrogenase family protein			v		1521
MKT250663_1_4	AT2G27260.1	Late embryogenesis abundant (LEA) hydroxyproline-rich glycoprotein family	v	v			1473
MKT251689_1_4_APOV	AT3G54170.1	FKBP12 interacting protein 37			v		1614
MKT253344_1_4	AT1G16290.1	transglycosylase	v			v	231
MKT253397_1_4	AT4G09140.1	MUTL-homologue 1	v	v			213
MKT255591_1_4	AT4G39660.2	alanine:glyoxylate aminotransferase 2	v	v			309
MKT255595_1_4	AT2G42570.1	TRICHOME BIREFRINGENCE-LIKE 39	v	v			237
MKT257161_1_4	AT4G02790.1	GTP-binding family protein	v	v			726
MKT257387_1_4	AT1G16800.1	P-loop containing nucleoside triphosphate hydrolases superfamily protein	v	v			369
MKT257746_1_4	AT4G25390.2	Protein kinase superfamily protein	v	v			282
MKT259369_1_4_APOV	AT3G28030.4	5'-3' exonuclease family protein			v		978
MKT261594_1_4	AT5G06440.1	polyketide cyclase/dehydrase/lipid transport superfamily protein	v			v	555
MKT264772_1_4_APOV	AT5G19130.1	GPI transamidase component family protein / Gaa1-like family protein			v		1479
MKT265035_1_4_APOV	AT3G12080.1	GTP-binding family protein			v		912
MKT265344_1_4_APOV	AT2G44760.1	dihydroorotate dehydrogenase (DUF3598)			v		1131
MKT265995_1_4	AT2G27120.1	DNA polymerase epsilon catalytic subunit	v	v			222
MKT267759_1_4	AT2G18030.1	Peptide methionine sulfoxide reductase family protein	v	v	v		759
MKT267794_1_4_APOV	AT5G39410.1	Saccharopine dehydrogenase			v		996
MKT268004_1_4_APOV	AT4G34140.10	D111/G-patch domain-containing protein			v		1437
MKT268009_1_4_APOV	AT3G27670.1	ARM repeat superfamily protein			v		1458
MKT271231_1_4_APOV	AT5G48830.2	phosphoglycolate phosphatase			v		1530
MKT271364_1_4	AT4G04970.1	glucan synthase-like 1	v	v			351
MKT272162_1_4_APOV	AT2G20980.1	minichromosome maintenance 10			v		1062
MKT272727_1_4_APOV	AT5G64860.1	disproportionating enzyme			v		957
MKT272827_1_4	AT3G59060.4	phytochrome interacting factor 3-like 6	v			v	2319
MKT273218_1_4_APOV	AT3G04160.3	U11/U12 small nuclear ribonucleoprotein			v		915
MKT273349_1_4_APOV	AT1G08750.3	Peptidase C13 family			v		990
MKT274838_1_4	AT5G53330.1	Ubiquitin-associated/translation elongation factor EF1B protein	v	v			423
MKT275800_1_4_APOV	AT3G17611.1	RHOMBOID-like protein 14			v		1491
MKT276078_1_4_APOV	AT5G52810.1	NAD(P)-binding Rossmann-fold superfamily protein			v		1119
MKT276084_1_4	AT1G77280.2	kinase with adenine nucleotide alpha hydrolases-like domain-containing protein	v	v			267
MKT277188_1_4	AT4G08685.1	Pollen Ole e 1 allergen and extensin family protein	v			v	495
MKT277229_1_4	AT1G33410.2	SUPPRESSOR OF AUXIN RESISTANCE1	v	v		v	744

MKT277271_1_4_APOV	AT1G50120.1	immunoglobulin			v		1509
MKT277532_1_4	AT5G66920.1	SKU5 similar 17	v	v			2040
MKT277935_1_4_APOV	AT5G56960.1	basic helix-loop-helix (bHLH) DNA-binding family protein			v		1455
MKT278004_1_4_APOV	AT1G55280.1	Lipase/lipooxygenase, PLAT/LH2 family protein			v		1488
MKT279186_1_4_APOV	AT3G09180.3	mediator of RNA polymerase II transcription subunit			v		1146
MKT279537_1_4	AT1G80410.1	tetratricopeptide repeat (TPR)-containing protein	v	v			702
MKT280150_1_4_APOV	AT2G14260.3	proline iminopeptidase			v		915
MKT281671_1_4_APOV	AT3G06950.1	Pseudouridine synthase family protein			v		1314
MKT282190_1_4	AT1G27680.1	ADPGLC-PPase large subunit	v	v			1116
MKT282250_1_4	AT3G02560.3	Ribosomal protein S7e family protein	v	v			453
MKT283198_1_4	AT3G26618.1	eukaryotic release factor 1-3	v	v			297
MKT283483_1_4	AT2G18990.1	thioredoxin-like/ATP-binding protein	v	v			438
MKT283955_1_4	AT1G22870.3	kinase family with ARM repeat domain-containing protein	v	v			567
MKT284160_1_4	AT4G35520.5	MUTL protein homolog 3	v	v			759
MKT285757_1_4	AT3G61500.2	BPS1-like protein	v	v			291
MKT286562_1_4_APOV	AT5G35670.1	IQ-domain 33			v		1122
MKT287698_1_4_APOV	AT1G10510.1	RNI-like superfamily protein			v		1260
MKT288332_1_4_APOV	AT4G27120.3	DDRGK domain protein			v		1143
MKT288424_1_4	AT3G47810.3	Calcineurin-like metallo-phosphoesterase superfamily protein	v			v	432
MKT290683_1_4	AT1G34070.1	Copia-like polyprotein/retrotransposon	v	v			207
MKT292559_1_4	AT5G56930.1	CCCH-type zinc finger family protein	v	v			255
MKT293201_1_4	AT5G64840.1	general control non-repressible 5	v	v		v	810
MKT293539_1_4	AT1G56570.2	Tetratricopeptide repeat (TPR)-like superfamily protein	v	v			225
MKT295011_1_4	AT4G15215.8	pleiotropic drug resistance 13	v	v			417
MKT295445_1_4_APOV	AT3G24080.4	KRR1 family protein			v		1482
MKT296549_1_4_APOV	AT5G44750.2	DNA-directed DNA polymerase			v		1143
MKT296836_1_4	AT1G47230.1	CYCLIN A3%3B4	v	v			360
MKT297546_1_4	AT3G56930.2	DHHC-type zinc finger family protein	v	v			471
MKT297810_1_4_APOV	AT1G50575.1	Putative lysine decarboxylase family protein			v		1422
MKT297825_1_4	AT1G43760.1	DNAse I-like superfamily protein	v	v			378
MKT298063_1_4	No_hit	No_hit	v	v			1296
MKT299474_1_4_APOV	AT3G63290.1	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein			v		1395
MKT300606_1_4_APOV	AT3G26085.4	CAAX amino terminal protease family protein			v		966
MKT301981_1_4_APOV	AT1G76280.2	Tetratricopeptide repeat (TPR)-like superfamily protein			v		1068
MKT302745_1_4	AT5G62570.4	Calmodulin binding protein-like protein	v	v			1086
MKT303404_1_4	AT4G08500.1	MAPK/ERK kinase kinase 1	v	v			843
MKT303711_1_4	AT2G38960.1	endoplasmic reticulum oxidoreductins 2	v	v			264
MKT304100_1_4_APOV	AT3G03790.1	ankyrin repeat family protein / regulator of chromosome condensation (RCC1) family protein			v		1629
MKT304375_1_4	AT5G37540.1	Eukaryotic aspartyl protease family protein	v	v			591
MKT305891_1_4	AT1G50200.2	Alanyl-tRNA synthetase	v	v			459
MKT306820_1_4	AT5G17250.1	Alkaline-phosphatase-like family protein	v	v			711
MKT307031_1_4_APOV	AT1G17665.1	CA-responsive protein			v		1104
MKT308263_1_4	AT3G52220.1	leukocyte immunoglobulin-like receptor family A protein	v	v		v	324
MKT308611_1_4	AT5G32470.1	heme oxygenase-like, multi-helical	v	v		v	549
MKT308778_1_4	AT3G24255.3	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	v	v			1335
MKT308997_1_4_APOV	AT5G23520.2	smr (Small MutS Related) domain-containing protein			v		1494
MKT310237_1_4_APOV	AT1G63160.1	replication factor C 2			v		1275
MKT311863_1_4_APOV	AT5G60540.1	pyridoxine biosynthesis 2			v		1005
MKT312086_1_4_APOV	AT1G01930.1	zinc finger protein-like protein			v		1452
MKT312515_1_4	AT1G19910.1	ATPase, F0/V0 complex, subunit C protein	v	v			459
MKT312523_1_4_APOV	AT5G08720.1	polyketide cyclase/dehydrase/lipid transporter			v		1464
MKT312769_1_4_APOV	AT5G41850.1	alpha/beta-Hydrolases superfamily protein			v		966
MKT314389_1_4	AT3G28480.1	Oxoglutarate/iron-dependent oxygenase	v	v			852
MKT314507_1_4	AT1G09795.1	ATP phosphoribosyl transferase 2	v			v	474
MKT314708_1_4	AT3G26480.2	Transducin family protein / WD-40 repeat family protein	v	v			255
MKT314787_1_4	AT2G04620.1	zinc transporter-like protein	v		v	v	2811
MKT315126_1_4	AT1G27595.1	symplekin	v	v			375

MKT315244_1_4_APOV	AT2G46060.2	transmembrane protein-like protein			v			918
MKT315917_1_4	AT1G14590.1	Nucleotide-diphospho-sugar transferase family protein	v	v				483
MKT316089_1_4	AT2G46900.1	transcription factor-like protein	v	v				939
MKT316544_1_4_APOV	AT5G03430.1	phosphoadenosine phosphosulfate (PAPS) reductase family protein			v			1293
MKT317772_1_4	AT2G04842.2	threonyl-tRNA synthetase, putative / threonine-tRNA ligase	v	v				882
MKT318012_1_4	AT1G48320.1	Thioesterase superfamily protein	v	v				411
MKT320490_1_4_APOV	AT3G15080.1	Polynucleotidyl transferase, ribonuclease H-like superfamily protein			v			1458
MKT322600_1_4	AT2G20420.1	ATP citrate lyase (ACL) family protein	v	v				735
MKT323905_1_4_APOV	AT5G12920.4	Transducin/WD40 repeat-like superfamily protein			v			1473
MKT325055_1_4	AT3G60740.3	ARM repeat superfamily protein	v	v				486
MKT325925_1_4	AT4G32200.2	DNA-binding HORMA family protein	v	v				267
MKT326621_1_4	AT3G24255.7	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	v	v				696
MKT328127_1_4	AT4G11280.1	1-aminocyclopropane-1-carboxylic acid (acc) synthase 6	v	v				240
MKT328764_1_4	AT3G15040.1	senescence regulator (Protein of unknown function, DUF584)	v				v	453
MKT331516_1_4_APOV	AT5G19970.1	GRAS family transcription factor family protein			v			1041
MKT332397_1_4	AT3G05390.1	S-adenosyl-L-methionine-dependent methyltransferase	v	v				393
MKT332424_1_4_APOV	AT3G10380.2	subunit of exocyst complex 8			v			972
MKT333354_1_4	AT4G24490.2	RAB geranylgeranyl transferase alpha subunit 1	v	v				678
MKT334782_1_4	AT3G61170.1	Tetratricopeptide repeat (TPR)-like superfamily protein	v	v				1029
MKT337520_1_4_APOV	AT5G48390.1	Tetratricopeptide repeat (TPR)-like superfamily protein			v			1422
MKT337557_1_4	AT5G43450.1	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	v	v				579
MKT339163_1_4	ATMG00750.1	GAG/POL/ENV polyprotein	v	v				1152
MKT341624_1_4_APOV	AT2G40760.1	Rhodanese/Cell cycle control phosphatase superfamily protein			v			975
MKT341643_1_4_APOV	AT1G19690.1	NAD(P)-binding Rossmann-fold superfamily protein			v			1287
MKT343704_1_4	AT1G07060.2	hypothetical protein	v	v				216
MKT344417_1_4	AT2G26140.1	FTSH protease 4	v	v			v	471
MKT345063_1_4	AT5G02780.3	glutathione transferase lambda 1	v	v				774
MKT346077_1_4_APOV	AT5G17240.2	SET domain group 40			v			1422
MKT346101_1_4	AT5G19900.5	PRLI-interacting factor	v	v				906
MKT346845_1_4_APOV	AT1G12370.1	photolyase 1			v			1632
MKT347521_1_4	AT1G21630.4	Calcium-binding EF hand family protein	v	v				1452
MKT348011_1_4_APOV	AT1G03687.1	DTW domain-containing protein			v			1005
MKT348468_1_4	AT5G14210.3	Leucine-rich repeat protein kinase family protein	v	v				573
MKT348660_1_4_APOV	AT5G04440.2	RAP release 2, galactose-binding-like domain protein, putative (DUF1997)			v			1089
MKT349073_1_4	AT1G16240.4	syntaxin of plants 51	v	v				597
MKT350500_1_4	AT2G45540.6	WD-40 repeat family protein / beige-like protein	v	v				1080
MKT351432_1_4	AT3G56960.2	phosphatidyl inositol monophosphate 5 kinase 4	v	v				495
MKT351705_1_4	AT4G31800.2	WRKY DNA-binding protein 18	v	v			v	1206
MKT351756_1_4_APOV	AT4G31460.1	Ribosomal L28 family			v			927
MKT351865_1_4	AT2G39750.1	S-adenosyl-L-methionine-dependent methyltransferases superfamily protein	v	v				1110
MKT353296_1_4_APOV	AT5G07380.6	hypothetical protein			v			984
MKT353714_1_4_APOV	AT5G64370.1	beta-ureidopropionase			v			1119
MKT354514_1_4	AT1G27530.1	ubiquitin-fold modifier-conjugating enzyme	v		v			648
MKT355030_1_4	AT5G66150.3	Glycosyl hydrolase family 38 protein	v	v				1062
MKT355367_1_4	AT4G05200.1	cysteine-rich RLK (RECEPTOR-like protein kinase) 25	v	v				474
MKT355607_1_4	AT4G02600.2	Seven transmembrane MLO family protein	v	v				1401
MKT358559_1_4_APOV	AT5G57160.1	DNA ligase IV			v			1041
MKT358844_1_4_APOV	AT3G04490.3	exportin-4 protein			v			1263
MKT358915_1_4	AT5G12200.1	pyrimidine 2	v	v				1626
MKT359827_1_4_APOV	AT5G35690.1	zinc metalloproteinase-like protein			v			1329
MKT359853_1_4	AT5G48760.2	Ribosomal protein L13 family protein	v	v				669
MKT362323_1_4	AT1G71070.1	Core-2/I-branching beta-1, 6-N-acetylglucosaminyltransferase family protein	v	v				660
MKT362454_1_4	AT1G50900.1	Ankyrin repeat family protein	v	v				423
MKT362594_1_4_APOV	AT2G33260.1	Tryptophan/tyrosine permease			v			1620
MKT363416_1_4_APOV	AT1G73180.2	Eukaryotic translation initiation factor eIF2A family protein			v			1074
MKT363585_1_4_APOV	AT4G27720.1	Major facilitator superfamily protein			v			1287
MKT363600_1_4	AT1G20650.1	Protein kinase superfamily protein	v	v				531

Appendix 28. Summary of the sequencing results and HybPiper statistics for assembly. The order listed is based on the concatenated ML tree order.

Sci. name	Read length	No. of Read pairs	No. of reads	No. of trimmed reads	Percent of trimmed reads (%)	Chloroplast reads	Percent chloroplast reads (%)	No. of reads on target	Percent reads on target (%)	No. of genes mapped	No. of genes with contigs	No. of genes with sequences	ParalogWarnings
Magnolia griffithii	151	580,890	1,161,780	1,098,256	94.5	352,003	30.3	339,596	29.2	501	490	488	12
Michelia baillonii	101	1,028,628	2,057,256	1,984,995	96.5	1,092,759	53.1	395,889	19.2	502	495	494	13
Michelia sirindhorniae	151	3,925,372	7,850,744	7,517,183	95.8	5,181,568	66.0	799,821	10.2	501	497	494	17
Michelia velutina	151	3,294,992	6,589,984	6,291,630	95.5	4,299,326	65.2	614,131	9.3	501	496	496	16
Michelia masticata	101	1,256,482	2,512,964	2,415,194	96.1	1,542,904	61.4	352,286	14.0	501	493	492	8
Michelia sphaerantha	101	2,772,138	5,544,276	5,344,889	96.4	3,959,060	71.4	506,022	9.1	500	495	495	12
Michelia doltsopa	101	2,190,207	4,380,414	4,205,485	96.0	2,615,487	59.7	653,837	14.9	503	495	493	14
Michelia lacei	101	1,726,999	3,453,998	3,319,294	96.1	2,044,134	59.2	528,205	15.3	502	497	496	14
Michelia salicifolia	151	1,786,122	3,572,244	3,455,826	96.7	2,034,737	57.0	690,069	19.3	503	497	496	10
Michelia martini	101	1,853,540	3,707,080	3,558,713	96.0	2,465,998	66.5	379,193	10.2	502	492	492	11
Michelia coriacea	101	1,311,727	2,623,454	2,510,984	95.7	1,191,501	45.4	586,727	22.4	502	494	492	13
Michelia ingrata	101	1,338,532	2,677,064	2,572,156	96.1	1,401,589	52.4	518,736	19.4	501	495	493	14
Michelia wilsonii	101	2,390,918	4,781,836	4,592,269	96.0	3,073,441	64.3	604,768	12.6	503	497	497	15
Michelia floribunda	101	1,094,258	2,188,516	2,115,684	96.7	1,112,710	50.8	473,904	21.7	502	497	496	15
Michelia chapensis	101	1,221,922	2,443,844	2,361,476	96.6	1,112,116	45.5	600,783	24.6	503	497	497	13
Michelia chapensis	101	978,736	1,957,472	1,887,132	96.4	1,064,275	54.4	367,745	18.8	502	492	492	13
Michelia hypolampra	101	1,729,187	3,458,374	3,327,842	96.2	2,322,361	67.2	421,615	12.2	501	494	492	12
Michelia viridipetala	151	1,214,944	2,429,888	2,282,742	93.9	1,259,876	51.8	339,148	14.0	502	491	490	20
Michelia balansae	101	1,224,430	2,448,860	2,367,607	96.7	1,270,970	51.9	501,048	20.5	503	496	494	12
Michelia guangxiensis	151	2,060,725	4,121,450	3,936,104	95.5	2,212,668	53.7	693,483	16.8	502	495	494	24
Michelia figo	101	2,193,144	4,386,288	4,211,682	96.0	3,127,793	71.3	409,069	9.3	502	492	489	7
Michelia shiluensis	101	1,208,731	2,417,462	2,333,996	96.5	1,408,541	58.3	408,638	16.9	502	493	493	10
Michelia odora	101	1,310,524	2,621,048	2,537,692	96.8	1,651,614	63.0	411,060	15.7	502	495	492	7
Michelia montana	101	3,268,088	6,536,176	6,322,827	96.7	4,635,548	70.9	707,599	10.8	501	496	496	14
Elmerrillia ovalis	151	1,545,200	3,090,400	2,991,654	96.8	2,012,840	65.1	447,956	14.5	500	494	493	7
Michelia compressa	101	544,134	1,088,268	1,047,199	96.2	310,200	28.5	351,333	32.3	502	493	492	11
Michelia macclurei	101	1,384,036	2,768,072	2,659,035	96.1	1,539,677	55.6	495,187	17.9	502	496	495	11
Michelia guangdongensis	101	475,968	951,936	917,430	96.4	307,291	32.3	300,792	31.6	501	491	489	8
Michelia maudiae	101	411,054	822,108	786,800	95.7	154,776	18.8	295,324	35.9	501	490	488	6
Michelia foveolata	101	741,676	1,483,352	1,424,007	96.0	651,131	43.9	340,960	23.0	500	493	491	9
Michelia cavaleriei	101	972,345	1,944,690	1,868,468	96.1	649,201	33.4	588,275	30.3	502	496	495	15
Magnolia elegans	151	943,744	1,887,488	1,815,345	96.2	846,252	44.8	499,792	26.5	502	494	493	14
Magnolia borneensis	151	719,139	1,438,278	1,325,177	92.1	888,581	61.8	203,677	14.2	495	408	388	0
Magnolia carsonii	151	946,854	1,893,708	1,828,702	96.6	844,110	44.6	529,848	28.0	502	492	488	7
Magnolia cathcartii	101	1,047,053	2,094,106	2,024,587	96.7	1,232,705	58.9	354,462	16.9	502	497	495	9
Magnolia zenii	101	1,302,541	2,605,082	2,527,817	97.0	1,733,775	66.6	379,768	14.6	503	498	497	14
Magnolia biondii	101	528,623	1,057,246	1,015,029	96.0	559,152	52.9	182,270	17.2	501	488	488	13
Magnolia amoena	101	1,268,290	2,536,580	2,462,083	97.1	1,582,313	62.4	432,121	17.0	503	497	496	12
Magnolia sinostellata	101	1,943,433	3,886,866	3,662,865	94.2	2,494,580	64.2	333,435	8.6	503	496	496	8

Magnolia stellata	101	3,190,014	6,380,028	6,167,883	96.7	4,525,380	70.9	700,153	11.0	503	499	499	20
Magnolia kobus	101	1,067,594	2,135,188	2,072,581	97.1	1,346,500	63.1	377,659	17.7	503	497	497	8
Magnolia salicifolia	101	934,947	1,869,894	1,784,994	95.5	1,008,389	53.9	372,902	19.9	502	498	496	12
Magnolia denudata	101	1,338,396	2,676,792	2,617,461	97.8	1,785,435	66.7	437,668	16.4	502	499	498	8
Magnolia cylindrica	101	937,247	1,874,494	1,820,665	97.1	1,181,311	63.0	317,995	17.0	502	497	495	9
Magnolia liliiflora	101	779,100	1,558,200	1,504,450	96.6	913,160	58.6	276,227	17.7	502	495	494	9
Magnolia sprengeri	101	1,217,693	2,435,386	2,340,211	96.1	1,593,722	65.4	300,018	12.3	503	495	494	8
Magnolia sargentiana	101	2,659,730	5,319,460	5,123,408	96.3	3,975,556	74.7	385,752	7.3	502	493	493	11
Magnolia campbellii	101	881,028	1,762,056	1,709,763	97.0	963,583	54.7	378,855	21.5	502	496	496	9
Magnolia dawsoniana	101	1,245,187	2,490,374	2,409,322	96.7	1,501,800	60.3	405,409	16.3	502	497	494	10
Magnolia acuminata var. *subcordata*	151	686,607	1,373,214	1,330,052	96.9	351,376	25.6	614,272	44.7	500	496	492	11
Magnolia acuminata	101	1,122,063	2,244,126	2,153,550	96.0	1,390,232	61.9	314,527	14.0	503	490	488	7
Kmeria duperreana	151	1,266,970	2,533,940	2,434,592	96.1	1,213,446	47.9	567,433	22.4	501	496	490	16
Kmeria septentrionalis	101	988,044	1,976,088	1,914,149	96.9	1,148,035	58.1	346,505	17.5	499	488	483	6
Magnolia nitida var. *lotungensis*	101	3,253,760	6,507,520	6,297,108	96.8	5,028,810	77.3	458,545	7.0	498	488	485	8
Pachylarnax praecalva	151	196,306	392,612	350,808	89.4	206,738	52.7	67,440	17.2	442	161	139	0
Magnolia kachirachirai	101	2,568,316	5,136,632	4,938,158	96.1	3,780,651	73.6	379,886	7.4	499	489	484	14
Magnolia sinica	101	978,160	1,956,320	1,878,249	96.0	897,597	45.9	407,330	20.8	500	487	485	9
Magnolia nitida	101	1,027,502	2,055,004	1,970,866	95.9	1,267,793	61.7	291,479	14.2	500	487	484	7
Magnolia poasana	151	2,397,775	4,795,550	4,605,165	96.0	3,029,269	63.2	621,017	12.9	498	490	487	14
Magnolia panamensis	101	3,144,793	6,289,586	6,083,382	96.7	4,183,244	66.5	794,145	12.6	499	492	489	14
Magnolia sharpii	101	3,606,811	7,213,622	6,981,328	96.8	5,075,975	70.4	743,571	10.3	498	491	488	12
Magnolia guatemalensis	151	3,796,936	7,593,872	7,329,910	96.5	4,970,436	65.5	929,549	12.2	498	490	488	16
Magnolia iltisiana	151	2,060,842	4,121,684	3,955,734	96.0	2,588,557	62.8	507,614	12.3	499	487	486	13
Magnolia grandiflora	151	3,423,887	6,847,774	6,591,704	96.3	3,930,954	57.4	1,134,719	16.6	500	496	495	30
Magnolia striatifolia	151	1,353,775	2,707,550	2,614,588	96.6	1,227,335	45.3	698,557	25.8	501	490	487	22
Magnolia schiedeana	101	811,967	1,623,934	1,536,764	94.6	692,556	42.6	404,721	24.9	501	488	486	12
Magnolia tamaulipana	101	718,649	1,437,298	1,388,779	96.6	743,784	51.7	296,819	20.7	500	485	482	9
Magnolia virginiana	101	2,460,782	4,921,564	4,741,280	96.3	3,796,481	77.1	306,338	6.2	500	487	484	12
Magnolia macrophylla	101	1,683,027	3,366,054	3,251,273	96.6	2,321,735	69.0	390,421	11.6	501	491	487	10
Magnolia macrophylla var. *ashei*	151	1,129,057	2,258,114	2,146,901	95.1	1,184,902	52.5	402,867	17.8	500	489	488	14
Magnolia dealbata	101	1,899,740	3,799,480	3,690,428	97.1	2,872,363	75.6	340,174	9.0	500	493	489	10
Magnolia championii	101	1,895,364	3,790,728	3,664,354	96.7	2,265,082	59.8	555,963	14.7	500	490	484	13
Magnolia coco	101	3,677,200	7,354,400	7,176,071	97.6	6,146,863	83.6	326,318	4.4	501	482	477	5
Magnolia phanerophlebia	101	1,151,309	2,302,618	2,217,025	96.3	1,400,518	60.8	346,843	15.1	498	487	479	11
Magnolia pterocarpa	101	1,607,876	3,215,752	3,095,273	96.3	1,127,980	35.1	782,851	24.3	500	480	470	8
Magnolia hodgsonii	151	1,013,627	2,027,254	1,954,342	96.4	763,610	37.7	668,792	33.0	498	492	483	17
Magnolia henryi	151	2,264,090	4,528,180	4,321,798	95.4	2,637,830	58.3	571,573	12.6	500	488	482	17
Magnolia albosericea	101	328,681	657,362	634,297	96.5	148,271	22.6	231,827	35.3	499	486	478	7
Magnolia liliifera	101	2,425,341	4,850,682	4,665,789	96.2	3,230,337	66.6	392,370	8.1	498	480	473	7
Magnolia delavayi	151	1,374,642	2,749,284	2,640,778	96.1	880,454	32.0	878,152	31.9	500	497	492	20
Magnolia pastazaensis	101	1,064,906	2,129,812	2,063,181	96.9	1,275,213	59.9	358,317	16.8	499	486	482	8
Magnolia equatorialis	151	1,279,865	2,559,730	2,399,149	93.7	1,362,110	53.2	356,067	13.9	499	472	471	4
Magnolia ovata	151	1,597,075	3,194,150	3,089,478	96.7	1,924,489	60.3	471,072	14.7	500	488	482	10
Magnolia dodecapetala	151	2,569,119	5,138,238	4,934,853	96.0	3,208,439	62.4	638,538	12.4	498	487	484	14
Magnolia kichuana	101	923,493	1,846,986	1,788,065	96.8	1,011,124	54.7	355,345	19.2	500	489	484	11
Magnolia zamorana	101	2,119,202	4,238,404	4,103,235	96.8	3,144,811	74.2	365,693	8.6	501	488	484	8
Magnolia mercedesiarum	151	1,187,462	2,374,924	2,283,666	96.2	1,299,775	54.7	430,818	18.1	499	487	484	11
Magnolia mindoensis	151	893,409	1,786,818	1,718,540	96.2	615,834	34.5	536,929	30.0	502	490	484	15
Magnolia mexicana	151	1,640,599	3,281,198	3,151,110	96.0	2,012,385	61.3	423,104	12.9	498	483	482	13
Manglietia conifera	101	1,495,639	2,991,278	2,893,318	96.7	2,080,921	69.6	326,745	10.9	500	491	487	12
Manglietia insignis	101	2,065,738	4,131,476	3,965,715	96.0	2,764,118	66.9	437,446	10.6	501	492	491	13
Manglietia duclouxii	101	1,043,861	2,087,722	2,013,619	96.5	1,260,168	60.4	324,477	15.5	501	491	488	12
Manglietia hookeri	101	701,418	1,402,836	1,355,652	96.6	495,349	35.3	448,789	32.0	501	494	492	10
Manglietia aromatica	101	1,203,654	2,407,308	2,261,852	94.0	1,404,181	58.3	367,173	15.3	501	486	484	5
Manglietia lucida	151	1,078,565	2,157,130	2,074,175	96.2	742,666	34.4	651,550	30.2	503	493	493	19

Manglietia grandis	101	1,566,156	3,132,312	3,016,692	96.3	1,674,883	53.5	571,100	18.2	501	495	493	13
Manglietia megaphylla	101	668,367	1,336,734	1,280,785	95.8	502,766	37.6	351,586	26.3	501	489	487	9
Manglietia rufibarbata	101	653,488	1,306,976	1,260,279	96.4	332,572	25.4	443,393	33.9	501	491	488	14
Manglietia ventii	101	755,648	1,511,296	1,464,744	96.9	630,055	41.7	424,647	28.1	501	487	483	8
Manglietia ovoidea	101	814,253	1,628,506	1,577,670	96.9	695,331	42.7	433,670	26.6	500	491	486	11
Manglietia kwangtungensis	101	1,970,630	3,941,260	3,783,862	96.0	2,551,325	64.7	472,848	12.0	498	489	488	13
Manglietia szechuanica	151	1,081,798	2,163,596	2,070,518	95.7	937,438	43.3	509,939	23.6	502	494	492	19
Manglietia pachyphylla	101	1,155,355	2,310,710	2,234,960	96.7	1,334,262	57.7	406,627	17.6	501	490	484	11
Manglietia fordiana	101	1,839,476	3,678,952	3,559,818	96.8	2,628,851	71.5	369,195	10.0	500	490	482	6
Manglietia glauca	151	546,568	1,093,136	1,054,905	96.5	228,056	20.9	500,262	45.8	501	494	485	16
Manglietia utilis	101	783,421	1,566,842	1,507,021	96.2	733,948	46.8	341,195	21.8	502	492	488	11
Manglietia caveana	151	677,997	1,355,994	1,310,192	96.6	370,767	27.3	588,605	43.4	501	491	488	13
Manglietia garrettii	101	1,258,574	2,517,148	2,427,018	96.4	1,285,385	51.1	509,337	20.2	500	490	489	11
Manglietia decidua	101	1,452,377	2,904,754	2,799,425	96.4	1,667,694	57.4	496,668	17.1	501	492	488	14
Magnolia obovata	101	1,135,426	2,270,852	2,195,788	96.7	1,290,572	56.8	426,314	18.8	500	490	488	8
Magnolia officinalis	101	1,068,709	2,137,418	2,045,622	95.7	1,359,268	63.6	295,812	13.8	503	487	486	6
Magnolia tripetala	101	1,629,624	3,259,248	3,115,105	95.6	1,879,926	57.7	471,382	14.5	499	492	492	13
Magnolia wilsonii	101	2,907,198	5,814,396	5,597,913	96.3	4,610,218	79.3	292,100	5.0	499	479	475	3
Magnolia globosa	101	5,534,412	11,068,824	10,647,972	96.2	8,733,359	78.9	540,858	4.9	499	494	493	8
Magnolia sieboldii	101	2,246,929	4,493,858	4,353,794	96.9	3,234,059	72.0	479,909	10.7	501	495	492	6
Magnolia sieboldii subsp. *sinensis*	101	3,005,417	6,010,834	5,840,853	97.2	4,526,952	75.3	555,677	9.2	500	494	492	6
Magnolia fraseri	101	2,728,047	5,456,094	5,259,406	96.4	3,875,484	71.0	496,970	9.1	501	489	486	14
Magnolia fraseri var. *pyrimidata*	101	1,016,423	2,032,846	1,958,514	96.3	1,116,762	54.9	380,325	18.7	500	486	483	7
Magnolia splendens	101	1,219,148	2,438,296	2,341,407	96.0	1,485,102	60.9	329,715	13.5	501	486	483	13
Magnolia portoricensis	101	1,302,076	2,604,152	2,511,880	96.5	1,545,348	59.3	412,806	15.9	500	489	486	12
Magnolia cubensis	151	1,162,539	2,325,078	2,246,189	96.6	1,210,652	52.1	541,636	23.3	501	492	490	13
Magnolia bankardiorum	101	1,198,484	2,396,968	2,320,725	96.8	1,105,395	46.1	577,739	24.1	500	492	491	14
Liriodendron chinense	101	1,986,711	3,973,422	3,812,294	95.9	2,885,569	72.6	269,190	6.8	478	430	424	9
Liriodendron tulipifera X *Liriodendron chinense*	101	2,884,250	5,768,500	5,594,752	97.0	4,444,788	77.1	339,703	5.9	486	432	428	8
Liriodendron tulipifera	101	3,336,849	6,673,698	6,413,814	96.1	5,136,328	77.0	331,414	5.0	486	436	425	9
Min.		196,306	392,612	350,808	89.4	148,271	18.8	67,440	4.4	442	161	139	0
Max.		5,534,412	11,068,824	10,647,972	97.8	8,733,359	83.6	1,134,719	45.8	503	499	499	30
Ave.		1,590,004	3,180,008	3,061,701	96.2	1,969,218	56.4	459,332	17.7	500	487	484	11

Appendix 29. Summary of the lengths recovered by the HybPiper for each sample against of coding sequences of 504 genes selected to design probes. The order listed is based on the concatenated ML tree order

Taxon name		Loci name	MKT001844_1_4_APOV	MKT002001_1_4_APOV	MKT005035_1_4_APOV	MKT006060_1_4_APOV	MKT008026_1_4_APOV	MKT012393_1_4_APOV	MKT012837_1_4_APOV	MKT014169_1_4_APOV	MKT014423_1_4_APOV	MKT014504_1_4_APOV	MKT018636_1_4_APOV	MKT021766_1_4_APOV	MKT021934_1_4_APOV	MKT023081_1_4_APOV	MKT025491_1_4_APOV	MKT026990_1_4_APOV	MKT027421_1_4_APOV	MKT028511_1_4_APOV
	Percentage captured	Total length of captured bp																		
Length of the reference for		443,988	1419	909	906	1500	1518	1572	927	1266	1014	1029	1557	960	1050	912	1206	1101	909	1689

each loci																					
Magnolia griffithii	89.02	395,226	1410	909	906	1497	1515	1569	774	876	885	846	1557	573	1083	810	1209	939	588	1437
Michelia baillonii	89.68	398,157	1410	909	915	1497	1515	1569	918	822	879	846	1503	663	1083	810	1074	897	687	1437
Michelia sirindhorniae	91.20	404,937	1416	909	921	1497	1518	1569	774	1140	885	981	1557	546	1083	918	1068	1098	729	1428
Michelia velutina	91.67	407,013	1410	909	918	1497	1515	1569	921	1119	972	978	1503	606	1083	810	1074	876	762	1437
Michelia masticata	88.89	394,677	1416	909	906	1497	1518	1437	927	375	873	846	1503	657	1005	912	1209	1014	723	1443
Michelia sphaerantha	90.32	400,998	1416	909	906	1497	1518	1257	927	1140	900	978	1503	642	1005	807	1074	1014	723	1443
Michelia doltsopa	91.87	407,892	1416	909	915	1497	1518	1569	927	1116	882	981	1557	663	1002	810	921	1074	762	1437
Michelia lacei	92.09	408,858	1416	909	906	1497	1518	1569	927	1119	933	846	1503	663	1005	912	1074	960	723	1437
Michelia salicifolia	88.90	394,704	1419	909	777	1497	1518	1569	927	981	885	888	1503	492	1083	840	1071	711	501	1437
Michelia martini	89.63	397,941	1413	906	921	1497	1518	1569	927	894	870	978	1560	564	1047	810	1209	1098	759	1272
Michelia coriacea	90.97	403,914	1416	909	918	1494	1518	1569	780	813	906	849	1503	621	1005	810	1209	954	729	1437
Michelia ingrata	90.52	401,889	1413	909	918	1497	1518	1572	927	1143	900	978	1497	615	1083	912	1074	975	762	1425
Michelia wilsonii	91.55	406,488	1416	909	915	1497	1518	1572	918	828	903	981	1557	654	1005	918	1209	477	651	1437
Michelia floribunda	90.25	400,680	1416	909	912	1497	1518	1569	774	828	885	984	1503	666	1083	1011	1074	840	720	1419
Michelia chapensis	91.09	404,445	1419	909	915	1497	1518	1569	927	1140	975	795	1521	660	1005	912	1209	1065	723	1380
Michelia chapensis	88.65	393,606	1416	909	915	1497	1332	1569	927	816	822	846	1503	663	1005	735	1209	1107	723	1380
Michelia hypolampra	88.64	393,558	1416	909	915	1248	1503	1569	780	813	819	981	1503	555	1083	810	1074	717	642	1374
Michelia viridipetala	87.08	386,628	1416	909	921	1389	1515	1470	774	543	762	798	1557	513	1050	915	1074	1098	687	1272
Michelia balansae	90.58	402,159	1416	909	894	1497	1515	1572	927	1071	885	846	1503	579	1083	807	1074	1104	759	1488
Michelia guangxiensis	89.47	397,227	1416	996	759	1497	1515	1569	630	1035	861	978	1557	564	1083	915	801	753	690	1269
Michelia figo	88.12	391,251	1416	909	906	1497	1515	1569	774	768	828	846	1557	615	1083	810	1056	975	444	1437
Michelia shiluensis	90.07	399,879	1416	909	858	1497	1521	1569	927	813	903	981	1506	633	1083	810	1209	1098	696	1437
Michelia odora	89.23	396,162	1416	909	813	1497	1518	1386	927	831	900	846	1503	591	1083	810	1074	480	279	1437
Michelia montana	91.07	404,352	1416	906	912	1497	1518	1572	927	1056	819	978	1557	660	1083	918	1074	762	720	1437
Elmerrillia ovalis	87.73	389,496	1197	909	927	1386	1515	1569	780	969	747	978	1425	453	1083	735	1068	708	735	1365
Michelia compressa	89.68	398,160	1416	909	918	1338	1500	1635	798	759	804	978	1491	585	1083	810	1074	1089	759	1437
Michelia macclurei	89.78	398,628	1335	909	912	1497	1518	1566	774	936	903	978	1503	624	1083	735	1209	954	690	1428
Michelia guangdongensis	86.22	382,812	1413	909	906	1497	1518	1566	774	441	819	846	1503	651	1005	756	1128	258	501	1428
Michelia maudiae	87.48	388,419	1413	909	915	1497	1515	1572	774	471	819	849	1557	513	1083	810	1209	1098	576	1437
Michelia foveolata	87.93	390,387	1416	909	906	1338	1518	1569	774	732	804	846	1503	639	1005	810	1074	771	759	1437
Michelia cavaleriei	91.35	405,564	1416	909	912	1497	1515	1572	927	1032	927	975	1503	663	1083	912	1068	825	696	1428
Magnolia elegans	89.07	395,466	1413	906	909	1497	1503	1326	780	1059	756	888	1500	204	1047	828	1071	894	639	1701
Magnolia borneensis	29.31	130,152	273	279	465	159	690	252	0	450	0	315	468	0	489	126	858	705	126	306
Magnolia carsonii	87.53	388,605	1413	906	741	1344	1503	1458	774	972	825	957	1425	618	1005	732	1068	408	813	1689
Magnolia cathcartii	89.50	397,374	1413	909	915	1497	1500	1569	927	753	882	1026	1557	513	1005	810	1206	621	759	1677
Magnolia zenii	92.22	409,467	1413	909	906	1500	1518	1569	927	1143	882	1020	1503	573	1053	807	1071	1101	510	1686
Magnolia biondii	79.62	353,490	570	909	777	1347	1026	1206	585	249	282	726	1155	513	1053	735	735	522	741	1620
Magnolia amoena	93.00	412,893	1407	909	897	1497	1518	1569	927	762	882	951	1503	669	1053	807	1071	1104	684	1686
Magnolia sinostellata	92.82	412,098	1416	909	906	1500	1518	1569	780	951	939	1029	1557	654	1053	807	1071	1101	756	1686
Magnolia stellata	93.83	416,574	1419	909	906	1500	1518	1569	927	831	918	1029	1557	660	1005	807	1065	984	762	1689
Magnolia kobus	92.42	410,328	1419	909	906	1500	1518	1569	927	942	885	939	1503	654	1050	915	1071	981	591	1689
Magnolia salicifolia	92.28	409,725	1416	909	897	1347	1503	1569	927	990	888	1029	1503	546	1005	807	1071	1008	651	1686
Magnolia denudata	89.88	399,072	1146	906	906	1236	1503	1569	780	999	882	975	1503	510	1050	810	1065	930	687	1686
Magnolia cylindrica	88.51	392,973	1416	909	906	1500	1518	1569	927	510	735	1029	1425	312	1053	735	1059	792	630	1686
Magnolia liliiflora	87.83	389,949	1416	909	906	1077	1518	1437	780	792	885	981	1503	558	741	810	1206	846	399	1686
Magnolia sprengeri	88.68	393,723	1413	783	906	1347	1518	1437	774	1020	483	1020	1425	642	741	765	1065	1050	732	1686
Magnolia sargentiana	89.65	398,019	1413	906	906	1497	1518	1566	774	720	909	975	1503	633	1047	810	1215	750	399	1695
Magnolia campbellii	90.52	401,913	1413	906	906	1500	1518	1569	780	1026	885	894	1422	660	1005	735	1215	870	687	1695
Magnolia dawsoniana	90.79	403,098	1416	909	906	1431	1518	1569	927	1050	888	975	1503	513	1035	810	1074	1011	621	1689
Magnolia acuminata var. *subcordata*	88.87	394,563	1416	909	912	1497	1515	1569	927	822	882	882	1503	537	1047	837	1071	870	660	1695
Magnolia acuminata	88.46	392,745	1416	909	903	1347	1515	1569	780	774	921	975	1392	615	1047	735	1071	903	585	1695
Kmeria duperreana	89.71	398,310	1416	777	906	1476	1503	1566	918	615	708	957	1422	591	1047	915	1074	912	756	1818
Kmeria septentrionalis	87.73	389,502	1416	624	924	1476	1518	1569	918	561	708	861	1263	519	1020	735	1209	678	747	1689
Magnolia nitida var. *lotungensis*	87.14	386,889	1413	786	894	1497	1350	1569	918	756	804	990	1500	588	1020	735	1032	621	690	1695
Pachylarnax praecalva	5.78	25,641	0	0	0	0	0	93	0	0	0	159	0	0	255	0	162	0	0	177
Magnolia kachirachirai	88.67	393,669	1410	909	912	1497	1503	1569	927	723	804	996	1497	507	1020	810	1188	987	762	1686
Magnolia sinica	88.82	394,338	1413	909	906	1494	1515	1569	780	444	801	981	1389	606	1098	834	1182	1059	756	1677
Magnolia nitida	87.56	388,776	1413	909	918	1344	1515	1509	780	771	747	942	1500	366	978	735	1047	1116	486	1695
Magnolia poasana	89.86	398,964	1401	909	906	1497	1506	1569	927	972	801	909	1500	663	1011	912	1209	1029	879	1689
Magnolia panamensis	90.75	402,924	1401	909	906	1497	1506	1569	927	855	801	978	1500	666	1020	810	1068	951	879	1689
Magnolia sharpii	90.35	401,163	1401	909	906	1473	1506	1569	780	1143	867	885	1500	663	1020	810	1068	975	879	1689
Magnolia guatemalensis	89.89	399,114	1404	909	906	1473	1506	1569	780	1050	804	978	1500	597	1020	810	1209	651	810	1689
Magnolia iltisiana	88.53	393,072	1401	909	906	1497	1506	1569	780	825	885	909	1500	675	978	912	1068	678	804	1689
Magnolia grandiflora	89.73	398,376	1407	906	912	1491	1521	1569	780	1140	804	951	1497	621	1020	876	1059	735	879	1686
Magnolia striatifolia	88.60	393,369	1407	906	912	1470	1521	1569	780	756	804	909	1551	552	1020	771	1059	858	879	1698

Magnolia schiedeana	88.63	393,486	1416	906	996	1344	1521	1569	780	555	900	906	1497	654	1020	735	1059	951	750	1662
Magnolia tamaulipana	85.81	380,967	1407	783	870	1497	1521	1569	780	732	528	882	1557	564	1020	735	1074	951	747	1824
Magnolia virginiana	87.73	389,526	1416	909	903	1497	1518	1437	780	699	885	888	1497	609	1020	810	1209	885	732	1698
Magnolia macrophylla	89.18	395,949	1410	909	843	1344	1515	1569	927	630	882	978	1503	675	741	810	1062	939	756	1692
Magnolia macrophylla var. *ashei*	89.02	395,217	1410	909	912	1236	1515	1569	927	696	822	981	1212	669	1020	735	903	954	474	1692
Magnolia dealbata	87.75	389,619	1407	909	777	1347	1500	1569	780	873	816	933	1503	570	741	810	1062	390	405	1692
Magnolia championii	88.53	393,078	1281	906	882	1497	1518	1569	780	795	804	981	1440	657	1047	810	1071	630	759	1686
Magnolia coco	84.42	374,823	1275	906	660	1407	1518	1506	780	543	804	846	1440	363	1020	702	1203	837	756	1686
Magnolia phanerophlebia	86.00	381,816	1416	786	912	1497	1518	1437	780	477	942	936	1497	618	1047	702	1200	840	759	1674
Magnolia pterocarpa	83.64	371,340	1410	786	879	1497	1293	1569	912	1002	885	981	1425	513	876	837	1056	636	729	1653
Magnolia hodgsonii	86.90	385,824	1416	783	870	1467	1503	1530	798	906	885	978	1497	483	1005	735	1152	627	759	1638
Magnolia henryi	87.99	390,666	1416	786	909	1497	1518	1542	798	855	1014	981	1518	660	1020	735	1065	819	762	1638
Magnolia albosericea	83.26	369,672	1413	780	807	1368	1503	1569	780	312	729	918	1329	453	1020	810	1212	549	690	1680
Magnolia liliifera	85.14	378,024	1416	786	912	1497	1518	1575	780	783	738	888	1476	462	909	810	1206	1098	684	1686
Magnolia delavayi	90.32	401,001	1332	906	885	1497	1503	1569	780	801	885	981	1497	576	1020	702	1068	624	852	1686
Magnolia pastazaensis	86.33	383,286	1416	903	777	1248	1509	1512	798	999	672	975	1452	549	906	735	1203	690	759	1698
Magnolia equatorialis	82.42	365,940	1416	906	774	1410	1524	1503	798	771	648	975	1275	351	906	912	1203	495	759	1701
Magnolia ovata	87.30	387,615	1416	897	774	1341	1512	1533	798	1176	762	885	1503	495	906	735	1074	771	822	1626
Magnolia dodecapetala	89.91	399,168	1416	906	888	1341	1524	1644	846	1035	840	975	1500	549	864	735	1074	939	879	1698
Magnolia kichuana	88.63	393,498	1416	903	990	1341	1521	1650	798	1158	843	885	1503	549	906	735	1074	609	810	1626
Magnolia zamorana	87.79	389,760	1416	903	906	1341	1524	1566	798	849	771	975	1452	549	906	843	1197	294	759	1698
Magnolia mercedesiarum	88.57	393,225	1416	903	909	1341	1524	1650	798	1071	798	975	1509	549	906	735	1197	714	759	1626
Magnolia mindoensis	89.03	395,271	1416	903	906	1341	1524	1644	927	1089	759	972	1452	549	906	837	1203	123	882	1701
Magnolia mexicana	87.66	389,217	1416	903	879	1233	1509	1566	930	876	885	879	1452	549	1020	810	1041	819	762	1698
Manglietia conifera	87.26	387,405	1404	909	906	1497	1503	1560	798	666	801	888	1395	546	1020	918	1011	936	471	1683
Manglietia insignis	89.31	396,534	1401	909	909	1497	1518	1560	798	975	882	888	1395	603	1020	810	1092	1098	492	1683
Manglietia duclouxii	86.87	385,683	1416	909	912	1500	1503	1560	798	516	954	888	1497	285	1020	810	1098	894	657	1698
Manglietia hookeri	88.33	392,166	1404	918	906	1500	1503	1560	798	507	858	969	1497	513	1020	840	1035	951	588	1683
Manglietia aromatica	85.44	379,350	1404	909	903	1500	1518	1560	798	651	885	888	1425	435	1020	735	1107	678	741	1683
Manglietia lucida	89.52	397,461	1416	909	906	1500	1503	1569	780	762	819	978	1497	603	1020	735	1098	975	666	1680
Manglietia grandis	89.64	397,977	1404	909	909	1350	1518	1560	798	651	963	888	1497	660	1020	915	1170	969	732	1683
Manglietia megaphylla	87.99	390,672	1416	909	906	1500	1503	1566	927	696	960	972	1557	516	741	735	1035	783	588	1683
Manglietia rufibarbata	87.93	390,402	1404	909	906	1500	1518	1560	798	678	963	972	1386	603	1020	810	1113	912	492	1683
Manglietia ventii	86.60	384,507	1416	909	906	1500	1503	1569	927	441	855	975	1320	564	1020	918	1170	627	735	1683
Manglietia ovoidea	87.96	390,540	1416	909	909	1500	1500	1569	918	699	885	969	1497	585	1020	735	1170	672	759	1683
Manglietia kwangtungensis	89.72	398,340	1404	903	909	1500	1518	1569	798	648	936	972	1497	603	1047	918	1035	1083	726	1698
Manglietia szechuanica	88.87	394,554	1404	906	906	1500	1518	1446	798	753	882	888	1557	603	1020	918	1035	1095	393	1683
Manglietia pachyphylla	88.14	391,332	1404	909	906	1500	1518	1572	927	648	885	888	1431	663	1020	810	1185	909	570	1686
Manglietia fordiana	87.17	387,006	1404	909	912	1500	1524	1569	780	648	897	972	1497	588	1020	735	1035	549	483	1701
Manglietia glauca	87.15	386,943	1404	909	906	1500	1500	1569	780	876	804	885	1497	408	1050	891	1185	621	600	1689
Manglietia utilis	88.50	392,949	1362	909	822	1500	1515	1437	927	498	801	888	1431	603	978	735	1185	852	684	1698
Manglietia caveana	86.83	385,536	1416	909	909	1503	1500	1569	798	894	885	858	1440	546	735	807	1170	819	666	1617
Manglietia garrettii	88.66	393,642	1404	909	909	1500	1515	1569	939	792	882	972	1407	615	1020	771	1035	822	402	1683
Manglietia decidua	89.41	396,966	1413	909	903	1500	1518	1572	780	774	882	945	1497	597	1047	810	1035	957	759	1689
Magnolia obovata	88.94	394,866	1413	909	810	1497	1503	1566	927	693	933	978	1425	603	1020	810	1113	738	588	1542
Magnolia officinalis	86.84	385,581	1413	909	624	1497	1503	1437	927	483	882	936	1431	324	1020	810	1098	837	393	1698
Magnolia tripetala	91.13	404,592	1416	909	810	1488	1503	1569	927	756	921	987	1425	603	1020	810	1065	1224	780	1698
Magnolia wilsonii	81.45	361,650	1416	909	906	1500	1512	1569	807	285	804	930	1263	312	1005	735	963	1089	402	1698
Magnolia globosa	90.21	400,530	1413	906	906	1500	1515	1569	780	687	1008	984	1497	642	1005	810	1110	861	501	1698
Magnolia sieboldii	89.48	397,293	1416	909	906	1497	1515	1437	780	645	747	927	1497	669	978	810	1170	909	723	1710
Magnolia sieboldii subsp. *sinensis*	89.12	395,682	1416	909	906	1500	1515	1500	780	192	777	909	1497	675	978	810	1035	762	756	1710
Magnolia fraseri	89.44	397,113	1416	906	912	1464	1521	1569	927	693	945	978	1497	663	975	873	1170	930	672	1353
Magnolia fraseri var. pyrimidata	88.81	394,284	1416	906	741	1497	1521	1446	927	762	885	981	1497	582	1047	876	963	927	669	1704
Magnolia splendens	88.00	390,720	1401	909	915	1497	1518	1503	798	654	804	948	1497	570	1020	810	1206	957	759	1692
Magnolia portoricensis	88.00	390,714	1404	909	918	1497	1518	1503	798	366	996	948	1560	570	1017	918	1071	954	759	1692
Magnolia cubensis	87.94	390,459	1404	909	912	1497	1521	1503	798	750	813	882	1497	570	1020	798	1206	684	759	1626
Magnolia bankardiorum	90.00	399,582	1404	906	906	1497	1521	1503	780	861	903	906	1425	570	1020	1011	1065	1047	759	1824
Liriodendron chinense	71.10	315,678	1365	786	612	1500	1503	1329	774	192	552	384	1083	174	744	702	1185	768	279	702
Liriodendron tulipifera X *Liriodendron chinense*	69.89	310,314	957	786	471	1389	1503	1446	774	192	642	744	1107	204	744	735	1185	768	279	666
Liriodendron tulipifera	72.84	323,388	1203	903	984	1500	1503	1575	810	192	552	792	1107	312	915	702	1185	711	279	822
Ave.	87.16	386,983	1372	882	873	1432	1486	1520	824	774	826	917	1449	555	992	799	1095	840	663	1570

Appendix 29. (Continued)

Taxon name	MKT033924 _1_4_APOV	MKT037336 _1_4_APOV	MKT040158 _1_4_APOV	MKT041541 _1_4_APOV	MKT043957 _1_4_APOV	MKT044207 _1_4_APOV	MKT048020 _1_4_APOV	MKT049010 _1_4_APOV	MKT049651 _1_4_APOV	MKT049974 _1_4_APOV	MKT050498 _1_4_APOV	MKT052244 _1_4_APOV	MKT054033 _1_4_APOV	MKT054141 _1_4_APOV	MKT055672 _1_4_APOV	MKT058473 _1_4_APOV	MKT059069 _1_4_APOV	MKT059496 _1_4_APOV	MKT062415 _1_4_APOV	MKT063650 _1_4_APOV	MKT064181 _1_4_APOV	MKT065092 _1_4_APOV	MKT065135 _1_4_APOV
Length of the reference for each loci	1023	1290	1095	1557	963	1137	1524	1086	1143	1101	1086	1317	963	1659	1002	924	984	1068	960	1053	1362	1335	1188
Magnolia griffithii	1023	1011	1098	1497	963	1050	1527	735	1023	1098	939	1314	963	1134	1002	927	699	948	891	1053	690	1335	1188
Michelia baillonii	1020	1011	960	1497	963	1044	1527	1086	1104	1104	939	1314	963	1356	1002	927	699	1065	828	909	813	1335	1188
Michelia sirindhorniae	1023	1011	981	1536	963	1140	1563	1086	1107	1050	984	1314	963	1464	1002	927	684	930	828	1053	1056	1335	1182
Michelia velutina	1023	1011	1056	1545	963	480	1524	1086	1104	1104	1080	1317	963	1305	1002	930	699	1059	828	1053	1251	1335	1188
Michelia masticata	1023	1011	768	1542	963	696	1524	1002	1104	1104	1068	1317	963	1374	1002	930	684	1065	828	1053	756	1335	1185
Michelia sphaerantha	1023	1011	1056	1542	963	1140	1524	1086	1104	1104	972	1317	963	1371	1002	930	684	1065	828	1053	1059	1239	1188
Michelia doltsopa	1023	1011	1056	1542	963	1044	1524	1086	1104	1068	1077	1317	963	1551	1002	930	699	1065	828	1053	1059	1335	1188
Michelia lacei	1023	1011	1056	1542	963	1134	1524	1083	1104	1098	1080	1317	963	1542	1002	930	699	1062	828	1053	1068	1335	1188
Michelia salicifolia	1023	1011	927	1542	912	1140	1398	1086	1104	1095	939	1317	963	966	1002	924	690	1065	828	1050	1134	1335	1188
Michelia martini	1023	1011	1065	1542	963	885	1890	1086	1023	1098	996	1317	960	1251	1002	864	699	1065	825	909	999	1335	1188
Michelia coriacea	1023	1011	1095	1542	963	1140	1524	1086	1104	1062	1086	1317	963	1341	1002	924	699	1065	828	771	1065	1335	1188
Michelia ingrata	1023	1011	1095	1545	963	1134	1524	1086	1104	1104	1089	1317	963	1539	1002	864	699	1062	816	1053	1068	1335	1188
Michelia wilsonii	1023	1011	1041	1545	963	1140	1524	1083	1104	1098	1008	1317	963	1365	1002	864	699	1065	816	909	1065	1335	1188
Michelia floribunda	1023	1011	948	1545	963	1143	1524	1086	1104	1098	999	1317	963	1344	1002	930	699	1065	828	771	1080	1335	1188
Michelia chapensis	1023	1011	1056	1542	963	1146	1521	1083	1104	1098	993	1317	963	1653	1002	930	690	1065	825	909	1065	1335	1188
Michelia chapensis	1023	1011	948	1545	963	1050	1524	1083	1104	1098	1074	1317	963	1371	1002	930	690	1065	825	771	1071	1233	1188
Michelia hypolampra	1023	1011	1095	1545	963	1137	1524	1083	1104	1098	924	1317	963	1317	1002	930	699	1065	828	843	897	1335	1188
Michelia viridipetala	1023	1011	1053	1542	957	897	1548	1002	1107	1098	753	1212	996	1035	1002	921	699	1065	771	909	1065	1335	1188
Michelia balansae	1023	1011	1005	1542	957	1140	1542	1086	1107	1098	972	1317	948	1524	1002	921	699	1065	636	909	1050	1335	1188
Michelia guangxiensis	1023	1011	1002	1542	963	981	1548	1086	1104	1101	1026	1317	939	1374	1002	927	699	1065	819	1053	1065	1335	1188
Michelia figo	1023	1011	765	1386	897	978	1410	1086	1023	1101	1047	1317	963	1281	1002	930	771	891	828	771	1065	1335	1188
Michelia shiluensis	1023	1011	1002	1542	963	1134	1518	1086	1104	1098	936	1317	963	1518	1002	930	699	1065	816	771	1065	1161	1188
Michelia odora	1023	1011	927	1542	963	963	1779	1086	1107	978	939	1317	963	1359	1002	930	699	1065	816	771	1065	1335	1188
Michelia montana	1023	1011	1056	1545	963	1143	1524	1086	1107	1104	1083	1305	963	1374	1002	930	699	1065	828	909	1065	1335	1188
Elmerrillia ovalis	1023	1011	966	1545	963	1140	1461	1086	1107	1101	972	1317	963	687	1002	924	771	1065	831	1023	768	1335	1188
Michelia compressa	1023	1290	972	1545	963	1140	1524	1086	1107	1104	1086	1317	963	1743	1002	930	690	1041	816	771	999	1335	1188
Michelia macclurei	1023	1011	1041	1542	963	1080	1521	1086	1107	1095	1047	1317	963	936	1002	930	699	1065	828	918	591	1335	1188
Michelia guangdongensis	1023	1011	1083	1536	963	888	1410	1002	1107	1089	972	1317	963	1347	1002	930	429	1065	828	909	786	1335	1188
Michelia maudiae	1023	1011	717	1320	963	1137	1521	645	1107	1098	993	1317	930	999	1002	930	699	1065	816	909	1056	1335	1188
Michelia foveolata	1020	1011	996	1545	963	1137	1014	1002	1107	1107	1083	1317	963	1350	1002	930	684	1065	819	771	1068	1335	1188
Michelia cavaleriei	1023	1011	1095	1545	963	957	1521	1086	1107	1104	1083	1317	963	1371	1002	930	699	1065	828	1053	1068	1335	1188
Magnolia elegans	1023	1011	1035	1449	963	1137	1257	1086	1107	1098	993	1317	933	1407	1002	930	666	1038	825	1053	1062	1335	1179
Magnolia borneensis	531	483	159	219	384	237	384	72	261	117	114	315	159	696	654	180	174	369	294	486	264	945	0
Magnolia carsonii	1023	1182	945	1449	963	1137	1395	1086	1107	1098	939	1317	933	1335	1002	864	666	1041	786	1053	1065	1335	1173
Magnolia cathcartii	1023	1290	966	1554	897	1140	1524	1086	1107	1098	939	1317	963	1581	1002	930	669	1065	828	909	1065	1335	1179
Magnolia zenii	1023	1011	1056	1557	963	996	1515	1086	1107	1155	1083	1317	963	1521	1002	930	699	1065	891	1053	1029	1335	1188
Magnolia biondii	1023	828	1095	1272	849	885	1392	1086	825	1101	654	1074	621	1413	1002	783	204	870	501	618	822	1332	1188
Magnolia amoena	1023	1011	1071	1557	963	1134	1527	1086	1023	1101	1083	1317	963	1521	1002	930	699	1065	885	1053	1059	1335	1188
Magnolia sinostellata	1023	1011	1095	1557	897	1137	1524	1002	1107	1101	1083	1317	963	1353	1002	924	699	1068	885	1053	1050	1335	1188
Magnolia stellata	1023	1011	1095	1557	963	978	1527	1086	969	1155	1083	1317	963	1659	1002	924	699	1068	891	1053	1362	1335	1188
Magnolia kobus	1023	975	996	1503	963	1137	1440	1086	1107	978	939	1317	963	1386	1002	864	699	1068	891	1053	990	1218	1188
Magnolia salicifolia	1020	1011	1095	1557	963	1047	1524	1086	1107	1110	798	1317	963	1590	1002	930	699	1068	816	918	1071	1335	1188
Magnolia denudata	1023	1227	972	1509	963	1134	1395	1086	1107	978	864	1317	1074	1194	1002	864	699	1044	891	768	1059	1335	1188
Magnolia cylindrica	1023	1011	951	1557	963	1074	1398	1002	1107	1101	897	1317	954	1341	1002	930	699	948	699	705	993	1335	1188
Magnolia liliiflora	1023	1011	768	1557	849	957	1524	1002	1020	1101	939	1317	954	1032	1002	930	699	1068	675	771	705	1335	1188
Magnolia sprengeri	1002	1011	1044	1557	963	939	1527	1086	1023	1098	729	1287	810	1533	1002	930	699	1044	891	771	1059	1335	1188
Magnolia sargentiana	1023	1011	966	1557	963	1227	1527	1086	1107	1098	939	1317	963	789	1002	924	711	1044	828	909	1137	1335	1191
Magnolia campbellii	1023	1011	918	1542	963	1140	1398	1086	1107	1098	909	1317	963	1416	1002	930	699	1044	828	1053	993	1335	1188
Magnolia dawsoniana	1023	1011	1029	1557	963	1137	1518	1086	1107	1101	930	1317	963	1242	1002	930	699	1065	828	1029	696	1335	1188
Magnolia acuminata var. *subcordata*	1026	1011	1029	1443	963	1077	1284	1050	1107	1059	906	1317	1068	1509	1002	930	615	1065	828	903	696	1218	1185
Magnolia acuminata	1026	1290	768	1551	963	1050	1524	966	1107	1101	789	1317	819	1164	1002	807	699	1068	828	903	990	1335	1185
Kmeria duperreana	1023	1287	1089	1557	963	1050	1476	1086	1023	1095	939	1317	957	1167	1002	924	699	1098	828	1053	1056	1335	1188
Kmeria septentrionalis	1023	1290	1092	1548	963	1050	1410	1086	1023	1098	939	1317	957	1545	1002	924	699	1056	894	909	990	1335	1188
Magnolia nitida var. *lotungensis*	1023	1302	726	1557	912	1026	1521	1002	1107	1071	939	1317	963	984	1002	930	600	1065	825	909	1056	1335	1131
Pachylarnax praecalva	0	297	0	0	123	87	0	0	0	102	159	126	0	231	0	0	198	0	0	0	0	0	0
Magnolia kachirachirai	1023	1005	849	1545	912	1140	1527	1086	1086	1098	984	1317	963	1353	1002	882	594	1065	801	891	990	1335	1188

Magnolia sinica	1023	1284	936	1557	912	1140	1524	1086	1107	1092	978	1317	960	1404	1002	924	690	1065	825	909	924	1335	1188
Magnolia nitida	1023	828	918	1557	912	1050	1518	1086	1107	978	873	1317	963	1353	1002	924	690	1065	825	771	1059	1335	1188
Magnolia poasana	1023	1290	1038	1554	966	1140	1524	1083	1107	1098	1020	1317	933	1383	1002	855	699	1020	828	1053	1050	1335	1188
Magnolia panamensis	1023	1290	1038	1557	963	1110	1524	1083	1107	1098	939	1317	933	1113	1002	837	699	1020	828	1053	1125	1335	1188
Magnolia sharpii	1023	1290	915	1557	963	1035	1524	1086	1107	1095	939	1317	933	1335	1002	897	339	1023	828	1053	1050	1335	1188
Magnolia guatemalensis	1023	1290	951	1536	963	1140	1398	1086	1107	1095	987	1317	933	1557	1002	924	696	1020	828	1053	1047	1335	1188
Magnolia iltisiana	1023	1290	951	1557	963	1140	1524	1083	1107	1095	939	1317	933	1350	1002	855	699	1020	828	1053	1125	1335	1188
Magnolia grandiflora	1023	1095	921	1455	963	1140	1425	1086	1101	1095	1002	1317	960	1305	1002	687	699	1041	828	1023	993	1335	1188
Magnolia striatifolia	1023	1095	882	1557	963	1143	1527	1086	1107	1098	993	1317	963	1131	1002	924	711	1008	828	1053	1065	1146	1182
Magnolia schiedeana	1023	1224	903	1557	963	1140	1524	1083	1107	978	1083	1317	963	1158	1002	954	699	1056	828	1053	696	1335	1188
Magnolia tamaulipana	1023	1299	966	1557	963	1092	1527	1086	1107	1098	939	1317	963	975	1002	897	699	1020	828	771	744	1335	1188
Magnolia virginiana	1023	1296	714	1557	963	1140	1524	1002	1107	1098	972	1317	963	1341	1002	930	699	1044	828	861	963	1335	1188
Magnolia macrophylla	1023	1011	975	1551	897	711	1521	1002	1107	1098	1077	1314	960	1341	1002	930	699	1071	828	1050	990	1335	1188
Magnolia macrophylla var. *ashei*	1023	1290	1086	1551	897	1041	1521	1002	1107	1098	1077	1314	960	1320	1002	924	699	1068	828	1050	1137	1335	1131
Magnolia dealbata	1023	1011	801	1458	963	849	1515	1056	1107	1098	909	1314	960	1320	1002	930	699	1068	828	771	990	1335	1188
Magnolia championii	1023	1011	804	1554	963	1143	1389	1086	1107	1101	966	1296	864	1551	1002	930	699	1044	825	909	1044	1335	1188
Magnolia coco	1023	1290	282	1455	963	909	1383	1086	1107	1101	816	1296	864	1296	1002	930	699	1044	825	705	696	1335	1146
Magnolia phanerophlebia	1023	1011	903	1557	963	885	1155	1002	1023	1077	786	1293	738	1209	1002	930	696	1062	828	744	741	1335	1188
Magnolia pterocarpa	1023	1290	765	1239	912	1053	1527	1086	1107	1074	846	1317	708	1179	1002	864	699	1098	807	798	981	1335	1188
Magnolia hodgsonii	1023	1290	804	1557	912	1140	1284	1086	1107	1101	861	1317	855	1146	1002	924	699	1044	816	909	981	1335	1188
Magnolia henryi	1023	1011	966	1557	912	1140	1398	1086	1107	978	846	1317	825	1074	1002	930	771	1044	828	909	1053	1335	1188
Magnolia albosericea	1023	1158	831	1557	963	1062	1524	1086	1023	942	864	1317	819	1035	1002	930	699	1044	828	705	282	1263	1203
Magnolia liliifera	1023	1290	720	867	906	1140	1323	1089	1104	1101	873	1317	963	1602	1002	864	699	1017	822	909	486	1335	1158
Magnolia delavayi	1023	1290	1038	1557	963	1140	1554	1086	1107	939	933	1320	945	1371	1002	927	699	1065	828	1053	1131	1335	1191
Magnolia pastazaensis	1023	1290	858	1503	963	1047	1524	1086	1107	1032	939	1314	963	1521	1002	930	699	1047	804	909	744	1335	1188
Magnolia equatorialis	1023	1290	561	1554	963	1152	1524	1002	1023	705	513	1314	924	438	1002	930	348	1068	693	933	696	1335	1188
Magnolia ovata	1020	1302	711	1548	963	1035	1287	1086	1047	1035	996	1314	924	1497	1002	882	702	1047	804	909	990	1335	1188
Magnolia dodecapetala	1023	1290	996	1551	963	1140	1524	1086	1107	1038	993	1314	924	1323	1002	927	699	1068	804	909	1056	1335	1128
Magnolia kichuana	1023	1290	1029	1551	963	1050	1527	1086	1107	1035	1017	1314	963	1323	1002	930	702	1068	828	909	1056	1335	1188
Magnolia zamorana	1023	1290	843	1551	963	1140	1500	1002	1107	1032	987	1314	963	1323	1002	930	699	1047	804	909	990	1335	1188
Magnolia mercedesiarum	1023	1287	843	1554	963	1140	1524	1086	1107	1038	939	1314	963	1314	1002	861	699	1068	828	909	1053	1335	1188
Magnolia mindoensis	1029	1290	849	1554	963	1140	1524	1086	1107	1035	897	1314	963	1089	1002	930	699	1068	804	909	990	1335	1188
Magnolia mexicana	1023	1290	792	1557	963	1050	1521	1086	1107	1104	939	1212	963	1287	1002	930	714	1047	828	909	1056	1335	1188
Manglietia conifera	1023	1011	795	1536	963	1017	1524	999	1113	1098	939	1317	963	1578	1002	930	699	1044	828	915	477	1257	1185
Manglietia insignis	1023	1011	876	1437	963	1134	1524	1086	1029	1098	1002	1317	963	1584	1002	924	699	1044	828	768	1056	1257	1185
Manglietia duclouxii	1023	1296	1095	1437	963	990	1521	1086	1023	1098	852	1317	960	1575	1002	930	699	1044	801	771	696	1335	1185
Manglietia hookeri	1023	1290	987	1536	963	1134	1416	1083	1107	1098	1083	1317	1077	1569	1002	930	699	1041	645	906	1044	1335	1188
Manglietia aromatica	1023	1290	771	1536	963	1053	1527	1086	1023	1011	873	1317	954	1401	1002	930	699	1044	828	906	966	1257	1188
Manglietia lucida	1023	1290	885	1329	963	1140	1713	1086	1107	1098	1083	1317	960	1326	1002	807	699	1044	774	1017	807	1335	1185
Manglietia grandis	1023	1287	1095	1557	963	1140	1527	1086	1110	1098	924	1317	963	1395	1002	807	699	1044	648	771	1056	1257	1182
Manglietia megaphylla	1023	1290	984	1536	963	1140	1527	1002	1107	1098	984	1317	963	1398	1002	882	699	1044	828	918	990	1335	1188
Manglietia rufibarbata	1023	1290	921	1536	957	855	1416	1002	1107	1098	1029	1317	963	1566	1002	924	699	1044	774	906	1044	1335	1185
Manglietia ventii	1023	1290	864	1437	963	1083	1521	1002	1023	1098	939	1317	960	1401	1002	789	699	1044	828	771	696	1335	1185
Manglietia ovoidea	1023	1290	930	1437	897	1077	1398	1002	1107	1098	942	1317	963	1278	1002	930	699	1044	828	771	1056	1335	1185
Manglietia kwangtungensis	1023	1290	984	1551	963	984	1524	1002	1107	1092	1071	1317	963	1494	1002	924	699	1044	759	906	1056	1335	1185
Manglietia szechuanica	1023	1290	948	1536	963	1140	1527	1002	1107	1098	939	1317	963	1584	1002	930	699	1044	828	906	990	1335	1185
Manglietia pachyphylla	1023	1290	1044	1557	963	957	1527	1002	1107	1098	939	1206	963	1455	1002	924	699	1044	774	771	990	1335	1131
Manglietia fordiana	1020	1290	657	1509	963	1047	1881	1002	1107	1098	1017	1317	963	1332	1002	807	699	1044	828	906	990	1335	1131
Manglietia glauca	1023	1287	690	1428	912	1023	1413	1002	1107	1098	939	1317	963	1257	1002	852	699	1044	825	840	996	1335	1131
Manglietia utilis	1023	1287	1008	1449	963	1050	1524	1002	1107	1098	1029	1317	963	1572	1002	858	690	1044	648	906	1056	1335	1179
Manglietia caveana	1023	1011	918	1536	963	1236	1608	1002	1020	1098	939	1317	963	1566	1002	864	699	1044	648	1050	1056	1335	1179
Manglietia garrettii	1020	1080	909	1557	963	1140	1521	1002	1020	1107	654	1311	963	1563	1002	924	699	1044	945	906	1056	1335	1185
Manglietia decidua	1020	1290	1035	1518	963	1005	1524	1086	1086	1098	957	1317	963	1410	1002	930	699	1044	828	906	990	1335	1188
Magnolia obovata	1023	1290	984	1506	963	1041	1524	1002	1107	1080	939	1317	963	1356	1002	930	699	1044	825	906	1056	1335	1188
Magnolia officinalis	1023	1290	1092	1506	963	1137	1371	1002	1107	1098	936	1317	963	1035	1002	930	699	1044	825	675	990	1335	1185
Magnolia tripetala	1023	1290	1095	1551	963	1140	1521	1002	1107	1098	1038	1317	963	1479	1002	924	699	1044	828	1050	1110	1335	1188
Magnolia wilsonii	1017	1290	546	1326	897	804	1521	1002	1023	1080	771	1212	957	1350	1002	879	723	1035	591	771	477	1335	1185
Magnolia globosa	1020	1011	552	1557	963	1032	1524	1080	1107	1080	993	1290	1062	1560	1002	927	723	1065	822	909	1056	1335	1188
Magnolia sieboldii	1020	1290	480	1557	963	1140	1524	1086	1107	1080	798	1317	963	1146	1002	882	699	1044	894	909	1056	1335	1188
Magnolia sieboldii subsp. *sinensis*	1020	1290	555	1557	963	1140	1506	1086	1107	1080	939	1317	963	1587	1002	840	699	1044	828	909	1056	1335	1188
Magnolia fraseri	1023	1290	1095	1557	963	1050	1527	1002	1107	1095	1083	1317	963	1338	1002	924	699	1065	825	909	1077	1335	909
Magnolia fraseri var. pyrimidata	1023	1290	939	1557	963	1215	1527	1002	1107	1092	939	1317	963	1338	1002	924	699	1044	825	909	816	1335	909
Magnolia splendens	1023	984	942	1449	969	1137	1410	1086	1107	1020	939	1317	963	1179	1002	864	699	1044	819	1053	1071	1335	1188
Magnolia portoricensis	1023	1008	969	1449	969	1038	1524	1086	1107	1020	1080	1317	963	1032	1002	864	699	1044	816	909	846	1335	1188
Magnolia cubensis	1023	1299	960	1458	969	1137	1527	1008	1107	1017	936	1317	963	1032	1002	864	699	1044	819	909	984	1335	1188

Magnolia bankardiorum	1023	984	915	1449	966	1134	1524	1086	1107	1017	984	1317	963	1032	1002	762	699	1044	816	909	1062	1335	1188
Liriodendron chinense	1023	1269	819	1236	816	936	702	924	1023	1029	831	1236	903	969	1002	876	528	537	642	912	906	1326	1278
Liriodendron tulipifera X *Liriodendron chinense*	1023	1272	729	1515	846	1089	702	924	1107	948	831	1215	801	669	1002	876	522	558	858	747	906	1326	900
Liriodendron tulipifera	1023	1272	585	1161	849	936	702	1002	1107	834	828	1215	909	1023	1002	876	522	690	555	912	906	1326	978
Ave.	1011	1132	912	1487	939	1051	1456	1035	1074	1059	940	1290	933	1308	991	891	673	1023	799	903	957	1312	1157

Appendix 29. (Continued)

Taxon name	MKT065481 _1_4_APOV	MKT071108 _1_4_APOV	MKT072919 _1_4_APOV	MKT074080 _1_4_APOV	MKT075417 _1_4_APOV	MKT075942 _1_4_APOV	MKT076335 _1_4_APOV	MKT077005 _1_4_APOV	MKT077409 _1_4_APOV	MKT079447 _1_4_APOV	MKT081437 _1_4_APOV	MKT083367 _1_4_APOV	MKT083464 _1_4_APOV	MKT084780 _1_4_APOV	MKT086766 _1_4_APOV	MKT087636 _1_4_APOV	MKT089525 _1_4_APOV	MKT095133 _1_4_APOV	MKT095730 _1_4_APOV	MKT097815 _1_4_APOV	MKT099172 _1_4_APOV	MKT099416 _1_4_APOV	MKT102093 _1_4_APOV
Length of the reference for each loci	1128	984	1017	1335	1068	1503	1065	1191	1029	1404	1131	1404	1173	1302	1296	951	1134	1086	1212	948	1452	1371	996
Magnolia griffithii	1125	900	894	1020	1005	1398	957	1191	792	1311	1122	1365	1059	1302	1188	951	942	1002	1212	930	1125	1371	996
Michelia baillonii	1131	966	933	1020	1005	1398	549	1191	792	1332	1122	1305	1059	1299	1296	951	942	993	1212	900	1125	1371	996
Michelia sirindhorniae	1128	900	987	1020	1005	1398	1065	1191	1065	1113	1122	1365	1059	1296	1299	951	942	1059	1212	930	1317	1371	996
Michelia velutina	1125	966	1023	1020	1005	1395	993	1191	987	1305	1131	1404	1059	1302	1293	951	942	1062	1212	930	1404	1371	996
Michelia masticata	1080	966	759	891	1005	1398	990	1191	1068	1128	1122	1404	1047	1302	1185	951	942	948	1212	930	1239	1371	996
Michelia sphaerantha	1059	966	756	1020	1005	1398	990	1191	879	1194	1122	1404	1047	1302	1296	951	942	1062	1212	930	1281	1371	996
Michelia doltsopa	1128	966	1023	1380	1005	1398	957	1191	978	1401	1119	1404	1173	1302	1293	945	942	1062	1209	885	0	1371	996
Michelia lacei	1128	966	1023	1314	1005	1398	957	1191	1068	1401	1119	1365	1173	1302	1296	945	942	1050	1209	915	0	1371	996
Michelia salicifolia	900	966	1023	1020	948	1398	813	1191	792	1230	1062	1404	1173	1302	1296	945	942	936	1212	882	1320	1371	996
Michelia martini	1014	903	1017	1020	1005	1395	996	1191	1068	1227	1119	1344	1059	1302	1188	951	942	1035	1212	930	1251	1371	996
Michelia coriacea	1110	966	1023	1008	1005	1398	996	1191	876	1392	1122	1311	1059	1266	1185	951	942	1083	1212	942	1272	1371	996
Michelia ingrata	1122	966	1023	1020	1005	1398	858	1191	879	1389	1119	1365	1170	1302	1296	951	942	996	1212	900	1257	1371	993
Michelia wilsonii	1110	966	882	1020	1005	1398	957	1191	978	1398	1119	1404	1059	1302	1293	945	942	1062	1212	930	1269	1371	996
Michelia floribunda	1098	966	1017	1020	1005	1398	996	1191	795	1290	1122	1365	1044	1302	1188	945	942	1062	1212	900	1242	1371	996
Michelia chapensis	1128	966	1023	1020	1005	1398	888	1191	1068	1191	1107	1404	1170	1302	1296	951	942	1062	1113	900	1287	1371	996
Michelia chapensis	1128	966	1017	891	1005	1398	987	1191	1068	1317	1050	1404	1059	1302	1188	951	942	978	1212	930	1101	1371	993
Michelia hypolampra	1053	966	867	1020	1005	1398	996	1191	753	978	1053	1404	1059	1302	1188	951	852	1062	1110	900	1056	1371	993
Michelia viridipetala	1098	903	762	1020	1005	1419	993	1191	1068	1101	957	1041	1059	1302	1299	951	936	1026	1212	900	1092	1371	996
Michelia balansae	999	903	765	1020	1005	1398	996	1191	984	1113	1119	1365	1170	1302	1299	951	942	1062	1212	924	1287	1371	996
Michelia guangxiensis	1125	903	1008	1020	1005	1398	996	1191	1092	1179	1122	1302	1170	1302	1299	951	942	1062	1209	930	1233	1371	996
Michelia figo	1128	969	1017	1020	1005	1398	945	1191	876	1095	960	1155	1173	1302	1299	951	942	1068	1206	900	1104	1371	633
Michelia shiluensis	1077	903	984	1020	1005	1398	993	1191	792	1197	1119	1404	1155	1302	1293	951	942	1059	1206	894	1293	1371	990
Michelia odora	1077	903	765	891	1218	1398	996	1191	795	1314	1116	1308	1059	1302	1188	948	942	1059	1212	900	1269	1371	996
Michelia montana	1125	903	1029	1020	1005	1398	993	1191	795	1323	1122	1404	1170	1302	1296	951	942	1062	1212	930	1305	1371	996
Elmerrillia ovalis	1050	897	729	1020	933	1398	996	1191	795	1131	1071	1395	1176	1302	1299	951	942	1026	1212	894	1317	1371	996
Michelia compressa	1119	903	1017	1020	1005	1398	996	1191	879	1401	1122	1356	1032	1299	1290	942	942	987	1212	930	1287	1371	996
Michelia macclurei	1104	903	738	1020	1005	1398	993	1191	984	1287	1062	1404	1059	1302	1188	951	942	1029	1107	918	1269	1371	996
Michelia guangdongensis	948	1581	903	891	948	1398	996	1191	792	1050	1062	1404	1059	1302	1188	951	942	948	1212	900	1104	1371	996
Michelia maudiae	1044	903	855	891	1005	1398	816	1191	795	1326	1035	1392	1059	1302	1299	951	942	1059	1113	888	1248	1371	996
Michelia foveolata	1128	903	1023	1008	1005	1398	753	1191	795	1122	1122	1392	1158	1302	1293	951	942	1011	1212	885	1245	1371	996
Michelia cavaleriei	1089	903	990	1020	1005	1398	993	1191	879	1212	1122	1392	1089	1302	1197	951	942	1062	1113	930	1287	1371	996
Magnolia elegans	1029	969	1017	1008	1005	1398	969	1191	876	1185	1122	1401	1101	1302	1299	948	942	948	1206	906	1209	1371	996
Magnolia borneensis	273	1638	291	177	273	0	444	258	90	243	171	240	204	438	96	156	285	249	651	432	672	447	537
Magnolia carsonii	978	900	771	879	948	1398	1002	1209	789	1188	1131	1176	1059	1302	1296	951	942	948	1170	861	972	1371	996
Magnolia cathcartii	1053	969	1017	1008	1005	1398	996	1191	876	1209	1131	1365	1059	1302	1188	951	849	996	1212	822	1128	1371	996
Magnolia zenii	1128	903	1017	1386	1005	1398	996	1191	903	1353	1128	1272	1170	1302	1296	951	942	1029	1212	906	1278	1371	996
Magnolia biondii	1038	969	510	1149	765	1398	549	558	1002	432	486	792	807	1302	1296	951	852	948	702	825	1251	1371	633
Magnolia amoena	1128	969	1017	1020	1005	1398	996	1191	876	1305	1131	1344	1170	1302	1296	951	942	1086	1212	906	1251	1371	996
Magnolia sinostellata	1128	969	1017	1419	1005	1398	996	1191	780	1053	1131	1404	1173	1299	1296	951	942	1086	1119	906	1143	1371	996
Magnolia stellata	1128	969	1023	1404	1005	1398	744	1191	792	1290	1131	1404	1173	1302	1188	951	942	1086	1212	936	1242	1371	996
Magnolia kobus	1077	969	1005	1020	1005	1398	996	1191	792	1281	912	1359	1173	1302	1293	951	942	948	1212	906	1284	1371	996
Magnolia salicifolia	1125	969	1011	1392	1005	1398	957	1191	876	1329	1131	1404	1173	1302	1296	951	942	996	1212	906	1248	1371	996
Magnolia denudata	975	957	765	1020	1005	1398	996	1191	876	1311	1035	1365	1173	1302	1296	951	942	885	1212	876	1101	1371	996
Magnolia cylindrica	1125	903	1020	1020	948	1398	996	1191	876	1236	1065	1281	1173	1302	1296	951	942	1086	1107	768	1149	1371	846
Magnolia liliiflora	1128	969	861	1020	1002	1398	996	1191	876	942	837	984	1173	1302	1296	951	717	747	1005	936	1227	1371	930

Magnolia sprengeri	1128	903	897	891	933	1398	996	1191	876	894	1125	1182	1059	1302	1188	951	942	1029	1107	888	1029	1371	996
Magnolia sargentiana	1056	969	1017	1299	1002	1398	993	1191	1008	1233	987	1404	1173	1302	1296	951	942	1086	1095	930	1284	1371	996
Magnolia campbellii	1062	969	1017	1359	1002	1398	996	1191	795	1401	1131	1269	1059	1302	1296	951	942	987	1212	900	1242	1371	996
Magnolia dawsoniana	1056	969	1014	1254	1005	1398	954	1191	663	1401	987	1365	1059	1302	1296	951	942	1038	1107	900	1113	1371	996
Magnolia acuminata var. *subcordata*	963	969	894	1506	948	1398	993	1191	795	1398	1026	1365	1059	1302	1296	948	942	999	984	885	1236	1371	996
Magnolia acuminata	1128	969	894	1539	1005	1458	993	1191	795	1050	987	1269	1059	1302	1188	948	942	1086	1005	900	972	1371	996
Kmeria duperreana	1119	969	1017	1008	1011	1398	672	1206	1029	1323	1131	1224	1167	1299	1185	942	942	1008	1215	903	1284	1371	996
Kmeria septentrionalis	1113	966	1020	891	1005	1398	1065	1194	1026	1218	1125	1215	1032	1302	1293	942	942	981	1215	933	1284	1371	996
Magnolia nitida var. *lotungensis*	936	969	999	891	1005	1398	996	1188	879	1050	1137	1179	1074	1302	1290	939	942	1008	1212	906	1242	1371	996
Pachylarnax praecalva	0	0	0	0	0	0	0	0	0	222	219	0	114	171	78	0	111	0	0	0	186	180	0
Magnolia kachirachirai	1038	903	990	891	1005	1398	1065	1077	876	1188	1131	1272	1059	1299	1290	951	942	1059	1212	906	1272	1371	996
Magnolia sinica	978	963	999	891	1005	1398	996	1194	951	1230	1212	1365	1074	1302	1296	951	942	1062	1137	906	1110	1371	996
Magnolia nitida	1053	969	990	891	1005	1398	996	1197	1029	1119	978	1266	1059	1302	1188	951	942	1023	1005	933	1143	1371	699
Magnolia poasana	1134	903	1017	1026	885	1398	996	1179	951	1131	1131	1362	1167	1302	1293	951	942	1071	1212	933	1221	1371	993
Magnolia panamensis	1134	903	1014	1263	885	1398	996	1179	948	1290	1134	1401	1053	1302	1296	951	942	1062	1212	918	1254	1371	993
Magnolia sharpii	1134	978	1014	1266	885	1398	996	1191	1029	1218	1131	1401	1056	1302	1350	951	942	1071	1212	945	1254	1371	930
Magnolia guatemalensis	1131	900	894	1026	885	1398	996	1191	951	1329	1131	1401	1167	1302	1293	951	942	1041	1212	945	1254	1371	996
Magnolia iltisiana	1134	900	1017	1026	885	1398	996	1191	951	1077	1131	1266	1167	1284	1296	951	942	948	1212	945	1287	1371	993
Magnolia grandiflora	1122	903	891	1026	948	1398	996	1191	951	1143	1134	1317	1056	1302	1296	951	942	1068	1113	933	1284	1371	990
Magnolia striatifolia	1107	969	1014	1026	948	1398	996	1191	732	1389	1134	1404	1059	1302	1290	951	942	1047	1212	885	1242	1371	996
Magnolia schiedeana	1122	963	1020	1026	1002	1398	996	1191	891	936	1074	1365	1056	1302	1296	951	942	1068	1107	906	1281	1368	945
Magnolia tamaulipana	1038	963	858	897	1002	1398	996	1191	1158	969	1074	1053	1059	1302	1296	951	942	1071	1107	906	1131	1674	996
Magnolia virginiana	1134	969	1002	897	996	1398	996	1191	876	1050	1140	1122	1059	1302	1299	945	852	948	1107	933	1143	1371	990
Magnolia macrophylla	1137	969	936	1527	1002	1398	1011	1191	1026	1197	1140	1383	1053	1293	1293	951	942	1023	1107	936	1245	1371	996
Magnolia macrophylla var. *ashei*	1137	969	1014	897	945	1398	1011	1191	732	1401	1134	1362	1053	1293	1293	951	942	1023	1212	936	1239	1371	996
Magnolia dealbata	1137	903	1014	1026	945	1398	903	1191	876	1233	1134	1329	1053	1293	1290	951	942	1035	1107	906	1212	1371	996
Magnolia championii	1119	900	1017	1338	834	1398	1065	990	1026	1236	1092	1362	1059	1254	1188	951	942	1008	942	900	1284	1371	996
Magnolia coco	861	900	1011	891	855	1398	1065	1065	939	1053	1071	1080	1059	1254	1287	951	807	948	945	903	1101	1371	930
Magnolia phanerophlebia	909	903	765	1290	855	1398	750	1071	795	1215	1080	1308	1059	1254	1296	951	852	996	1113	933	1284	1371	996
Magnolia pterocarpa	1131	903	993	1257	891	1398	1065	1191	951	696	915	957	1170	1254	1296	951	807	1023	1113	933	1143	1371	999
Magnolia hodgsonii	1029	969	990	1335	1011	1398	972	1191	786	1140	1071	1266	1170	1239	1296	951	942	840	1209	906	1224	1371	993
Magnolia henryi	1131	903	1014	1023	834	1398	996	1188	792	1017	1131	1362	1059	1257	1188	951	942	1023	1209	933	1284	1371	996
Magnolia albosericea	1125	903	861	891	834	1398	852	999	867	1053	978	1104	1059	1254	1179	951	717	987	1113	906	1143	1371	996
Magnolia liliifera	828	969	1017	1023	894	1398	996	1191	948	696	1131	885	1059	1242	1290	951	807	945	1209	933	1293	1371	930
Magnolia delavayi	1077	969	768	1473	894	1398	996	858	951	1236	1134	1365	1170	1257	1137	951	942	948	1212	906	1251	1371	996
Magnolia pastazaensis	1125	900	936	1020	957	1395	423	1074	1707	1233	1128	1362	1059	1299	1287	951	909	912	1209	939	1284	1371	990
Magnolia equatorialis	1119	900	1017	1020	957	1395	309	1053	1023	780	1122	1272	1059	1224	1284	951	807	1083	1113	939	1143	1371	699
Magnolia ovata	1038	897	1017	1020	957	1395	672	1119	795	1308	1068	1365	1059	1302	1182	951	942	996	1209	939	1245	1371	990
Magnolia dodecapetala	1134	1638	1017	1020	1017	1395	777	1194	1023	1395	1128	1404	1059	1299	1290	951	942	1014	1209	906	1287	1371	996
Magnolia kichuana	1053	903	1017	1020	957	1395	549	1197	1707	1191	1128	1365	1059	1299	1290	951	942	1065	1209	909	1137	1371	996
Magnolia zamorana	1134	900	1023	1020	960	1395	651	1194	1023	1326	1128	1365	1059	1299	1290	951	942	1050	1209	939	1248	1371	945
Magnolia mercedesiarum	1134	900	894	1020	960	1395	666	1197	1023	1398	1128	1365	1059	1299	1290	951	942	999	1113	909	1251	1371	996
Magnolia mindoensis	1134	900	894	1020	960	1395	549	1197	1029	1386	1128	1365	1059	1302	1290	951	942	1008	1113	939	1287	1371	996
Magnolia mexicana	1059	903	1017	891	1005	1398	549	1092	1161	1311	1137	1365	1056	1299	1290	951	942	999	1212	915	1248	1371	996
Manglietia conifera	1002	969	1017	1458	927	1398	876	1071	792	1065	1131	1182	1059	1302	1188	951	939	1062	1212	906	1239	1371	996
Manglietia insignis	1134	969	1017	1143	927	1398	957	1191	792	870	1131	1176	1059	1302	1188	951	939	1080	1212	936	1281	1371	996
Manglietia duclouxii	1134	969	636	1311	930	1398	873	1188	792	756	978	1182	1059	1302	1188	951	942	948	975	936	1278	1374	930
Manglietia hookeri	1134	969	855	1557	894	1398	825	1191	792	774	1041	1269	1059	1302	1188	951	939	1062	1107	867	1281	1374	993
Manglietia aromatica	768	969	933	1485	573	1398	861	1071	876	759	1134	1083	1059	1302	1188	951	942	885	1107	939	1092	1374	699
Manglietia lucida	1053	969	1017	1020	900	1398	1047	1191	792	1137	1128	1269	1059	1302	1296	951	942	1059	1212	906	1281	1371	930
Manglietia grandis	1134	969	1017	1374	834	1398	957	1191	792	1017	1131	1305	1059	1302	1293	951	939	1086	1212	936	1281	1374	996
Manglietia megaphylla	1071	969	765	1263	930	1398	867	1116	792	837	1071	1182	1059	1302	1290	951	942	1083	1212	906	1239	1371	996
Manglietia rufibarbata	1083	969	1017	1377	894	1398	831	1191	792	963	978	1365	1059	1302	1188	951	942	948	1137	936	1074	1371	996
Manglietia ventii	993	969	1014	1230	885	1398	894	1077	792	954	978	1263	807	1302	1293	951	942	948	1212	906	975	1371	996
Manglietia ovoidea	1134	969	813	1314	834	1395	876	1191	792	1056	1131	1182	1059	1302	1296	951	942	1059	1212	906	1239	1374	993
Manglietia kwangtungensis	1134	903	1017	1350	894	1398	912	1191	876	963	1131	1365	1059	1302	1296	951	942	1086	1212	936	1281	1374	996
Manglietia szechuanica	1116	969	1008	1020	741	1398	876	1191	792	1104	1131	1269	1059	1302	1296	951	942	948	1212	936	1281	1374	993
Manglietia pachyphylla	1134	969	1014	1314	861	1398	690	1191	792	1017	978	1209	1059	1299	1296	951	939	1086	1212	906	1140	1371	993
Manglietia fordiana	1128	969	1017	1491	894	1398	897	1191	792	774	978	1269	1059	1299	1296	951	939	744	1212	906	1278	1371	993
Manglietia glauca	1053	969	1014	1020	834	1398	840	1191	792	810	1131	1269	1059	1299	1296	951	939	876	1212	738	1098	1371	822
Manglietia utilis	1047	969	855	1302	894	1398	921	1191	921	693	1140	1275	1059	1302	1296	951	804	948	1212	936	1281	1371	996
Manglietia caveana	1002	903	894	1020	870	1398	822	1191	792	1191	1131	1269	1002	1302	1086	951	942	948	1212	888	1182	1371	996
Manglietia garrettii	1134	981	1017	1464	930	1398	735	1191	792	1050	1134	1269	1059	1302	1188	951	942	1086	1212	906	1281	1371	996
Manglietia decidua	1134	903	855	1494	894	1395	960	1191	876	1050	1134	1269	1059	1305	1296	951	942	981	1212	936	1281	1371	996
Magnolia obovata	1134	969	1017	1374	894	1398	948	1191	669	1134	1131	1305	1059	1302	1188	951	942	1050	1212	909	1218	1371	996

Magnolia officinalis	1140	969	1017	1410	894	1398	1065	1191	876	1137	1131	1209	1059	1302	1029	951	807	948	1212	909	1218	1371	996
Magnolia tripetala	1134	969	1017	1494	834	1401	996	1191	921	1308	1131	1401	1059	1302	1263	951	942	1137	1212	909	1218	1371	996
Magnolia wilsonii	1053	972	765	1089	855	1398	957	1191	843	699	1017	894	1059	1332	1296	948	852	948	1113	897	1098	1371	930
Magnolia globosa	1140	969	1020	1146	945	1398	957	1191	792	942	1047	1122	1059	1269	1296	930	942	1074	1212	936	1155	1371	996
Magnolia sieboldii	1134	969	1011	1389	945	1398	1065	1188	792	1095	1143	1248	1059	1266	1293	948	942	1071	1212	936	1182	1371	996
Magnolia sieboldii subsp. *sinensis*	1134	969	1017	1329	945	1398	1065	1188	876	1191	1143	1269	1059	1266	1362	948	942	1086	1212	906	1278	1371	996
Magnolia fraseri	1140	969	798	1515	945	1398	1062	1191	792	1110	1125	1302	1056	1299	1395	951	942	1086	1212	933	1284	1371	996
Magnolia fraseri var. pyrimidata	1140	969	708	1401	954	1398	996	1191	792	1110	1125	1341	1056	1299	1296	951	942	948	1197	933	1242	1371	993
Magnolia splendens	1137	873	1017	1020	849	1398	549	1071	951	1326	1131	1311	1059	1302	1185	951	942	948	897	930	1284	1371	996
Magnolia portoricensis	1053	873	1017	1020	849	1398	672	1191	951	1404	1131	1311	1059	1302	1293	951	942	1083	780	930	1284	1371	996
Magnolia cubensis	972	900	1017	1020	813	1398	741	1191	951	1152	1128	1368	1059	1302	1137	948	942	882	783	870	1272	1371	996
Magnolia bankardiorum	1131	903	1002	1020	876	1398	549	1191	1026	1326	1131	1365	1059	1302	1296	951	942	1083	1290	930	1242	1371	993
Liriodendron chinense	870	903	297	1026	504	1398	240	1191	792	480	600	1212	1002	1314	978	939	942	951	990	870	1101	1371	960
Liriodendron tulipifera X *Liriodendron chinense*	819	903	297	1026	384	1398	240	1170	792	909	735	1275	1002	1314	606	939	798	945	1011	870	1098	1371	909
Liriodendron tulipifera	849	1524	270	1026	618	1398	540	1134	792	888	849	1314	1002	1197	1005	939	798	990	1104	870	1098	1371	975
Ave.	1063	954	920	1109	923	1376	886	1152	885	1125	1067	1276	1064	1279	1234	936	913	999	1145	899	1186	1357	963

(cont. Appendix 29)

Taxon name	MKT102617_1_4_APOV	MKT103531_1_4_APOV	MKT108799_1_4_APOV	MKT110241_1_4_APOV	MKT111153_1_4_APOV	MKT111535_1_4_APOV	MKT111570_1_4_APOV	MKT113256_1_4_APOV	MKT115451_1_4_APOV	MKT115677_1_4_APOV	MKT116442_1_4_APOV	MKT117656_1_4_APOV	MKT120073_1_4_APOV	MKT122427_1_4_APOV	MKT124409_1_4_APOV	MKT124578_1_4_APOV	MKT125774_1_4_APOV	MKT126260_1_4_APOV	MKT127097_1_4_APOV	MKT127492_1_4_APOV	MKT129330_1_4_APOV	MKT129653_1_4_APOV	MKT130843_1_4_APOV
Length of the reference for each loci	1017	1218	942	912	1263	1041	1242	951	906	1278	1377	1110	903	1218	1038	1116	1371	1233	1062	924	951	1059	1179
Magnolia griffithii	1017	1218	903	912	1191	915	1236	807	609	1104	1377	1029	903	930	1050	966	1170	1233	1056	198	216	1023	1176
Michelia baillonii	1017	759	942	912	1248	831	1233	807	729	1104	1203	1071	903	615	1026	966	1170	1191	1056	198	543	1023	1179
Michelia sirindhorniae	1017	861	903	912	1092	753	1236	807	789	1107	1377	1074	903	1077	1056	966	1170	1191	1056	198	678	1023	1179
Michelia velutina	1017	996	942	912	1251	831	1236	807	804	1116	1377	1110	903	1071	1020	966	1170	1233	1056	198	366	1023	1170
Michelia masticata	1017	996	942	912	1254	894	1236	807	588	1119	1203	1068	903	930	1038	966	1170	1110	1056	198	546	1023	1161
Michelia sphaerantha	1017	996	903	906	1248	831	1233	807	744	1119	1203	894	903	1077	1035	966	1170	1227	1056	198	681	1023	1161
Michelia doltsopa	1017	777	942	912	1257	957	1236	804	789	1056	1377	1020	903	1131	1032	966	1170	1158	1053	489	687	1023	1164
Michelia lacei	1017	777	903	912	1254	840	1236	804	678	1107	1377	1071	903	1077	1062	981	1170	1230	1056	489	717	1023	1179
Michelia salicifolia	1017	996	903	912	1251	831	1236	807	804	1107	1368	1020	903	1077	1020	966	1170	1233	1056	105	465	1023	1176
Michelia martini	1020	1218	912	912	1254	753	1236	807	804	1119	1377	1107	900	930	1044	960	1170	1191	1056	198	681	1023	1179
Michelia coriacea	1017	996	942	912	1257	831	1266	807	783	1119	1377	1107	903	1071	1038	627	1170	1233	1056	105	687	1023	1164
Michelia ingrata	1017	759	942	912	1251	753	1236	804	804	1119	1377	1071	903	1011	1026	966	1170	1233	1056	198	390	1023	1179
Michelia wilsonii	1017	864	921	912	1248	831	1236	807	678	1119	1377	1071	903	927	1032	951	1170	1233	1056	198	687	1023	1179
Michelia floribunda	1017	759	942	912	1248	831	1236	807	804	1107	1377	1071	903	1071	1032	966	1158	1233	1056	198	606	1023	1179
Michelia chapensis	1020	996	942	912	1032	831	1236	807	636	990	1377	1107	900	1077	1056	624	1170	1233	1056	198	687	1023	1176
Michelia chapensis	1020	996	909	912	987	831	1236	807	693	1107	1203	1071	909	930	1050	624	1170	1116	1056	198	606	1023	1164
Michelia hypolampra	1017	996	879	912	1140	831	1236	807	621	1119	1203	1074	900	930	1020	966	1170	1191	1056	198	558	1023	1179
Michelia viridipetala	1017	981	942	909	1200	855	1236	807	387	1107	1203	1071	846	1071	1026	978	1176	1230	1056	198	606	1023	1164
Michelia balansae	1017	1218	942	912	1254	831	1236	804	678	1107	1377	1074	846	1071	1050	981	1176	1233	1056	147	471	1023	1164
Michelia guangxiensis	1017	834	942	912	1200	855	1236	807	678	1107	1203	930	819	1140	1026	966	1176	1233	1056	198	516	1023	1179
Michelia figo	1017	1215	939	912	1251	855	1236	807	678	1101	1203	1074	903	930	1029	966	1122	1191	1056	198	249	1023	1152
Michelia shiluensis	1017	981	942	912	1257	753	1236	807	678	1107	1377	1074	846	1077	1047	966	1176	1233	1056	198	531	1023	1179
Michelia odora	1017	1218	942	912	1254	798	1182	807	339	1062	1377	1074	846	1077	1026	966	1176	1188	1056	198	597	1023	1176
Michelia montana	1017	996	933	912	1260	831	1236	543	678	1104	1377	1074	846	1077	1044	1026	1176	1233	1056	198	681	1023	1164
Elmerrillia ovalis	1017	813	900	912	1257	852	1230	801	618	1113	1185	786	846	1011	1026	966	1167	1077	1056	198	432	1023	1179
Michelia compressa	1017	1218	942	912	1254	861	1233	807	678	1032	1203	1074	903	1065	1125	978	1167	1233	1056	198	522	1023	1164
Michelia macclurei	1017	1218	942	912	1254	954	1236	807	678	792	1377	1074	846	1071	1026	963	1170	1233	1056	198	555	1023	1152
Michelia guangdongensis	1017	1050	924	909	1260	831	1236	807	372	1104	1203	1074	846	927	1023	966	1170	1158	1056	198	606	1023	762
Michelia maudiae	1017	981	942	912	1041	753	1236	807	696	1044	1203	1074	735	1071	1143	966	1170	1233	1110	198	681	1023	1152
Michelia foveolata	1017	981	939	912	1248	831	1236	807	678	1107	1203	1074	846	543	1032	966	1170	1233	1068	198	546	1023	1179
Michelia cavaleriei	1017	759	942	912	1254	831	1236	807	678	1104	1377	1065	846	1077	1050	966	1170	1233	1056	198	336	1023	1179
Magnolia elegans	1020	1044	942	909	1203	855	1287	804	768	1104	1377	1074	903	1026	1041	966	1149	1233	1014	378	651	1023	1176

Magnolia borneensis	1020	210	750	216	498	333	537	309	0	567	261	423	123	261	207	84	519	228	678	0	222	327	207
Magnolia carsonii	1020	1218	903	912	1152	855	1236	804	804	1104	1203	1074	903	1083	1038	951	1128	1191	1056	489	687	1014	1179
Magnolia cathcartii	1017	1218	942	912	1260	855	1236	807	567	1104	1377	1023	903	777	1056	951	1242	1233	1056	489	639	1023	1179
Magnolia zenii	1017	999	942	912	1260	828	1266	804	777	1110	1203	1074	903	1023	1029	966	1194	1251	1062	603	906	1023	1179
Magnolia biondii	1017	834	942	912	1101	843	1236	807	633	786	1005	741	735	633	693	576	1194	1176	945	330	657	1023	822
Magnolia amoena	1017	759	942	912	1260	855	1236	807	780	1056	1377	1110	903	1026	1059	981	1194	1254	1062	525	807	1023	1179
Magnolia sinostellata	1017	1218	903	912	1260	978	1236	807	678	963	1203	1110	792	939	936	981	1194	1233	1062	615	858	1023	1179
Magnolia stellata	1017	996	912	912	1260	855	1236	804	783	1110	1377	1110	903	1086	1056	981	1194	1233	1062	576	951	1023	1179
Magnolia kobus	1017	1005	885	912	1266	855	1236	804	738	1110	1377	1110	903	1020	1032	966	1191	1233	1062	564	888	1023	1179
Magnolia salicifolia	1017	447	903	912	1263	855	1236	807	783	1110	1131	1008	792	1065	1041	966	1191	1233	1056	489	546	1023	1179
Magnolia denudata	1017	1215	864	912	1260	855	1236	807	678	1131	1290	1077	903	1017	1041	966	1194	1158	1062	489	621	1023	1179
Magnolia cylindrica	1017	990	789	912	1143	855	1236	804	513	1110	1377	921	903	879	924	966	1194	918	1062	489	942	1023	762
Magnolia liliiflora	1017	759	912	912	1257	855	1236	807	738	1110	1377	1080	903	1086	1029	966	1194	1083	1062	525	696	1023	1152
Magnolia sprengeri	1017	981	912	912	1254	753	1236	807	678	1095	1203	972	903	1023	1032	966	1194	1158	1062	489	816	1023	1008
Magnolia sargentiana	1011	759	903	912	1260	972	1236	807	783	1092	1377	972	846	879	1029	969	1194	1233	990	489	810	1023	1179
Magnolia campbellii	1011	1218	942	912	1257	855	1236	807	759	1020	1377	1023	903	1029	1035	969	1191	1233	1062	489	873	1023	1179
Magnolia dawsoniana	1011	1332	942	813	1257	855	1236	807	783	1083	1203	1074	903	1026	1032	969	1194	1233	1062	489	957	1023	1179
Magnolia acuminata var. *subcordata*	1020	621	891	912	1260	855	780	807	783	1083	1194	828	900	1080	1065	1014	1152	1233	1056	489	780	1023	1170
Magnolia acuminata	1020	384	891	912	1257	855	1236	807	678	954	1203	1023	735	1086	1011	1014	1194	1158	1056	489	906	1023	1170
Kmeria duperreana	1017	975	918	912	1257	855	1233	807	783	1101	1374	1074	903	1095	840	969	1143	1233	1056	468	687	1023	1176
Kmeria septentrionalis	1017	999	918	912	1197	855	1233	807	798	975	1374	1074	819	555	831	969	1194	1191	1056	489	540	1023	1176
Magnolia nitida var. *lotungensis*	1017	837	933	912	1113	855	1233	807	783	1020	1203	1068	792	933	1029	1044	1194	993	990	384	702	1023	1176
Pachylarnax praecalva	1017	0	330	90	0	0	0	0	0	189	0	81	0	0	102	0	0	0	0	0	141	0	72
Magnolia kachirachirai	1017	990	933	912	1257	855	1233	807	783	1080	1203	972	903	909	1017	951	1140	1233	1056	384	606	1023	1176
Magnolia sinica	1017	1218	933	912	1197	921	1236	807	786	1074	1203	1110	846	1077	1005	951	1194	1158	1056	105	498	1023	1179
Magnolia nitida	1017	759	909	912	1257	852	1236	807	678	1083	1200	1074	762	1020	1038	951	1194	1191	1056	489	669	1023	1176
Magnolia poasana	1017	390	939	912	1260	855	1236	807	783	1101	1377	1074	903	1080	972	963	1182	1149	1056	489	591	1023	1176
Magnolia panamensis	1017	996	942	912	1197	855	1236	807	783	1101	1377	1074	903	894	963	963	1182	1191	1056	489	657	1023	1176
Magnolia sharpii	1017	621	936	912	1254	855	1236	807	783	1104	1377	1074	903	1080	957	963	1194	1149	1056	489	291	1023	1176
Magnolia guatemalensis	1017	759	939	912	1254	855	1236	807	723	1101	1377	1074	903	1077	969	963	1194	1191	1056	489	603	1023	1176
Magnolia iltisiana	1017	621	903	912	1077	753	1236	807	777	1092	1203	1074	903	879	972	963	1188	1191	1056	489	597	1023	1176
Magnolia grandiflora	1017	378	900	912	1077	855	1236	807	711	1104	1377	1074	903	1080	969	963	1194	1233	1056	489	681	1023	1176
Magnolia striatifolia	1017	390	903	912	1077	855	1236	807	786	1104	1377	1107	903	1080	948	963	1194	1233	1056	486	597	1023	1176
Magnolia schiedeana	1017	810	927	912	1248	855	1236	807	792	1104	1203	1071	903	1023	951	963	1194	1233	1056	489	591	1023	1176
Magnolia tamaulipana	1017	297	930	912	1257	855	1236	807	576	1104	1203	1071	903	927	969	888	1194	1197	1056	384	336	1035	1167
Magnolia virginiana	1017	846	942	912	1260	855	1236	807	489	1059	1377	1074	903	879	1023	963	1194	1233	1056	483	543	1023	1005
Magnolia macrophylla	1017	390	939	912	1029	855	1233	807	678	1104	1203	1074	903	882	1005	969	1194	1230	1056	513	684	1023	1179
Magnolia macrophylla var. *ashei*	1017	759	939	912	966	753	1233	807	783	1104	1311	1074	846	1089	1005	969	1194	1152	945	489	444	1023	1179
Magnolia dealbata	1017	390	879	912	1218	855	1233	807	771	1104	1131	1074	783	1029	1005	939	1194	1152	1056	489	597	1023	1179
Magnolia championii	1017	639	942	912	1257	855	1236	993	654	1104	1203	1071	903	1080	813	963	1194	1191	945	456	498	1023	1179
Magnolia coco	1017	990	879	810	1218	852	1236	804	618	1104	1203	1071	792	1080	1014	948	1152	1083	1059	456	441	1023	1173
Magnolia phanerophlebia	1017	615	942	912	1257	855	1236	804	801	1116	1203	1071	792	933	1023	948	1146	1116	1056	444	501	1023	1179
Magnolia pterocarpa	1197	543	942	912	1257	804	1236	804	570	1194	1203	1074	714	843	810	948	1191	1233	858	321	543	1023	1176
Magnolia hodgsonii	1017	1011	903	912	1254	855	1236	744	783	1104	1344	1023	903	1080	960	948	1146	1158	945	456	651	1023	1176
Magnolia henryi	1017	990	942	912	1254	753	1236	807	804	1155	1344	1071	792	933	948	960	1191	1230	1056	456	471	1023	1179
Magnolia albosericea	1017	513	903	912	1251	852	1236	804	657	789	1203	894	783	753	897	963	1152	1113	990	378	606	1023	1098
Magnolia liliifera	1017	375	777	906	1194	933	1236	750	699	987	1203	1065	735	933	897	960	1152	1191	990	345	639	1023	1179
Magnolia delavayi	1017	390	912	912	1260	855	1236	807	798	792	1374	1110	903	1056	957	963	1194	1233	1056	489	480	1023	1179
Magnolia pastazaensis	1017	675	903	906	1173	855	1236	804	684	1071	1377	1074	783	1080	1002	966	1152	1191	1056	105	681	1014	1008
Magnolia equatorialis	981	996	942	906	1176	855	1236	801	126	1101	1203	972	903	1080	1002	981	1194	1233	1056	489	540	1023	1020
Magnolia ovata	1017	999	942	906	1176	753	1236	804	606	906	1377	1074	903	981	1011	966	1152	1191	1056	456	390	1023	1179
Magnolia dodecapetala	1017	768	939	906	1008	978	1236	804	783	1098	1377	1074	903	1173	1002	966	1194	1233	1056	489	291	1023	1179
Magnolia kichuana	1017	906	936	906	1128	855	1236	804	783	1101	1377	1074	903	933	1002	966	1194	1191	1056	489	687	1023	1179
Magnolia zamorana	1017	804	942	906	1176	855	1236	804	573	1101	1377	1020	783	780	1002	966	1152	1116	1056	489	603	1023	1179
Magnolia mercedesiarum	1017	768	903	906	1173	753	1236	804	783	1101	1377	1074	903	1080	1011	966	1179	1191	1056	489	288	1023	1179
Magnolia mindoensis	1023	906	942	906	1197	855	1236	804	759	1101	1377	1074	903	1080	1002	966	1152	1233	1056	489	366	1023	1179
Magnolia mexicana	1017	1218	897	906	1194	753	1236	804	678	1104	1377	1074	903	933	1005	966	1194	1233	1056	456	582	1023	1179
Manglietia conifera	1017	1218	942	912	201	855	1236	807	567	1089	1203	879	789	843	906	939	1194	1230	1056	441	390	1023	1179
Manglietia insignis	1017	1218	903	912	213	855	1236	807	783	1089	1203	1071	900	933	1008	939	1194	1230	1056	441	570	1059	1179
Manglietia duclouxii	1017	1218	936	912	192	753	1236	807	783	1080	1203	1074	900	678	1008	759	1194	1158	1056	438	594	1023	1179
Manglietia hookeri	1017	852	903	912	126	855	1236	807	783	1080	1203	1074	900	780	1020	939	1194	1233	1056	441	483	1023	1179
Manglietia aromatica	1017	852	897	912	192	855	1236	807	411	1158	1203	1074	900	1083	1011	939	1194	1158	1056	441	612	1023	1179
Manglietia lucida	1017	765	939	912	180	753	1236	807	783	1110	1203	1110	900	1077	1011	921	1194	1233	1056	441	120	1023	1179
Manglietia grandis	1017	852	942	912	297	855	1236	807	783	1080	1203	1074	900	930	1041	963	1149	1155	1056	441	609	1023	1179
Manglietia megaphylla	1017	1218	942	912	192	855	1236	807	783	1086	1203	1074	900	933	1017	963	1194	1116	1056	375	594	1023	1179
Manglietia rufibarbata	1017	1002	903	912	192	855	1236	807	783	1155	1203	1074	900	933	1011	939	1194	1158	1056	441	663	1023	1179

Manglietia ventii	1017	1218	903	912	192	855	1236	804	672	1044	1131	783	900	393	1044	963	1194	1065	1056	441	528	1023	1179
Manglietia ovoidea	1017	852	942	912	201	855	1236	804	678	1101	1203	969	906	933	1005	939	1194	1191	1056	441	414	1023	1179
Manglietia kwangtungensis	1017	1218	942	912	213	855	1236	807	783	1098	1203	1047	786	933	1017	963	1194	1236	1056	441	507	1023	1179
Manglietia szechuanica	1017	381	942	912	66	855	1233	807	783	1101	1203	1074	900	933	1029	963	1194	1233	1056	441	678	1023	1179
Manglietia pachyphylla	1017	615	903	912	192	855	1236	807	675	1080	1203	1074	897	363	1017	963	1194	1236	1056	345	480	1023	1176
Manglietia fordiana	1017	1206	903	912	192	855	1236	807	783	1005	1203	1074	729	678	903	963	1194	1128	1053	441	807	1023	1179
Manglietia glauca	1017	852	942	741	180	855	1227	807	723	1269	1359	1074	897	1080	1011	951	1149	1233	1056	447	861	1023	1179
Manglietia utilis	1017	858	942	912	186	753	1236	807	783	1095	1203	1074	900	1080	1023	963	1194	1227	1056	441	450	1023	1068
Manglietia caveana	1017	852	903	912	192	855	1236	807	708	1080	1203	972	816	843	1002	939	1194	1233	1056	468	249	1023	1173
Manglietia garrettii	1017	1218	942	912	192	840	1236	807	783	1158	1203	1074	900	933	1011	939	1194	1233	1056	486	390	1023	1179
Manglietia decidua	1017	1002	942	912	0	849	1236	807	783	1197	1203	1074	789	933	1014	963	1194	1233	1056	147	597	1023	1173
Magnolia obovata	1017	990	942	906	465	855	1236	807	678	1089	1203	1074	903	876	999	957	1218	1068	1056	471	546	1023	1176
Magnolia officinalis	1017	981	903	909	180	855	1236	756	618	1101	1203	1023	903	633	999	963	1218	1065	1056	471	576	1023	1095
Magnolia tripetala	1017	990	879	912	192	885	1233	807	804	1098	1203	1074	903	1077	1005	963	1218	1182	1056	471	390	1023	1134
Magnolia wilsonii	1017	240	912	912	192	753	1233	807	384	1041	1116	744	735	633	927	708	1194	1083	945	486	546	1023	840
Magnolia globosa	1017	999	909	912	192	855	1236	807	783	1104	1203	1074	903	933	1011	969	1194	1233	1056	486	633	1023	1179
Magnolia sieboldii	1017	522	942	912	180	855	1218	765	783	1101	1203	1074	903	1041	924	951	1152	1233	1056	486	630	1023	1179
Magnolia sieboldii subsp. *sinensis*	1017	522	903	912	180	855	1218	807	678	1101	1203	1074	903	858	1008	951	1152	1233	1056	486	687	1023	1179
Magnolia fraseri	1017	1215	936	912	465	855	1236	807	804	1104	1203	1110	903	1023	945	969	1164	1233	990	456	939	1023	1167
Magnolia fraseri var. pyrimidata	1017	996	942	912	465	855	1230	807	783	1104	1203	1074	903	1023	1005	969	1164	1158	945	486	951	1023	1167
Magnolia splendens	1017	597	942	912	1260	849	1233	804	783	990	1203	1074	903	924	1014	969	1194	1152	1047	486	678	1023	1176
Magnolia portoricensis	1017	597	939	912	1137	849	1233	804	783	960	1203	1074	792	882	1005	969	1194	1152	1047	486	624	1023	1176
Magnolia cubensis	1017	633	900	912	1143	849	1233	807	783	963	1203	969	903	936	1014	969	1194	1152	1047	486	669	1023	1176
Magnolia bankardiorum	1017	390	906	912	1257	744	1233	807	783	1104	1377	1071	903	1083	969	630	1194	1104	1056	486	630	1023	1173
Liriodendron chinense	996	978	333	912	813	753	1359	798	537	495	1122	1020	639	1080	693	858	642	825	945	429	546	1023	660
Liriodendron tulipifera X *Liriodendron chinense*	996	978	333	912	819	753	1311	801	297	495	1122	918	639	1080	759	858	642	717	945	444	546	1023	990
Liriodendron tulipifera	1011	978	387	912	819	753	1344	804	597	495	1122	1068	639	1080	759	858	642	825	942	444	597	1023	249
Ave.	1018	866	902	896	953	830	1219	793	690	1055	1249	1033	851	952	982	929	1153	1164	1033	387	588	1009	1126

Appendix 29. (Continued)

Taxon name	MKT130987_1_4_APOV	MKT131604_1_4_APOV	MKT137622_1_4_APOV	MKT139741_1_4_APOV	MKT146240_1_4_APOV	MKT149396_1_4_APOV	MKT149614_1_4_APOV	MKT152047_1_4_APOV	MKT154349_1_4_APOV	MKT154711_1_4_APOV	MKT157257_1_4_APOV	MKT157285_1_4_APOV	MKT157286_1_4_APOV	MKT160185_1_4_APOV	MKT160703_1_4_APOV	MKT160851_1_4_APOV	MKT161705_1_4_APOV	MKT162606_1_4_APOV	MKT164012_1_4_APOV	MKT165734_1_4_APOV	MKT167910_1_4_APOV	MKT169758_1_4_APOV	MKT175152_1_4_APOV
Length of the reference for each loci	1245	981	1068	1143	918	1194	1401	1044	1161	1272	1476	1461	1071	1176	1035	1092	1245	1110	1110	1275	1161	1188	1056
Magnolia griffithii	1239	978	1062	1143	657	1194	1161	1041	1161	1023	1470	1431	1071	1158	873	933	1245	1104	948	1236	984	1125	924
Michelia baillonii	1200	969	1068	1143	924	1194	1101	1041	1161	1023	1470	1431	1071	1158	888	1023	1131	1104	948	1236	984	1008	921
Michelia sirindhorniae	1104	978	1062	1143	906	1194	1233	1041	1161	1020	1470	1431	1071	1158	984	1092	1224	1110	969	1236	984	1122	921
Michelia velutina	1125	978	1062	1143	657	1170	1245	1041	1161	1023	1470	1425	1071	1158	984	1092	1224	1104	1095	1236	984	1125	921
Michelia masticata	1230	978	1062	1143	876	1191	1386	1041	1161	930	1470	1431	1071	1158	885	732	1224	1110	948	1236	984	1125	921
Michelia sphaerantha	1206	978	1062	1143	870	1191	1176	1041	1161	1020	1470	1431	1071	1158	981	1041	1224	1110	948	1233	984	1188	921
Michelia doltsopa	1125	789	1062	1143	936	1194	1392	1041	1161	1020	1470	1428	1071	1551	807	1089	1221	1110	1101	1236	984	1125	921
Michelia lacei	1086	789	1062	1143	915	1194	1245	1041	1161	1020	1470	1428	1071	1443	975	1092	1224	1104	1101	1236	984	1008	921
Michelia salicifolia	1227	978	1032	1152	915	1194	1179	1041	1161	1059	1470	1431	1071	1158	807	960	1131	1110	1230	1236	984	1008	921
Michelia martini	1122	975	1062	1143	918	1194	1350	1044	1161	918	1470	1431	1071	1158	984	1092	1224	1110	918	1236	984	1125	921
Michelia coriacea	1230	978	1062	1143	894	1194	1395	1041	1161	1023	1470	1431	1071	1158	888	1080	1224	1110	948	1236	984	1125	921
Michelia ingrata	1230	975	1062	1143	876	1194	1350	1041	1161	933	1470	1431	1071	1158	984	822	1221	1104	948	1236	984	1008	921
Michelia wilsonii	1125	978	1062	1143	876	1194	1179	1044	1161	1017	1470	1431	1071	1158	984	1014	1218	1104	1101	1236	984	1188	921
Michelia floribunda	1311	978	1062	1143	921	1194	1092	1041	1161	1020	1470	1308	1071	1143	984	732	1221	1104	1101	1236	984	1008	921
Michelia chapensis	1188	978	1062	1143	657	1194	1179	1041	1161	1023	1470	1431	1071	1158	888	1023	1224	1110	948	1236	984	1008	921
Michelia chapensis	1254	960	1062	1143	657	1194	1179	1041	1161	939	1470	1431	1071	1158	885	1041	1224	1110	1107	1236	984	1008	921
Michelia hypolampra	1140	807	1062	1143	876	1194	1200	1041	1161	1023	1470	1428	1071	1158	744	852	1221	1110	948	1236	984	1107	921
Michelia viridipetala	969	969	1062	1143	876	1194	1395	1041	1161	933	1470	1431	1071	1158	984	1092	1224	1110	1071	1236	984	1125	807
Michelia balansae	1230	969	1062	1143	924	1194	1242	1041	1161	1023	1470	1431	1071	1158	978	852	1224	1110	915	1236	984	1125	921

Michelia guangxiensis	1140	969	1062	1143	876	1194	1194	1041	1161	1023	1470	1431	1071	1158	984	1092	1221	1032	915	1236	984	1125	882
Michelia figo	1230	807	1062	1143	657	1194	1134	1041	1161	978	1470	1431	1071	1158	954	1092	1221	1110	948	1236	984	984	921
Michelia shiluensis	1230	978	1062	1143	657	1194	1365	1041	1161	933	1470	1431	1071	1158	807	1092	1242	1104	948	1236	984	1008	921
Michelia odora	1161	978	1068	1143	657	1194	1143	1041	1161	933	1470	1347	1071	1158	885	1092	1221	1104	948	1236	984	1008	921
Michelia montana	1044	978	1062	1140	924	1194	1170	1041	1161	1023	1470	1431	1071	1152	849	1014	1209	1110	948	1236	984	1125	921
Elmerrillia ovalis	1143	978	1062	987	657	1194	1176	1038	1161	1023	1419	1335	1071	1155	903	1017	1131	1110	918	1236	984	1125	918
Michelia compressa	1230	975	1068	1143	876	1194	1140	1041	1161	1023	1470	1431	1071	1158	984	1014	1221	1110	948	1236	984	1125	921
Michelia macclurei	1137	789	1068	1143	876	1194	1086	1041	1161	939	1470	1431	1071	1158	963	1092	1224	1110	948	1236	984	1008	921
Michelia guangdongensis	1254	807	1068	1143	921	1089	1014	1038	1161	1023	1470	1431	1071	1158	807	927	1224	1110	948	1236	984	1008	921
Michelia maudiae	1227	807	1068	1140	657	1194	1179	1041	1161	1023	1470	1431	1071	1158	909	1092	1224	1110	918	1236	984	1125	921
Michelia foveolata	1236	807	1068	1143	657	1194	1137	1038	1161	933	1470	1431	1071	1179	930	1014	1224	1110	930	1236	984	1008	921
Michelia cavaleriei	1230	966	1068	1146	873	1194	1230	1041	1161	1023	1470	1431	1071	1158	981	1092	1221	1110	1101	1236	984	984	921
Magnolia elegans	753	978	1068	1143	657	1194	1179	1041	1161	1023	1419	1449	1071	1161	924	840	1245	1110	948	1236	984	1125	819
Magnolia borneensis	204	0	1122	516	336	267	774	654	573	324	759	255	261	0	0	69	819	195	93	675	0	183	198
Magnolia carsonii	1056	978	1068	1143	873	1194	1023	1044	1158	1026	1416	1365	1071	1161	744	1086	1131	1104	945	1236	984	1125	921
Magnolia cathcartii	1053	966	1068	1143	882	1194	1026	1044	1161	990	1470	1461	1071	1158	900	1092	1245	1110	948	1236	984	1008	921
Magnolia zenii	1245	618	1068	1143	921	1194	1092	1044	1161	1023	1470	1461	1071	1173	945	993	1245	1110	1104	1236	984	1008	924
Magnolia biondii	1245	807	1068	1143	915	1194	1113	1044	1161	933	1314	1338	1071	1176	744	339	1245	747	942	1236	984	1008	558
Magnolia amoena	1242	807	1068	1143	918	1194	1176	1044	1161	1023	1470	1461	1071	1176	984	1092	1245	1110	1104	1236	984	1107	924
Magnolia sinostellata	1245	969	1068	1143	918	1194	1221	1044	1161	1023	1470	1461	1065	1176	984	741	1245	1110	948	1236	984	1125	924
Magnolia stellata	1245	978	1068	1143	918	1194	1179	1044	1161	1023	1470	1461	1071	1176	984	1014	1245	1110	1110	1236	984	1155	924
Magnolia kobus	1140	783	1068	1011	918	1194	1074	1044	1161	1023	1470	1458	1071	1176	894	1014	1245	1110	942	1236	984	1008	924
Magnolia salicifolia	1242	969	1068	1143	918	1194	1179	1044	1161	1023	1419	1461	1071	1176	903	1077	1245	1110	1110	1236	984	1116	924
Magnolia denudata	1242	978	1068	987	861	1194	1104	1044	1161	1023	1419	1446	1071	1176	807	1074	1131	1101	984	1233	984	1008	924
Magnolia cylindrica	1239	978	1068	1143	759	1194	1176	999	1161	1023	1467	1458	1071	1176	807	660	1131	1110	951	1236	984	1008	924
Magnolia liliiflora	1242	807	1068	1143	876	1194	1179	1044	1161	1023	1470	1458	1071	1176	885	972	1245	1110	612	1233	984	1188	924
Magnolia sprengeri	1230	807	1068	1071	810	1020	1179	1044	1161	1023	1419	1461	1071	1176	744	813	1245	1110	774	1425	984	1188	924
Magnolia sargentiana	1230	807	1068	1143	1080	1194	1176	1044	1161	1023	1470	1461	1071	1161	984	840	1176	1110	948	1281	984	1125	924
Magnolia campbellii	1227	798	1068	1143	876	1194	1089	1044	1161	1023	1470	1461	1071	1176	867	1086	1245	1110	948	1299	984	1008	924
Magnolia dawsoniana	1230	807	1068	1143	876	1194	1179	1044	1161	1023	1470	1458	1071	1176	882	1092	1131	1110	1110	1236	984	1188	924
Magnolia acuminata var. *subcordata*	1227	978	1068	1143	870	1194	1092	1041	1161	1023	1470	1461	1071	1176	807	1029	1131	1110	948	1236	984	1008	924
Magnolia acuminata	1227	978	1068	1143	876	1194	1176	1041	1161	933	1470	1461	1071	1176	933	621	1245	1110	939	1236	984	1125	924
Kmeria duperreana	1194	978	1068	1143	876	1194	1224	963	1161	1023	1470	1461	1068	1461	963	1092	1245	1110	948	1236	981	1188	906
Kmeria septentrionalis	1191	963	1068	1143	870	1194	1128	867	1161	933	1470	1461	1068	1461	744	987	1245	1110	948	1236	981	1125	906
Magnolia nitida var. *lotungensis*	1230	807	1068	987	657	1194	1119	942	1161	1023	1470	1338	1071	1158	744	816	1239	1110	948	1233	984	1017	753
Pachylarnax praecalva	0	183	0	0	246	0	246	147	0	135	0	0	0	0	144	0	0	0	0	240	0	132	0
Magnolia kachirachirai	822	789	1068	1143	654	1194	1185	786	1161	1023	1419	1338	1071	1161	891	1092	1239	1104	948	1236	984	1122	924
Magnolia sinica	945	807	1068	1143	657	1194	1248	1044	1161	1023	1419	1338	1071	1449	867	1092	1230	1110	948	1236	984	1017	924
Magnolia nitida	954	807	1068	1143	657	1194	1092	1038	1161	1023	1470	1338	1071	1158	867	1092	1245	1110	1098	1236	984	1017	924
Magnolia poasana	1203	978	1062	1143	657	1191	774	1044	1158	1023	1470	1461	1071	1164	954	948	1245	1110	1071	1236	984	1125	783
Magnolia panamensis	1200	972	1062	1143	867	1194	681	1038	1158	1023	1470	1461	1071	1164	984	1092	1245	1110	921	1236	984	1125	783
Magnolia sharpii	1200	978	1062	1143	870	1194	1050	1044	1158	1023	1416	1461	1071	1164	918	1092	1245	1110	921	1236	984	1125	783
Magnolia guatemalensis	1239	978	1062	1143	870	1194	1092	1044	1158	1023	1470	1461	1071	1164	906	1014	1245	1110	1068	1236	984	1125	783
Magnolia iltisiana	1227	789	1062	1143	657	1194	1179	603	1158	1008	1419	1461	1071	1164	924	1092	1245	1110	921	1236	984	1125	783
Magnolia grandiflora	1083	843	1062	1143	876	1107	1179	1044	1161	1020	1470	1461	1071	1161	885	1014	1245	1110	1101	1236	984	1125	924
Magnolia striatifolia	1044	975	1062	1041	657	1194	1179	1044	1161	1023	1419	1455	1071	1161	984	786	1323	1110	921	1236	984	1125	924
Magnolia schiedeana	1191	972	1062	1143	858	1194	1179	1044	1161	1023	1419	1461	1071	1161	936	1029	1245	1110	921	1236	984	1125	924
Magnolia tamaulipana	771	807	1062	1143	876	1194	1182	1044	1161	1020	1470	1461	1071	1161	744	1092	1245	1110	948	1236	984	1008	924
Magnolia virginiana	1092	993	1062	1143	873	1194	1179	1044	1161	1023	1419	1461	1071	1161	852	930	1170	1110	951	1236	984	783	921
Magnolia macrophylla	1239	789	1062	1143	918	1194	1089	1041	1161	1020	1419	1461	1071	1440	801	1089	1245	1110	948	1236	984	1125	924
Magnolia macrophylla var. *ashei*	1185	789	1062	1143	918	1194	1191	1044	1161	1020	1419	1461	1071	1440	897	1086	1245	1110	948	1236	984	1083	924
Magnolia dealbata	1227	732	1062	1143	870	1194	1176	1044	1161	1020	1419	1461	1071	1287	738	1089	1215	1110	948	1236	984	1125	921
Magnolia championii	1167	978	1068	1146	657	1194	951	549	1161	1023	1470	1458	1071	1161	744	1092	1245	1110	1053	957	984	1134	924
Magnolia coco	1035	807	1068	963	657	1194	1050	1044	1161	1023	1467	1458	1071	1161	834	1092	1245	1110	1056	1278	984	1008	924
Magnolia phanerophlebia	1170	978	1068	1146	657	1194	1251	894	1158	1023	1467	1452	1071	1152	744	762	1245	1110	948	0	984	1008	924
Magnolia pterocarpa	1194	804	1068	933	876	1194	711	894	1161	1023	1470	1461	1071	1152	744	816	1239	1110	1083	0	984	849	912
Magnolia hodgsonii	1197	978	1065	987	876	1194	1068	852	1161	1023	1470	1458	1071	1155	852	1059	1245	1110	1053	0	984	984	912
Magnolia henryi	1200	978	1068	1146	876	1194	1089	894	1161	1020	1470	1458	1071	1155	984	1092	1245	1110	954	0	984	1125	924
Magnolia albosericea	1059	807	1068	1146	654	1194	594	1044	1161	1023	1470	1461	1071	1161	744	990	1245	1110	951	1236	984	753	966
Magnolia liliifera	1026	789	1068	1146	906	1194	1149	1080	1158	1032	1305	1461	1071	1158	744	888	1245	1110	948	1233	990	975	924
Magnolia delavayi	1002	903	1068	1146	879	1194	1134	1044	1161	1023	1470	1461	1065	1269	867	1089	1245	1110	1104	1236	984	1188	924
Magnolia pastazaensis	942	789	1068	1143	657	1194	1170	1047	1158	1002	1416	1461	1071	1389	756	1011	1173	1110	909	1236	984	1002	927
Magnolia equatorialis	849	615	1068	987	657	1194	1173	645	1161	909	1473	1461	1071	1344	744	924	1245	1110	912	1236	984	831	927
Magnolia ovata	1005	789	1068	1143	657	1194	1092	897	1161	1002	1416	1461	1071	1464	744	933	1215	1110	900	1236	984	1119	924
Magnolia dodecapetala	1212	960	1068	1143	657	1194	1338	900	1161	1002	1464	1461	1071	1152	954	1092	1245	1110	909	1236	984	1116	927
Magnolia kichuana	1095	792	1068	987	876	1194	1179	1047	1158	1002	1416	1461	1071	1269	885	1092	1230	1110	909	1236	984	1119	927

Magnolia zamorana	1062	804	1068	1143	873	1194	1179	1047	1161	912	1416	1461	1071	1152	744	1092	1239	1110	900	1236	984	1002	927
Magnolia mercedesiarum	1083	789	1068	1143	876	1194	1173	564	1161	1002	1416	1461	1071	1302	783	1092	1245	1110	909	1236	984	1119	927
Magnolia mindoensis	1188	978	1068	1041	657	1194	1149	897	1158	1002	1473	1461	1071	1161	978	1092	1245	1110	1095	1236	984	1119	927
Magnolia mexicana	951	978	1068	1143	873	1194	1116	1086	1158	1095	1416	1461	1065	1164	963	990	1122	1110	909	1236	984	1008	927
Manglietia conifera	1137	978	1068	1143	657	1194	1191	1044	1161	1023	1470	1461	1071	1161	891	744	1245	1110	948	279	984	1017	924
Manglietia insignis	1101	978	1068	1143	657	1194	1221	1044	1161	1023	1470	1461	1071	1161	960	867	1245	1110	948	2001	984	1125	924
Manglietia duclouxii	1137	807	1068	1143	876	1191	1194	1044	1161	933	1470	1461	1071	1161	915	864	1245	1110	948	279	984	918	924
Manglietia hookeri	1074	978	1068	939	657	1194	1167	1050	1161	1020	1419	1461	1071	1092	882	879	1245	1110	948	1275	981	1011	924
Manglietia aromatica	1116	807	1068	936	657	1194	1182	1062	1161	1023	1470	1461	1071	1161	984	828	1245	1110	948	387	984	1008	921
Manglietia lucida	1122	960	1068	1143	876	1194	1182	1044	1161	1023	1470	1461	1071	1161	744	927	1245	1110	1101	1236	984	1125	921
Manglietia grandis	1206	978	1068	1143	657	1191	1161	1044	1161	1020	1470	1461	1071	1161	942	864	1245	1110	948	1275	984	1125	924
Manglietia megaphylla	1038	978	1068	1104	870	1191	1050	1089	1161	1023	1470	1461	1071	1161	807	825	1245	1110	957	1239	984	1014	924
Manglietia rufibarbata	1074	978	1068	993	657	1194	1245	1089	1161	933	1470	1461	1071	1161	807	927	1245	1110	957	0	984	1014	924
Manglietia ventii	1266	807	1068	1143	657	1191	1101	1044	1161	1023	1470	1461	1071	1161	744	867	1245	1110	948	2022	984	1008	924
Manglietia ovoidea	1194	978	1068	1143	657	1194	1173	1044	1158	1023	1467	1461	1071	1161	900	867	1245	1110	948	0	984	1005	924
Manglietia kwangtungensis	1206	804	1068	1143	876	1191	1203	1044	1161	1020	1470	1461	1071	1161	807	945	1245	1110	948	1236	984	1152	924
Manglietia szechuanica	1230	789	1068	1143	657	1191	1119	1044	1161	1023	1470	1461	1071	1161	981	867	1245	1110	1086	0	984	1038	924
Manglietia pachyphylla	1266	807	1068	1143	882	1191	1032	1044	1161	933	1470	1455	1071	1161	807	927	1245	1110	951	957	984	1017	924
Manglietia fordiana	936	975	1068	1143	657	1191	1245	1038	1161	1023	1470	1455	1071	1152	888	864	1239	1110	948	1230	984	1155	921
Manglietia glauca	1062	789	1047	1143	657	1191	939	1038	1161	1020	1419	1455	1071	1161	906	834	1395	1110	948	0	984	813	921
Manglietia utilis	1077	978	1068	987	876	1194	1176	1038	1161	1023	1470	1458	1071	1161	984	930	1245	1110	948	1230	984	1017	924
Manglietia caveana	1137	978	1068	1143	657	1194	1074	1044	1161	1023	1419	1461	1071	1152	807	762	1245	1035	948	957	981	1155	924
Manglietia garrettii	1050	978	1068	1143	657	1194	1179	1044	1161	1023	1365	1461	1071	1161	984	951	1245	1110	948	0	984	1125	924
Manglietia decidua	1167	978	1068	1143	1107	1194	1368	1044	1161	1023	1470	1461	1071	1305	984	951	1215	1104	951	279	984	1140	918
Magnolia obovata	1041	978	1068	1143	657	1149	1074	1035	1161	1023	1470	1461	1071	1161	984	1092	1242	1110	969	1236	984	1128	924
Magnolia officinalis	1074	978	1068	1143	657	1149	1074	1044	1161	1020	1470	1461	1071	1158	852	1092	1242	1110	969	1236	984	1008	924
Magnolia tripetala	996	978	1068	1143	657	1194	1395	1044	1161	1023	1470	1461	1071	1161	891	1092	1242	1110	1101	1236	978	1125	924
Magnolia wilsonii	879	555	1068	939	654	1194	1077	1032	1161	933	1470	1338	1071	1161	744	561	1242	1110	951	1236	984	1017	732
Magnolia globosa	1218	942	1068	1143	654	1194	1179	1122	1161	1026	1470	1464	1071	1149	753	1092	1242	1110	948	1236	984	1125	924
Magnolia sieboldii	1146	789	1068	1143	654	1194	1179	1041	1158	1023	1470	1461	1071	1161	888	1092	1245	1110	945	1083	984	1017	924
Magnolia sieboldii subsp. *sinensis*	1224	978	1068	1143	654	1194	1176	981	1161	1026	1470	1461	1071	1161	882	1092	1245	1110	948	1083	984	1017	924
Magnolia fraseri	1170	978	1068	1143	663	1194	1077	1032	1161	1023	1470	1461	1071	1158	867	1014	1245	1110	951	1230	987	1149	924
Magnolia fraseri var. pyrimidata	1083	903	1068	1143	657	1194	1092	1041	1161	1023	1470	1461	1071	1158	984	1092	1245	1110	963	1230	987	1017	924
Magnolia splendens	1125	978	1068	1041	657	1194	1089	1044	1161	1014	1470	1461	1071	1152	903	909	1245	1110	930	1233	984	999	924
Magnolia portoricensis	1125	903	1068	1143	657	1194	1176	1044	1161	1014	1470	1461	1071	1152	867	1071	342	1110	945	1233	984	1116	924
Magnolia cubensis	1086	978	1068	1041	876	1194	1029	597	1161	1014	1470	1461	1071	1152	744	1071	1245	1110	1077	1233	984	1116	924
Magnolia bankardiorum	1194	978	1068	1143	1092	1194	1239	543	1161	1020	1470	1461	1071	1152	903	1071	1245	1110	945	1233	984	1179	924
Liriodendron chinense	639	789	1068	963	657	1185	1128	1062	1161	987	1467	1458	1071	1095	744	537	1248	1110	852	1845	984	1020	540
Liriodendron tulipifera X *Liriodendron chinense*	603	789	1068	969	657	1185	960	1008	1080	897	1365	1452	1071	1158	744	1074	1134	1110	855	1224	984	978	492
Liriodendron tulipifera	603	900	1068	969	657	1185	1017	1002	1161	966	1467	1458	1071	927	744	918	1230	1110	852	1227	984	1020	699
Ave.	1111	886	1058	1102	782	1173	1137	997	1146	994	1438	1422	1056	1167	863	959	1209	1089	956	1116	968	1051	888

Appendix 29. (Continued)

Taxon name	MKT177392_1_4_APOV	MKT182888_1_4_APOV	MKT184400_1_4_APOV	MKT185663_1_4_APOV	MKT185666_1_4_APOV	MKT186190_1_4_APOV	MKT188496_1_4_APOV	MKT190086_1_4_APOV	MKT193786_1_4_APOV	MKT194050_1_4_APOV	MKT194086_1_4_APOV	MKT196134_1_4_APOV	MKT196157_1_4_APOV	MKT198387_1_4_APOV	MKT202602_1_4_APOV	MKT203205_1_4_APOV	MKT205092_1_4_APOV	MKT206098_1_4_APOV	MKT206466_1_4_APOV	MKT208284_1_4_APOV	MKT210113_1_4_APOV	MKT210707_1_4_APOV	MKT211758_1_4_APOV
Length of the reference for each loci	996	1005	1434	936	1635	1074	1113	1299	1167	918	993	1377	975	1140	1116	1485	966	939	1044	1233	1410	1620	1680
Magnolia griffithii	990	981	1353	891	1635	897	1059	1299	1167	918	993	1176	978	459	1059	1104	963	927	1347	1236	1407	1620	1680
Michelia baillonii	894	981	1371	891	1563	897	1059	1299	1017	897	993	1215	978	459	900	792	963	939	1023	1233	1407	1620	1680
Michelia sirindhorniae	822	981	1434	891	1638	915	1059	1299	1191	909	912	1362	975	444	963	837	963	933	1371	1236	1407	1620	1680
Michelia velutina	774	981	1434	891	1638	897	1059	1299	1044	912	993	1365	978	456	1023	840	963	939	918	1020	1407	1620	1296
Michelia masticata	822	981	1332	891	1548	897	1059	1299	1068	909	987	912	933	456	1038	1440	963	930	1371	1179	1404	1620	1680
Michelia sphaerantha	822	981	1353	891	1638	897	1059	1299	1068	909	882	900	933	456	996	1485	963	861	1323	1179	1404	1620	1680

Michelia doltsopa	918	981	1434	891	1638	897	1059	1299	1038	912	903	1107	978	657	1062	1422	963	930	1026	1179	1407	1620	1680
Michelia lacei	822	981	1434	888	1638	897	1059	1296	1110	912	984	1368	912	735	900	1374	963	930	906	1179	1407	1620	1680
Michelia salicifolia	780	981	1344	891	1392	897	1059	1299	1068	894	771	1041	978	456	996	1107	963	861	1176	1179	1407	1620	1680
Michelia martini	780	981	1434	891	1638	771	1059	1299	1158	918	984	1308	924	456	900	1356	963	939	969	1236	1401	1620	1680
Michelia coriacea	822	981	1404	891	1737	897	1059	1299	1164	891	984	1245	933	951	927	1488	963	939	1035	1233	1404	1620	1680
Michelia ingrata	894	981	1434	804	1638	897	1059	1284	1143	900	984	1362	933	456	900	1308	933	936	969	1179	1404	1620	1680
Michelia wilsonii	822	981	1428	891	1638	1056	1059	1299	1023	924	975	1146	933	579	963	1452	963	936	1365	1176	1401	1620	1680
Michelia floribunda	822	981	1350	888	1638	897	1059	1299	1191	903	993	1476	933	843	1023	1170	963	861	912	1179	1401	1620	1680
Michelia chapensis	894	981	1422	888	1638	897	1059	1296	1170	927	933	1266	978	600	1071	1422	1041	909	918	1176	1398	1608	1680
Michelia chapensis	822	981	1347	891	1656	756	1059	1296	1170	723	993	1266	978	453	996	1422	963	924	1026	1236	1398	1530	1680
Michelia hypolampra	990	981	1344	891	1575	897	1059	1299	1161	729	882	1176	978	825	900	1485	963	861	996	1038	1389	1620	1680
Michelia viridipetala	621	981	1434	660	1482	672	1059	1299	1095	909	993	954	978	177	624	1218	939	858	897	1239	1407	1620	1680
Michelia balansae	918	981	1347	891	1638	756	1059	1299	1038	924	993	1242	975	456	900	1440	936	927	924	1179	1407	1620	1659
Michelia guangxiensis	918	981	1404	891	1638	897	1059	1299	1182	912	930	978	978	477	900	795	963	861	1002	1113	1407	1620	1452
Michelia figo	990	981	1434	831	1749	897	1059	1299	1185	891	912	1143	978	177	900	1395	963	921	1002	1227	1407	1620	1680
Michelia shiluensis	915	981	1434	891	1638	897	1047	1299	1146	759	876	1137	978	477	900	1443	939	891	1035	1233	1401	1620	1650
Michelia odora	822	981	1353	891	1638	897	1059	1299	1149	921	969	1014	975	387	1014	1437	1032	861	906	1179	1410	1620	1650
Michelia montana	822	981	1434	885	1635	897	1026	1299	1149	906	972	1248	978	456	885	1221	942	939	927	1236	1410	1620	1677
Elmerrillia ovalis	918	981	1314	861	1635	885	1059	1302	1137	876	909	1299	975	477	996	1428	963	780	906	1179	1407	1620	1674
Michelia compressa	990	981	1326	891	1635	897	1059	1299	1068	900	993	1383	975	444	984	1422	936	936	1020	1017	1410	1620	1677
Michelia macclurei	990	981	1338	891	1587	894	1059	1299	1143	753	990	1422	933	243	900	1461	963	897	822	1182	1398	1620	1680
Michelia guangdongensis	780	981	1317	891	1638	897	1059	1299	1029	921	864	1155	978	459	894	1179	963	696	927	1179	1401	1620	1737
Michelia maudiae	780	981	1314	891	1680	825	1059	1299	1266	912	990	1212	978	390	624	1434	936	861	906	1188	1410	1566	1680
Michelia foveolata	600	981	1431	891	1638	894	1059	1299	1038	963	990	924	933	456	996	1407	963	903	897	1179	1401	1620	1650
Michelia cavaleriei	894	981	1401	891	1638	897	1059	1299	1302	915	990	1014	966	477	1062	1221	963	936	1029	1179	1401	1620	1680
Magnolia elegans	918	981	1314	828	1635	897	1059	1299	1179	897	912	1191	975	474	906	759	963	855	912	1182	1413	1620	1680
Magnolia borneensis	150	753	798	225	405	423	669	507	627	102	564	213	117	0	105	759	366	180	207	81	555	312	651
Magnolia carsonii	918	981	1305	891	1563	864	1059	1299	1173	894	993	1029	978	522	981	1068	963	855	912	1182	1413	1620	1422
Magnolia cathcartii	918	981	1311	840	1563	900	1095	1299	1176	900	993	1212	978	966	900	1032	963	873	1263	1182	1407	1620	1680
Magnolia zenii	894	1005	1377	891	1635	897	1059	1299	1182	918	972	930	978	849	996	1338	966	897	915	1230	1395	1620	1680
Magnolia biondii	621	981	1164	852	1359	633	1005	1299	1137	918	891	894	936	615	330	1338	966	852	915	870	852	1620	1680
Magnolia amoena	894	1005	1314	891	1713	897	1059	1299	1071	918	972	1014	978	477	996	1485	966	855	975	1230	1404	1617	1680
Magnolia sinostellata	894	1005	1434	891	1749	897	1098	1299	1179	918	993	975	978	915	1266	1221	966	930	807	1230	1407	1620	1680
Magnolia stellata	990	1005	1434	891	1635	897	1059	1299	1068	918	993	1101	975	1086	996	1338	966	930	1044	1233	1407	1620	1680
Magnolia kobus	990	999	1299	861	1635	897	1059	1299	1167	918	972	1371	975	1047	996	1431	966	897	1044	1233	1410	1620	1680
Magnolia salicifolia	990	1005	1242	894	1563	897	1059	1299	1131	918	993	1245	975	921	996	1485	966	930	1002	1233	1401	1620	1680
Magnolia denudata	873	981	1335	717	1635	897	1059	1299	1179	915	969	1371	936	642	900	1443	966	855	915	1230	1302	1620	1680
Magnolia cylindrica	720	1002	1293	891	1566	633	1059	1299	1182	918	930	1374	978	465	795	1176	966	855	915	1197	1410	1620	1680
Magnolia liliiflora	621	981	1335	891	1473	405	1059	1299	1155	921	930	1029	978	477	984	1176	966	930	915	903	1407	1620	1680
Magnolia sprengeri	621	1002	1281	789	1629	897	1059	1299	1182	750	990	1374	978	687	795	1035	795	822	915	1152	1404	1620	1680
Magnolia sargentiana	894	1005	1410	717	1539	897	1059	1212	1179	909	993	1380	978	1086	933	1359	963	861	816	1074	1299	1620	1680
Magnolia campbellii	990	1002	1308	891	1632	897	1059	1296	1158	900	990	1191	978	831	1104	1221	963	861	933	1179	1407	1620	1680
Magnolia dawsoniana	915	1002	1317	714	1632	897	1059	1299	1167	903	993	1227	978	888	1038	1455	963	861	906	1230	1407	1620	1680
Magnolia acuminata var. *subcordata*	987	981	1371	714	1587	762	1059	1299	1185	864	876	1287	978	468	819	1356	963	861	981	1179	1407	1494	1680
Magnolia acuminata	894	1005	1332	717	1635	648	1059	1299	1185	879	912	1239	978	744	1059	1428	786	696	915	1236	1407	1623	1680
Kmeria duperreana	978	981	1329	717	1632	897	1059	1230	1155	912	852	1119	978	477	1119	840	921	696	948	1218	1401	1620	1680
Kmeria septentrionalis	894	981	1302	891	1635	897	1059	1230	1137	918	912	951	978	477	1116	1221	795	696	1029	1218	1296	1620	1680
Magnolia nitida var. *lotungensis*	894	1005	1410	828	1536	897	1059	1296	1182	912	993	1227	936	735	843	1431	789	930	903	1221	1404	1620	1680
Pachylarnax praecalva	78	216	0	0	78	204	0	0	225	0	102	114	0	0	0	399	0	0	0	90	0	189	0
Magnolia kachirachirai	822	1005	1368	828	1572	897	1059	1236	1065	720	993	969	948	270	744	1431	789	858	876	1215	1386	1617	1680
Magnolia sinica	825	1005	1335	861	1737	897	1059	1293	1161	903	954	1386	936	414	879	1485	789	876	1020	1176	1404	1614	1677
Magnolia nitida	822	1005	1434	861	1542	897	1059	1296	1137	906	957	957	936	408	843	1407	789	885	924	1176	1407	1512	1680
Magnolia poasana	990	981	1371	861	1623	897	1059	1296	1143	918	990	1380	975	747	984	1098	789	693	975	1182	1404	1617	1680
Magnolia panamensis	918	1005	1434	891	1557	897	1059	1296	1005	918	990	1389	975	882	984	1476	789	693	999	1182	1404	1563	1680
Magnolia sharpii	990	1005	1395	891	1623	897	1059	1296	1164	915	993	1383	975	936	1068	1476	789	693	1029	1182	1401	1620	1680
Magnolia guatemalensis	990	981	1431	891	1620	897	1059	1296	981	915	993	1386	975	672	888	1212	789	693	1002	1182	1404	1620	1680
Magnolia iltisiana	774	1005	1341	891	1623	897	1059	1296	1176	915	993	1383	981	474	885	885	789	711	951	1182	1404	1617	1680
Magnolia grandiflora	678	981	1293	891	1620	897	1059	1296	1179	894	912	1290	978	510	996	951	960	507	948	1146	1404	1620	1680
Magnolia striatifolia	918	981	1419	891	1623	708	1059	1296	1074	840	984	1335	981	720	996	1098	960	696	891	1182	1299	1620	1680
Magnolia schiedeana	990	981	1428	891	1623	894	1062	1296	1068	900	993	1335	981	459	900	1329	918	693	906	1182	1299	1620	1680
Magnolia tamaulipana	873	996	1365	891	1623	897	1059	1296	1167	915	993	1104	978	330	693	951	789	693	993	1179	1191	1620	1680
Magnolia virginiana	894	999	1329	891	1476	897	1059	1296	1167	855	831	1143	978	915	1074	1479	789	696	918	1182	1404	1512	1680
Magnolia macrophylla	876	1005	1314	705	1632	897	1059	1296	1089	915	909	1383	978	825	810	1176	963	696	975	1182	1404	1620	1680
Magnolia macrophylla var. *ashei*	918	1005	1353	840	1632	897	1059	1296	1206	915	849	1203	978	807	804	1158	963	696	870	1182	1404	1620	1680
Magnolia dealbata	876	1005	1359	891	1632	897	1059	1296	1110	915	888	1173	978	666	801	1176	963	696	735	1182	1404	1620	1680
Magnolia championii	990	1005	1293	828	1632	897	1059	1296	1113	915	972	1200	915	720	1092	1485	963	696	927	1188	1398	1605	1680

Magnolia coco	990	1005	1350	816	1476	897	1059	1299	1113	720	912	1164	978	603	858	1164	963	507	873	1188	1293	1605	1680
Magnolia phanerophlebia	990	1005	1368	828	1572	897	1059	1299	1113	864	801	942	978	714	1035	1227	795	696	873	1140	1401	1512	1680
Magnolia pterocarpa	894	1005	1281	840	1632	897	1059	1299	1173	420	993	1059	978	522	1200	1392	750	696	876	1080	1293	1605	1680
Magnolia hodgsonii	873	981	1218	861	1632	900	1059	1290	1050	810	909	1281	969	1104	996	840	963	696	894	1215	1401	1605	1683
Magnolia henryi	990	1005	1431	717	1746	897	1059	1299	1182	675	972	1101	975	465	999	1104	942	690	876	1215	1386	1605	1680
Magnolia albosericea	720	1005	1206	615	1557	768	1059	1194	1158	870	972	936	978	498	750	1224	963	693	858	1191	1404	1620	1680
Magnolia liliifera	786	1005	1347	891	1632	897	1053	1194	1182	0	852	1383	978	414	708	1317	960	696	924	1188	1404	1605	1680
Magnolia delavayi	903	981	1431	888	1632	894	1062	1299	1182	870	969	1110	978	1023	1119	1485	963	696	876	1221	1404	1620	1674
Magnolia pastazaensis	990	981	1302	1029	1506	885	1062	1299	912	855	894	1008	975	324	1029	1410	963	696	891	1182	1299	1620	1680
Magnolia equatorialis	621	1005	1371	861	1506	762	1062	1299	1167	135	912	1170	975	255	858	1038	963	489	891	1116	1404	1620	1680
Magnolia ovata	993	981	1260	861	1584	897	1062	1299	915	903	912	1101	975	318	996	999	963	681	915	1182	1398	1620	1680
Magnolia dodecapetala	990	1005	1410	891	1584	897	1062	1299	1167	855	993	1077	963	435	996	1482	963	696	987	981	1296	1620	1680
Magnolia kichuana	993	1005	1317	891	1632	894	1062	1299	1167	903	957	1077	975	171	891	774	963	696	915	1182	1401	1620	1680
Magnolia zamorana	996	999	1326	891	1632	897	1062	1299	1020	720	939	1008	975	351	795	1476	963	696	954	1020	1296	1620	1680
Magnolia mercedesiarum	990	1005	1365	891	1632	909	1062	1299	1179	855	912	1260	975	375	795	1032	1041	696	948	1182	1404	1620	1680
Magnolia mindoensis	990	981	1344	891	1548	897	1062	1263	1164	855	993	1173	975	375	1044	948	963	696	918	1218	1404	1620	1680
Magnolia mexicana	897	1005	1332	861	1629	897	1062	1299	1182	855	972	918	933	372	864	1056	963	696	912	1179	1401	1620	1680
Manglietia conifera	990	981	1323	795	1569	894	1059	1245	1119	789	993	1359	978	816	894	1206	966	696	906	1134	1398	1617	1680
Manglietia insignis	822	1002	1434	891	1572	894	1059	1296	1176	777	993	1359	978	813	966	1206	966	696	1005	1134	1398	1617	1680
Manglietia duclouxii	822	1002	1305	669	1710	894	1059	1296	1956	840	993	1059	978	861	1014	1206	966	696	942	1179	1401	1614	1680
Manglietia hookeri	990	1002	1293	891	1749	879	1059	1287	1161	738	912	1359	978	804	1137	1161	966	696	915	1182	1401	1620	1680
Manglietia aromatica	780	999	1365	966	1605	879	1059	1296	1182	654	993	960	969	543	1029	1125	966	696	1044	1182	1401	1617	1680
Manglietia lucida	918	1002	1356	891	1605	888	1059	1293	1158	762	876	1371	978	438	978	1209	963	696	954	1140	1401	1509	1680
Manglietia grandis	894	1002	1434	891	1572	897	1059	1296	1176	651	852	1143	978	1125	996	1470	963	696	954	1269	1401	1620	1680
Manglietia megaphylla	900	1002	1371	891	1608	894	1059	1296	1185	846	993	1242	978	885	1026	1179	966	696	861	1185	1404	1620	1680
Manglietia rufibarbata	918	1002	1434	891	1572	894	1059	1296	1179	855	993	1221	978	633	1128	1206	963	693	879	1182	1404	1620	1680
Manglietia ventii	918	981	1356	798	1602	891	1059	1296	1179	840	993	1287	969	804	1059	1209	963	696	936	1074	1401	1512	1680
Manglietia ovoidea	894	1002	1371	891	1632	873	1059	1296	1161	846	957	1377	978	834	1092	1158	966	696	1035	1140	1401	1620	1680
Manglietia kwangtungensis	918	1002	1413	828	1632	894	1059	1212	1146	813	993	1356	978	1074	990	1176	963	696	975	1182	1401	1617	1680
Manglietia szechuanica	918	1002	1422	861	1632	894	1059	1299	1167	678	993	1257	978	462	1020	1206	963	696	903	1182	1401	1617	1680
Manglietia pachyphylla	822	981	1350	828	1632	897	1059	1296	1629	906	993	1380	978	801	999	1200	963	696	855	1521	1296	1617	1680
Manglietia fordiana	819	1005	1371	891	1557	768	1059	1296	1182	678	993	1242	978	948	795	1182	960	696	912	1143	1404	1620	1680
Manglietia glauca	918	975	1317	861	1629	897	1059	1296	1083	678	912	1245	894	411	951	1167	963	696	1242	972	1401	1617	1680
Manglietia utilis	894	981	1422	891	1539	894	1059	1296	1182	681	993	1173	936	822	756	1392	966	693	975	1179	1404	1620	1680
Manglietia caveana	894	981	1281	861	1446	897	1059	1296	1251	501	816	1380	936	741	624	1170	966	693	906	1185	1401	1620	1680
Manglietia garrettii	990	1002	1389	828	1632	894	1059	1296	1086	768	993	1383	978	972	1128	1218	864	696	1035	1218	1401	1617	1680
Manglietia decidua	984	981	1431	891	1626	894	1059	1296	1788	843	993	1356	975	888	957	1218	963	696	954	1191	1296	1620	1680
Magnolia obovata	918	1002	1353	714	1557	897	1059	1296	1179	921	972	1380	978	726	1095	1473	963	696	903	1182	1401	1617	1680
Magnolia officinalis	621	1002	1245	714	1557	897	1059	1296	1158	642	909	1239	978	885	987	1209	963	696	852	1143	1404	1617	1680
Magnolia tripetala	918	1002	1434	765	1557	897	1059	1296	1158	918	993	1383	978	1095	1212	1479	963	696	1359	1176	1404	1617	1668
Magnolia wilsonii	621	1005	1227	804	1461	897	1050	1296	1494	720	720	915	978	654	786	1212	963	678	741	951	1293	1617	1680
Magnolia globosa	990	1002	1434	708	1614	867	1050	1296	1158	822	993	1347	978	1032	1020	1479	963	912	852	1212	1395	1617	1680
Magnolia sieboldii	990	981	1302	711	1602	762	1050	1296	1182	873	960	1182	978	1050	927	1473	963	930	903	1155	1404	1617	1680
Magnolia sieboldii subsp. *sinensis*	918	981	1323	699	1614	867	1050	1296	1179	873	960	1086	978	1071	1047	1431	963	858	930	1155	1404	1617	1680
Magnolia fraseri	990	1002	1422	822	1569	897	1059	1296	1113	900	993	1281	978	813	1086	1218	963	861	951	1104	1347	1617	1680
Magnolia fraseri var. *pyrimidata*	990	1002	1434	822	1569	897	1059	1296	1209	900	993	1281	978	537	1050	1218	963	861	981	1104	1401	1620	1686
Magnolia splendens	984	993	1347	891	1569	897	1059	1296	1530	912	969	1374	978	258	705	1113	954	696	921	1233	1401	1620	1680
Magnolia portoricensis	915	993	1434	891	1632	897	1059	1296	1104	912	888	1374	978	402	624	1113	951	696	897	1233	1401	1620	1680
Magnolia cubensis	918	993	1314	885	1629	891	1059	1296	1098	909	1176	1383	978	405	699	1422	954	696	957	1233	1407	1620	1680
Magnolia bankardiorum	987	993	1371	891	1512	897	1059	1293	1245	906	951	1287	978	582	909	1365	954	696	984	1230	1401	1620	1680
Liriodendron chinense	993	978	1392	840	1437	267	1062	1296	873	663	912	705	924	0	582	1113	858	678	720	798	1263	1503	1692
Liriodendron tulipifera X *Liriodendron chinense*	993	957	1371	840	1305	339	1062	1296	873	804	987	666	882	153	582	1020	915	678	864	801	975	1614	1692
Liriodendron tulipifera	813	975	1371	840	1380	339	1062	1296	1080	684	972	723	924	0	582	1110	774	672	912	1179	1290	1617	1692
Ave.	874	983	1345	839	1578	851	1047	1275	1144	826	943	1177	953	604	920	1238	924	770	945	1151	1362	1589	1651

Appendix 29. (Continued)

Taxon name	MKT212863 _1_4_APOV	MKT223188 _1_4_APOV	MKT225962 _1_4_APOV	MKT227293 _1_4_APOV	MKT229926 _1_4_APOV	MKT232584 _1_4_APOV	MKT232706 _1_4_APOV	MKT233399 _1_4_APOV	MKT234475 _1_4_APOV	MKT236372 _1_4_APOV	MKT239819 _1_4_APOV	MKT240662 _1_4_APOV	MKT241357 _1_4_APOV	MKT242726 _1_4_APOV	MKT245813 _1_4_APOV	MKT246079 _1_4_APOV	MKT246461 _1_4_APOV	MKT248631 _1_4_APOV	MKT249328 _1_4_APOV	MKT250009 _1_4_APOV	MKT251689 _1_4_APOV	MKT259369 _1_4_APOV	MKT264772 _1_4_APOV
Length of the reference for each loci	990	969	921	987	1221	1017	1338	1272	1368	1398	1116	1479	939	1071	1014	1098	1275	1311	1401	1521	1614	978	1479
Magnolia griffithii	990	822	921	948	1224	1017	693	1233	948	1308	1053	1605	939	1071	1011	1098	1173	1311	1335	1515	1506	975	1476
Michelia baillonii	990	873	921	897	1230	1017	921	1272	870	1308	1053	1542	939	984	987	1098	1215	1311	1401	1521	1506	978	1476
Michelia sirindhorniae	987	822	714	948	1218	1017	921	1233	1191	1380	1053	1563	939	1218	987	1098	1275	1311	1326	1521	1587	978	1473
Michelia velutina	990	873	921	948	1221	1017	1038	1266	1173	1380	1125	1710	939	1068	1011	1098	1275	1311	1353	1521	1506	975	1476
Michelia masticata	984	822	891	948	1023	1017	276	1233	1155	1308	1053	1311	939	984	1011	1068	1275	1308	1329	1512	1575	978	1476
Michelia sphaerantha	984	822	885	897	1212	1017	1023	1272	990	1380	1125	1479	939	930	1011	1068	1275	1308	1329	1512	1575	978	1476
Michelia doltsopa	990	867	921	945	1224	1017	693	1233	1188	1308	1125	1332	939	1071	1014	1098	1188	1311	1329	1521	1488	978	1476
Michelia lacei	990	822	921	948	1224	1017	813	1233	1182	1308	1038	1311	774	1071	987	1068	1269	1311	1293	1521	1425	978	1476
Michelia salicifolia	990	810	921	912	1167	1017	921	1230	1125	1203	1122	1167	939	984	987	1098	1155	1311	1350	1515	1521	978	1476
Michelia martini	990	822	921	948	1020	1017	693	1233	1032	1308	1044	1311	939	1068	1011	1038	1170	1221	1206	1521	1524	978	1401
Michelia coriacea	990	852	828	948	1233	1017	582	1272	1191	1359	1038	1479	936	1071	987	1098	1272	1308	1401	1518	1515	978	1470
Michelia ingrata	963	822	930	948	948	1017	918	1233	867	1383	1125	1344	939	1071	1011	1095	1113	1311	1548	1521	1455	978	1476
Michelia wilsonii	978	834	921	948	1215	1017	921	1233	1191	1380	1116	1422	939	1071	987	1098	1275	1308	1401	1521	1278	978	1476
Michelia floribunda	981	822	921	948	1008	1017	921	1272	1002	1308	1047	1482	939	1071	987	1101	1206	1308	1551	1521	1509	978	1476
Michelia chapensis	984	822	897	897	1221	1017	918	1272	1152	1383	1002	1311	939	1068	1011	1074	1275	1308	1398	1521	1398	978	1476
Michelia chapensis	984	876	888	948	1221	1017	918	1233	948	1101	1125	1335	939	1071	1011	1074	1113	1308	1293	1458	1470	978	1476
Michelia hypolampra	768	822	921	909	1212	1017	918	1233	1068	1101	1110	1311	942	894	987	1098	1152	1218	1401	1515	1398	978	1482
Michelia viridipetala	897	822	921	948	1227	1017	924	1272	1161	1104	1053	1377	939	1071	1011	1098	1272	1095	1329	1287	1455	978	1401
Michelia balansae	987	819	918	948	1221	1017	1038	1233	1191	1305	1053	1380	939	981	1011	1098	1269	1308	1389	1518	1530	978	1476
Michelia guangxiensis	990	822	921	948	1221	1017	1023	1272	1173	1308	1125	1311	930	1014	1011	1098	1275	1299	807	1386	1530	978	1473
Michelia figo	822	822	915	897	1212	1017	921	1233	891	1308	1053	1380	813	1014	1011	1098	1275	1311	1293	1521	1542	975	1473
Michelia shiluensis	990	663	930	897	1221	1017	921	1218	1191	1203	1125	1311	936	984	1011	1098	1275	1311	1293	1521	1500	978	1470
Michelia odora	738	822	921	897	1044	1017	921	1272	945	1305	1125	1311	939	972	984	1038	1200	1095	1398	1458	1365	978	1455
Michelia montana	990	822	921	948	1215	1017	1038	1272	1191	1377	1125	1347	942	1071	1011	1098	1275	1308	1398	1518	1536	978	1476
Elmerrillia ovalis	987	822	918	897	768	1017	918	1230	1005	1191	1056	1311	939	984	990	1098	1203	1251	1353	1443	1434	966	1476
Michelia compressa	981	858	921	897	780	1017	1041	1233	1071	1305	1053	1332	939	1071	1011	1098	1206	1299	1389	1521	1542	978	1476
Michelia macclurei	990	822	921	897	1101	1017	924	1272	870	1305	1053	1326	939	1074	1014	1098	1275	1164	1356	1527	1518	978	1476
Michelia guangdongensis	714	822	924	825	1128	1017	921	1272	858	1101	1053	1311	939	894	1011	1098	1107	1143	1158	1362	1455	978	1476
Michelia maudiae	990	822	921	897	1032	1017	921	1233	711	1077	1053	1338	657	984	1014	1098	1125	1311	1398	1521	1506	978	1476
Michelia foveolata	822	816	918	897	948	1017	921	1233	990	1305	1044	1371	927	1071	990	1068	1113	1299	1356	1521	1506	978	1476
Michelia cavaleriei	990	822	921	948	1215	1017	921	1233	1191	1305	975	1476	939	1068	1011	1098	1275	1311	1392	1521	1497	1044	1476
Magnolia elegans	990	672	921	927	1215	1017	1134	1233	1113	1305	1053	1311	822	978	1014	1101	1152	1311	1293	1515	1458	978	1446
Magnolia borneensis	315	69	534	333	531	0	123	165	120	255	426	336	420	105	951	483	219	948	474	597	516	372	240
Magnolia carsonii	768	660	921	897	1191	1017	1134	1233	936	1377	1053	1311	831	984	990	1101	1110	1308	1356	1374	1392	978	1434
Magnolia cathcartii	990	663	921	897	1218	1017	921	1269	768	1308	1125	1338	936	1017	1011	1095	1188	1311	1401	1515	1434	978	1479
Magnolia zenii	822	819	915	774	1215	1017	1041	1272	1197	1377	1122	1569	939	984	1014	1098	1110	1311	1398	1521	1536	978	1479
Magnolia biondii	192	591	783	936	1215	1017	813	1272	1029	939	867	1311	921	765	990	915	546	504	513	1224	1110	978	1404
Magnolia amoena	990	819	921	897	1218	1017	1062	1269	1194	1377	1125	1311	939	984	990	1098	1197	1311	1455	1521	1533	978	1479
Magnolia sinostellata	822	876	921	987	1218	1017	1041	1272	951	1377	1125	1479	939	1071	990	1098	1275	1311	1401	1521	1533	1044	1479
Magnolia stellata	975	819	915	987	1221	1017	1041	1272	1164	1377	1125	1311	939	1071	1014	1098	1275	1311	1401	1521	1614	978	1479
Magnolia kobus	990	816	849	936	1191	1017	1041	1272	1053	1377	1122	1311	927	1020	990	1098	1275	1317	1401	1521	1536	978	1479
Magnolia salicifolia	963	819	921	936	1218	1017	918	1272	1170	1305	1113	1311	939	843	1014	1098	1272	1209	1395	1521	1521	978	1479
Magnolia denudata	990	825	603	897	1143	1017	477	1251	1071	1305	1116	1311	939	882	1014	1047	1125	1311	1356	1521	1464	978	1476
Magnolia cylindrica	909	825	921	774	1182	1017	921	1251	951	1377	1116	1311	936	984	990	1098	1194	1164	1359	1491	1527	978	1479
Magnolia liliiflora	690	822	921	897	1200	1014	921	1272	924	1020	1053	1308	939	957	1014	915	1188	1308	1401	1227	1443	978	1479
Magnolia sprengeri	909	825	783	936	1563	1017	921	1326	750	1305	867	1311	822	1068	990	1098	1188	1143	1401	1284	1458	978	1314
Magnolia sargentiana	819	855	921	912	1200	1017	921	1026	1095	1179	1125	1380	663	975	990	1098	1092	1299	1401	1143	1536	978	1479
Magnolia campbellii	987	855	915	897	1200	1017	921	1269	1218	1305	1125	1311	936	984	1014	1098	1275	1311	1401	1386	1362	1032	1479
Magnolia dawsoniana	990	873	921	900	1137	1017	891	1242	1071	1305	1053	1542	939	972	990	1098	1125	1308	1401	1521	1533	978	1479
Magnolia acuminata var. *subcordata*	990	825	888	897	1224	1017	921	1251	1116	1200	1128	1320	939	1071	990	1098	1188	1311	1410	1521	1491	978	1479
Magnolia acuminata	510	849	921	897	1218	1017	921	1272	1002	768	1125	1308	939	984	1014	1071	1275	1224	1401	1362	1491	978	1479
Kmeria duperreana	990	849	723	897	1221	1017	693	1233	864	1377	1125	1311	939	1068	1014	1098	1269	1308	1386	1521	1533	981	1449
Kmeria septentrionalis	990	825	666	891	1161	1017	924	1272	663	1305	1125	1311	939	894	1014	1098	1188	1182	1338	1521	1608	981	1281
Magnolia nitida var. *lotungensis*	858	744	921	897	1224	1017	828	1227	951	1305	1125	1308	822	1068	990	1098	1275	1311	1257	1518	1455	978	1479
Pachylarnax praecalva	0	120	120	0	0	0	228	0	0	0	399	276	0	96	0	210	153	0	0	183	240	0	0
Magnolia kachirachirai	984	744	918	897	1164	1017	906	1227	1206	1305	1125	1311	939	1068	1014	1098	1188	1311	1398	1503	1455	978	1428
Magnolia sinica	882	780	918	897	1230	1017	849	1227	747	1308	1053	1326	939	1068	990	1098	1188	1215	1383	1515	1530	978	1479
Magnolia nitida	549	813	591	897	1212	1017	921	1242	948	1305	1050	1410	822	894	1014	1098	1101	1224	1386	1518	1542	978	1395
Magnolia poasana	990	825	681	897	1212	1017	948	1233	1011	1146	1122	1338	936	1074	1014	1098	1170	1320	1338	1518	1461	954	1476
Magnolia panamensis	990	849	918	897	1140	1017	921	1233	1203	1305	1122	1311	936	1074	1014	1098	1275	1320	1284	1518	1464	954	1476
Magnolia sharpii	990	825	921	897	1215	1017	828	1233	993	1377	1122	1311	939	1074	1014	1098	1275	1308	1398	1521	1464	954	1476
Magnolia guatemalensis	990	849	294	897	1215	1017	924	1272	1140	1272	1122	1560	939	1074	990	1098	1275	1308	1287	1521	1542	954	1476

Magnolia iltisiana	990	825	987	897	1188	1017	828	1233	1158	1203	1119	1359	939	1077	1014	1098	1275	1308	1299	1521	1464	954	1476
Magnolia grandiflora	990	825	819	897	1224	1017	828	1272	1203	1377	1125	1311	939	642	990	1098	1203	1224	1347	1521	1506	978	1476
Magnolia striatifolia	990	825	900	897	1209	1017	828	1272	777	1200	1122	1311	939	990	990	1098	1281	1308	1368	1362	1308	795	1476
Magnolia schiedeana	768	825	777	897	1218	1017	825	1233	744	1161	1125	1473	939	975	1014	1098	1275	1311	1347	1488	1608	978	1476
Magnolia tamaulipana	780	825	780	897	1206	1017	828	1233	672	1014	1125	1311	939	984	1014	1047	1275	1221	1266	1521	1584	954	1470
Magnolia virginiana	681	831	900	897	1215	1017	828	1272	807	1305	1116	1308	939	1074	1005	1098	1137	1278	1392	1521	1443	978	1479
Magnolia macrophylla	933	741	690	897	969	1017	828	1272	1149	1305	1107	1311	939	984	1014	1047	1125	1308	1386	1521	1419	978	1476
Magnolia macrophylla var. *ashei*	933	741	741	897	1218	1017	693	1272	1050	1221	1122	1401	939	1071	990	1047	1275	1308	1386	1521	1419	978	1476
Magnolia dealbata	765	594	672	897	1146	1017	921	1272	1104	1257	1110	1362	939	1011	1014	1047	1092	1311	1386	1521	1440	978	1473
Magnolia championii	990	822	675	936	1140	1014	828	1233	1020	1305	1053	1311	936	888	990	1098	1269	1311	1140	1386	1533	978	1479
Magnolia coco	816	825	594	936	1161	1014	609	1272	897	1176	1053	1311	639	732	990	915	1047	1311	1185	1509	1533	978	1479
Magnolia phanerophlebia	822	771	591	897	1221	1014	828	1269	711	1305	1053	1311	939	600	990	1047	1269	1308	1323	1521	1335	978	1476
Magnolia pterocarpa	987	909	915	897	1230	1017	828	1272	327	873	897	1266	912	600	990	1047	1269	1248	1335	1515	1533	978	1479
Magnolia hodgsonii	990	825	684	897	1170	1017	693	1233	891	1203	1053	1311	540	801	987	1047	1050	1311	978	1515	1533	978	1479
Magnolia henryi	990	825	918	897	1221	1014	828	1272	1011	1305	1119	1410	939	600	1014	1098	1269	1311	1149	1515	1533	729	1449
Magnolia albosericea	906	822	597	897	1149	1014	801	1251	549	1305	1053	1353	792	585	990	915	447	1164	1275	1521	1305	978	1407
Magnolia liliifera	819	849	852	897	1149	972	828	1047	1080	999	1125	1311	807	600	1014	1098	1269	1308	1341	1365	1455	1020	1476
Magnolia delavayi	978	825	921	897	1215	1017	921	1272	1128	1377	1053	1344	936	759	1011	1047	1275	1311	1386	1386	1524	978	1476
Magnolia pastazaensis	765	825	672	897	1179	1017	912	1233	1095	1125	1041	1542	939	873	1014	915	1167	1311	1110	1386	1236	978	1311
Magnolia equatorialis	765	825	777	912	1185	1017	489	1233	894	1020	1053	1542	939	951	1014	1098	1188	1311	1125	1386	885	978	1479
Magnolia ovata	879	825	687	897	1185	1017	921	1233	1173	1125	1053	1584	939	861	990	1098	1185	1311	1323	1386	1347	978	1479
Magnolia dodecapetala	987	825	699	948	1212	1017	921	1272	1218	1278	1053	1311	939	951	990	1098	1275	1311	1275	1521	1335	978	1479
Magnolia kichuana	972	825	918	897	639	1017	828	1233	1191	1176	1053	1542	939	636	1014	1098	1275	1311	1323	1386	1284	978	1479
Magnolia zamorana	987	825	921	897	1140	1017	828	1233	1062	1020	906	1542	792	861	1014	1038	1188	1311	1323	1386	1236	978	1479
Magnolia mercedesiarum	876	825	924	897	1215	1017	891	1269	1068	1281	1053	1542	939	951	1014	1098	1188	1311	1314	1386	1398	978	1479
Magnolia mindoensis	987	825	921	897	783	1017	921	1272	1068	1281	1053	1542	939	1035	1014	1098	1188	1311	1332	1386	1395	978	1479
Magnolia mexicana	963	627	918	897	1215	1017	948	1233	1218	1080	1053	1332	939	735	1014	1098	1272	1311	1275	1407	1284	978	1479
Manglietia conifera	768	744	918	948	1215	1017	915	1227	1071	1200	1044	1422	939	1011	1014	1047	1188	1308	1227	1383	1491	978	1479
Manglietia insignis	909	825	918	948	1209	1017	915	1227	1221	1284	1053	1311	939	1011	990	1098	1188	1308	1338	1488	1491	978	1479
Manglietia duclouxii	699	876	591	897	1140	1005	918	1227	1098	975	1053	1356	939	837	1014	1098	1188	1224	1353	1518	1359	978	1479
Manglietia hookeri	585	807	768	897	1230	699	915	1227	1215	1131	1020	1311	825	927	1014	1098	1188	1311	1398	1518	1533	978	1479
Manglietia aromatica	510	825	921	897	1191	1014	828	1221	648	1284	804	1311	822	1011	1014	1047	1089	1311	1293	1515	1455	978	1314
Manglietia lucida	990	825	921	948	1221	1017	915	1224	1164	1353	1053	1311	939	1068	990	1098	1203	1311	1293	1518	1575	978	1476
Manglietia grandis	987	825	921	897	1227	1017	918	1227	1209	1071	1044	1371	936	963	1014	1098	1188	1308	1419	1383	1533	978	1479
Manglietia megaphylla	990	825	687	948	1221	1017	921	1227	1080	1284	1122	1302	825	834	1014	1047	1188	1311	1335	1518	1509	978	1479
Manglietia rufibarbata	948	822	918	939	1221	1014	918	1227	1221	1284	1122	1305	864	921	1014	1098	1275	1311	1227	1521	1509	978	1479
Manglietia ventii	990	825	885	897	1206	1017	915	1227	870	1080	1053	1311	939	927	990	1098	1038	1308	1338	1518	1524	978	1479
Manglietia ovoidea	990	876	918	897	1134	1014	1032	1227	1221	1284	1116	1311	942	837	1011	1098	1119	1311	1254	1518	1512	978	1476
Manglietia kwangtungensis	990	744	831	936	1230	1017	921	1272	1221	1179	912	1407	939	1011	1014	1098	1188	1311	1398	1521	1509	978	1479
Manglietia szechuanica	990	825	915	897	1227	1017	918	1272	1200	1281	1110	1311	993	1011	1008	1098	1275	1311	1398	1518	1587	978	1479
Manglietia pachyphylla	990	825	921	897	1200	993	918	1227	1071	1284	1053	1311	822	927	1014	1098	1272	1311	1338	1518	1512	975	1479
Manglietia fordiana	909	837	918	897	1152	1017	918	1227	1164	1101	1041	1311	939	837	990	1098	1275	1317	1338	1518	1506	978	1479
Manglietia glauca	990	744	918	897	1206	1017	918	1227	1071	1074	1044	1167	939	927	1014	1095	1164	1311	1293	1467	1512	978	1476
Manglietia utilis	990	825	918	897	1215	1017	918	1227	852	1284	1044	1380	939	1008	987	1098	1188	1311	1227	1518	1509	978	1479
Manglietia caveana	990	825	729	897	1170	1017	528	1227	900	1179	1053	1215	825	690	990	1098	915	1311	1338	1515	1398	978	1479
Manglietia garrettii	990	825	918	897	1200	1017	918	1227	1218	1284	1044	1356	939	984	1014	1098	1188	1311	1338	1518	1002	978	1464
Manglietia decidua	990	771	831	897	1215	1017	915	1227	1209	1254	1116	1311	792	777	1014	1098	1119	1305	1389	1386	1527	978	1464
Magnolia obovata	990	825	708	897	1188	1017	810	1227	1212	1131	1125	1311	933	984	990	1098	1185	1308	1350	1521	1431	978	1464
Magnolia officinalis	990	744	591	897	1176	1017	819	1227	1122	867	1125	1311	939	840	990	1098	1188	1308	1290	1521	1419	978	1464
Magnolia tripetala	990	825	678	954	1215	1017	1038	1272	1203	1206	1125	1311	822	1071	1014	1098	1275	1311	1335	1521	1365	978	1464
Magnolia wilsonii	549	744	618	897	1197	1017	639	1272	666	789	1125	1311	822	807	1014	915	681	1122	1200	1284	1524	978	1464
Magnolia globosa	990	762	684	897	1143	1005	693	1272	1050	1179	1125	1413	939	984	1014	1098	1188	1311	1383	1386	1533	978	1464
Magnolia sieboldii	879	744	582	897	1197	1017	828	1233	1011	1284	1125	1293	942	975	1014	1098	1059	1311	1245	1521	1509	978	1464
Magnolia sieboldii subsp. *sinensis*	984	744	774	897	1086	1017	639	1272	1176	1236	1116	1293	942	975	990	1047	1275	1311	1386	1521	1509	978	1464
Magnolia fraseri	984	741	918	945	1224	1017	828	1230	1068	1281	1125	1419	888	1071	1014	1098	1188	1293	1293	1521	1452	978	1479
Magnolia fraseri var. *pyrimidata*	984	741	918	897	1224	1017	825	1272	939	1233	1125	1326	942	1071	1014	1098	1188	1179	1338	1518	1599	978	1479
Magnolia splendens	822	780	783	948	1140	1017	915	1272	1050	1290	1053	1311	918	1065	990	1098	1188	1311	1398	1497	1488	975	1479
Magnolia portoricensis	990	780	921	948	1215	1017	915	1233	1056	1239	1053	1311	1149	1008	1014	1098	1275	1311	1377	1521	1488	975	1479
Magnolia cubensis	990	744	753	897	1215	1017	918	1233	858	1080	1044	1311	636	825	990	1035	1083	1311	1386	1491	1488	981	1479
Magnolia bankardiorum	990	819	921	897	1206	1017	1011	1272	1146	1290	1050	1341	939	1029	1014	1098	1170	1308	1416	1488	1488	978	1479
Liriodendron chinense	432	741	582	897	1230	1020	828	1191	609	789	810	1335	822	519	993	912	1089	987	1149	1005	786	984	1290
Liriodendron tulipifera X *Liriodendron chinense*	432	585	585	897	819	1020	639	1191	543	735	1059	1269	822	519	993	912	969	1161	1149	1005	879	984	1290
Liriodendron tulipifera	612	642	612	897	1182	1020	828	1179	897	927	1074	1329	822	519	993	912	828	1161	1389	1287	789	984	1290

Ave.	891	792	828	898	1156	997	863	1225	1009	1207	1062	1342	894	934	995	1064	1166	1264	1307	1451	1433	963	1440

Appendix 29. (Continued)

Taxon name	MKT265035_1_4_APOV	MKT265344_1_4_APOV	MKT267794_1_4_APOV	MKT268004_1_4_APOV	MKT268009_1_4_APOV	MKT271231_1_4_APOV	MKT272162_1_4_APOV	MKT272727_1_4_APOV	MKT273218_1_4_APOV	MKT273349_1_4_APOV	MKT275800_1_4_APOV	MKT276078_1_4_APOV	MKT277271_1_4_APOV	MKT277935_1_4_APOV	MKT278004_1_4_APOV	MKT279186_1_4_APOV	MKT280150_1_4_APOV	MKT281671_1_4_APOV	MKT286562_1_4_APOV	MKT287698_1_4_APOV	MKT288332_1_4_APOV	MKT295445_1_4_APOV	MKT296549_1_4_APOV
Length of the reference for each loci	912	1131	996	1437	1458	1530	1062	957	915	990	1491	1119	1509	1455	1488	1146	915	1314	1122	1260	1143	1482	1143
Magnolia griffithii	825	1131	1002	1332	1458	1251	942	972	834	978	1140	1119	1509	1368	1488	1146	771	1296	1122	1263	1056	1491	1143
Michelia baillonii	825	1131	1002	1332	1458	993	918	765	864	978	1140	1119	1509	1368	1404	1089	771	1296	1122	1263	1140	1485	1143
Michelia sirindhorniae	825	1131	1002	1437	1458	1305	918	765	900	981	0	1119	1509	1368	1488	1089	915	1296	1122	1260	1056	1479	1143
Michelia velutina	825	1131	1002	1437	1458	1086	942	765	879	978	1293	1119	1509	1368	1485	1146	771	1269	1122	1260	1140	1494	1143
Michelia masticata	825	1131	1002	1332	1458	1062	918	765	834	975	1131	1119	1509	1368	1485	1089	771	1296	1122	1254	1056	1494	1143
Michelia sphaerantha	825	1131	1002	1332	1458	1263	918	765	834	975	1131	1119	1509	1368	1485	1146	651	1200	1122	1260	1056	1494	1143
Michelia doltsopa	825	1125	1002	1332	1449	1269	918	945	867	981	1140	1119	1509	1368	1485	1146	915	1296	1122	1260	1143	1485	1143
Michelia lacei	825	1125	1002	1329	1449	1377	918	765	867	981	1140	1119	1509	1368	1485	1089	771	1311	1122	1311	1143	1485	1143
Michelia salicifolia	825	1125	996	1332	1458	1017	918	765	867	969	1140	1119	1509	1455	1485	1020	651	1146	1122	1263	1140	1491	1143
Michelia martini	825	1131	1002	1332	1458	885	918	765	903	981	1260	1119	1506	1368	1485	1089	915	1296	1122	1257	1143	1479	1143
Michelia coriacea	804	1131	1002	1332	1449	1209	942	765	867	978	1230	1119	1509	1368	1485	1089	915	1296	1122	1260	1143	1491	1143
Michelia ingrata	768	1131	1002	1332	1455	1152	918	765	900	969	1131	1119	1509	1368	1485	1146	687	1296	1122	1263	1143	1482	1143
Michelia wilsonii	819	1131	1002	1329	1458	1206	918	765	888	981	1239	1119	1509	1368	1485	1089	915	1296	1122	1257	1056	1485	1143
Michelia floribunda	825	1125	1005	1437	1452	1356	918	765	837	978	915	1119	1509	1368	1488	1089	795	1296	1122	1257	1140	1491	1143
Michelia chapensis	828	1125	996	1332	1455	1203	918	912	867	978	1143	1119	1500	1368	1485	1089	771	1311	1119	1263	1143	1482	1143
Michelia chapensis	828	1131	996	1332	1455	1380	918	765	867	978	1134	1119	1500	1368	1485	1089	771	1080	1119	1266	1143	1485	1143
Michelia hypolampra	825	1131	999	1332	1452	933	918	843	840	978	1131	1119	1503	1368	1485	1089	651	1080	1122	1263	1143	1482	1143
Michelia viridipetala	825	1131	939	1335	1455	1143	918	765	903	978	1140	1119	1509	1368	1485	1146	795	1080	1122	1152	1140	1485	1143
Michelia balansae	825	1131	1005	1335	1452	1410	918	765	870	978	1140	1119	1509	1368	1485	1089	915	1308	1122	1257	1143	1482	1143
Michelia guangxiensis	825	1131	1005	1335	1455	999	918	765	99	978	1131	1119	1509	1368	1485	1089	915	1314	1122	1257	1056	1494	1143
Michelia figo	768	1131	1005	1332	1437	747	918	765	867	969	1131	1119	1515	1368	1488	1077	915	1308	1122	1107	1143	1488	1143
Michelia shiluensis	825	1068	987	1332	1455	1008	918	765	897	969	1176	1119	1509	1455	1485	1089	771	1146	1101	1257	1056	1482	1143
Michelia odora	804	1131	1005	1332	1455	924	918	765	903	978	1131	1119	1509	1368	1404	1146	915	1065	1122	1263	1143	1473	1143
Michelia montana	825	1131	1005	1332	1455	1110	918	765	636	969	1128	1119	1509	1368	1488	1146	915	1254	1122	1248	1143	1476	1143
Elmerrillia ovalis	804	1131	885	1332	1452	621	918	768	867	837	1131	1119	1509	1368	1482	1089	912	1296	1119	1059	822	1482	1143
Michelia compressa	825	1131	1005	1332	1449	1149	918	765	99	972	1131	1119	1509	1368	1485	1089	915	1269	1122	1260	1143	1488	1143
Michelia macclurei	825	1131	1002	1332	1455	951	918	765	903	969	1137	1119	1509	1368	1485	1089	915	1203	1122	1257	1143	1485	1143
Michelia guangdongensis	768	1131	1002	1332	1455	903	918	762	768	963	1119	1119	1509	1368	1404	1089	840	1122	1122	1101	1143	1479	1143
Michelia maudiae	825	1131	885	1332	1455	804	918	765	858	969	1131	1119	1509	1368	1404	1146	915	1146	1122	1254	1143	1485	1143
Michelia foveolata	825	1131	930	1332	1455	1434	918	765	894	969	1140	1119	1509	1368	1485	1089	915	1296	1122	1254	1143	1491	1143
Michelia cavaleriei	825	1131	1002	1332	1455	1146	918	765	867	969	1131	1119	1509	1368	1485	1089	915	1296	1122	1254	1143	1491	1143
Magnolia elegans	762	1131	972	1332	1455	1098	918	765	903	975	1131	1119	1506	1368	1359	1086	771	1248	1122	1260	1140	1485	1143
Magnolia borneensis	0	588	177	621	915	150	390	198	114	279	219	531	78	0	258	0	141	498	510	399	231	558	201
Magnolia carsonii	798	1131	987	1332	1455	1098	918	765	99	975	1131	1119	1506	1242	1401	1089	771	1185	1122	1263	816	1473	1143
Magnolia cathcartii	819	1068	999	1437	1458	999	918	765	867	975	1254	1119	1506	1368	1401	1089	771	1185	1122	1203	816	1545	1143
Magnolia zenii	825	1131	996	1437	1458	1056	942	765	99	978	1263	1119	1509	1455	1488	1071	915	1296	1122	1263	1143	1485	1143
Magnolia biondii	663	1131	996	1065	1458	846	942	504	768	759	1263	1119	720	1302	1488	933	840	1155	930	921	876	1479	969
Magnolia amoena	825	1125	996	1437	1458	1194	942	765	870	978	1293	1119	1503	1368	1485	1146	915	1296	1122	1263	1143	1479	1143
Magnolia sinostellata	825	1131	996	1437	1458	1353	1023	846	918	978	1140	1119	1509	1368	1485	1146	915	1146	1122	1260	1128	1476	1143
Magnolia stellata	825	1131	996	1437	1458	1428	942	921	99	978	1263	1119	1509	1368	1485	1146	915	1296	1122	1260	1143	1482	1143
Magnolia kobus	825	1131	996	1437	1461	966	918	765	99	978	1263	1119	1509	1368	1485	1146	915	1296	1122	1260	1044	1482	1143
Magnolia salicifolia	825	1131	996	1437	1458	1110	942	765	99	978	1263	1119	1509	1455	1488	1089	840	1146	1122	1260	1143	1491	1140
Magnolia denudata	825	1131	993	1332	1458	999	918	765	870	978	1263	1119	1509	1368	1488	1089	915	1002	1122	1260	1143	1488	1143
Magnolia cylindrica	825	1131	996	1332	1407	1089	918	765	768	978	1113	1119	1509	1368	1485	1089	840	1254	1122	1263	1026	1473	975
Magnolia liliiflora	825	1128	993	1437	1458	978	918	765	99	978	1140	1119	1509	1368	1485	1089	771	1143	1122	984	1056	1479	1119
Magnolia sprengeri	825	1131	996	1437	1458	879	942	765	867	978	1263	1119	1455	1455	1485	1020	915	1296	1125	1257	1143	1488	1119
Magnolia sargentiana	825	1131	984	1440	1458	918	918	765	867	978	1260	1119	1506	1368	1485	1089	831	1317	1122	1260	1155	1479	1119
Magnolia campbellii	825	1131	888	1332	1458	1026	918	765	894	969	1137	1119	1506	1368	1485	1089	915	1290	1122	1260	822	1479	1119
Magnolia dawsoniana	825	1131	990	1437	1458	972	918	894	867	978	1260	1119	1506	1368	1485	1020	915	1308	1119	1257	1143	1563	1119
Magnolia acuminata var.	825	1128	993	1437	1440	1104	942	765	138	978	1125	1119	1509	1449	1485	1089	771	1146	1122	1254	822	1482	840

subcordata																								
Magnolia acuminata	825	1131	999	1437	1452	804	942	765	876	978	1518	1119	1509	1368	1485	1089	771	1311	1122	1260	1143	1482	756
Kmeria duperreana	804	1131	999	1332	1455	1242	942	762	864	978	1146	1119	1503	1368	1485	1074	771	1230	1122	1254	822	1464	1143
Kmeria septentrionalis	768	1131	879	1332	1455	990	942	765	864	909	1146	1119	1506	1368	1485	1086	771	1200	1122	1260	822	1458	1143
Magnolia nitida var. *lotungensis*	825	1131	999	1332	1455	606	918	765	867	978	1185	1119	1509	1368	1482	1044	912	1077	1119	1260	978	1476	1131
Pachylarnax praecalva	108	0	0	78	0	0	0	99	0	90	0	279	0	0	0	0	105	108	0	0	405	222	0
Magnolia kachirachirai	825	1131	993	1332	1458	987	918	765	867	978	1140	1119	1509	1368	1485	1068	912	1266	1122	1257	1143	1479	1140
Magnolia sinica	825	1131	999	1332	1455	1167	942	768	903	975	1140	1119	1509	1368	1404	1008	840	1269	1119	1260	1050	1479	1143
Magnolia nitida	825	1131	921	1332	1455	765	918	765	867	975	1140	1119	1506	1368	1485	1008	912	1269	1122	1257	1143	1479	1143
Magnolia poasana	825	1122	1014	1440	1452	996	918	663	99	975	1263	1119	1503	1455	1488	1146	771	1290	1119	1263	1143	1485	1140
Magnolia panamensis	825	1122	996	1440	1452	1152	942	663	870	975	1263	1119	1503	1368	1488	1146	915	1269	1119	1266	1143	1479	1140
Magnolia sharpii	825	1122	1014	1335	1452	1272	942	843	870	975	1140	1119	1503	1368	1488	1146	912	1302	1122	1260	1143	1479	1098
Magnolia guatemalensis	825	1122	996	1440	1452	1086	918	663	864	975	1263	1119	1503	1455	1488	1146	771	1269	1119	1260	1143	1479	1140
Magnolia iltisiana	825	1122	882	1110	1452	1176	942	876	99	975	1140	1119	1503	1368	1488	1146	915	1269	1122	1260	1140	1479	1098
Magnolia grandiflora	825	1122	924	1332	1455	1332	942	765	837	978	1194	1119	1506	1368	1488	1146	915	1296	1122	1203	1143	1485	1140
Magnolia striatifolia	825	1122	930	1335	1455	1110	942	987	99	978	1263	1119	1506	1455	1488	1089	915	1236	1122	1152	960	1476	1140
Magnolia schiedeana	825	1122	1005	1332	1455	1083	942	663	870	978	1140	1119	1506	1368	1488	1089	915	1245	1119	1260	729	1473	963
Magnolia tamaulipana	825	1122	924	1332	1455	804	918	765	870	978	1137	1119	1506	1368	1488	1089	915	1182	1122	1260	933	1476	1140
Magnolia virginiana	804	1122	999	1332	1455	834	918	765	864	984	1137	1041	1503	1368	1485	1143	915	1302	1116	1272	615	1485	1140
Magnolia macrophylla	825	1131	1002	1437	1455	1086	918	765	864	978	1095	1119	1485	1368	1485	1089	915	1296	1122	1263	963	1464	1140
Magnolia macrophylla var. *ashei*	825	1131	999	1332	1455	1269	942	765	864	978	1095	1119	1485	1455	1485	681	915	1146	1122	1254	1050	1473	966
Magnolia dealbata	825	1131	1002	1332	1455	1053	918	765	864	978	1218	1119	1506	1368	1488	858	915	1200	1122	1257	1053	1473	1140
Magnolia championii	804	1131	999	1434	1455	987	918	765	864	981	1140	1119	1464	1371	1473	1146	840	1269	1131	1263	822	1473	1056
Magnolia coco	768	1131	882	1329	1455	777	918	765	870	708	1140	1119	1464	1371	1473	1062	771	1146	1122	1236	822	1473	1134
Magnolia phanerophlebia	768	1131	990	1332	1455	990	918	765	870	987	1140	1119	1404	1371	1488	1089	771	1200	1122	1233	822	1485	1143
Magnolia pterocarpa	768	1185	669	1215	1455	1053	918	909	864	687	1140	1119	1509	1371	1488	1014	882	1131	1122	906	528	1488	1143
Magnolia hodgsonii	768	1218	861	1107	1455	1080	918	765	0	990	1140	1119	1509	1371	1485	1089	822	1200	1122	1257	822	1473	1143
Magnolia henryi	825	1131	990	1332	1455	1167	918	765	0	993	1140	1119	1503	1371	1488	1089	882	1269	1122	1257	822	1470	1143
Magnolia albosericea	825	1131	915	1437	1455	705	915	768	870	693	1140	1119	1446	1371	1488	1089	915	1206	1122	1260	822	1476	1143
Magnolia liliifera	813	1131	888	1227	1455	738	918	768	873	540	1137	1119	1506	1371	1416	1089	897	1200	1068	1230	1143	1485	1143
Magnolia delavayi	804	1131	999	1332	1452	1203	918	762	864	990	1140	1119	1509	1371	1488	1089	915	1266	1122	1263	1056	1491	1143
Magnolia pastazaensis	774	1119	921	1209	1449	603	918	765	882	990	1140	1119	1503	1368	1485	1089	912	1200	1116	1257	822	1461	1113
Magnolia equatorialis	831	1119	999	1431	1458	432	942	876	882	990	1002	1119	1503	1368	1404	1089	771	1146	1116	1257	1044	1461	1113
Magnolia ovata	831	1119	921	1209	1458	711	918	765	882	990	1143	1119	1503	1455	1485	1089	915	1185	1116	1257	1143	1461	1113
Magnolia dodecapetala	831	1119	999	1431	1458	777	942	912	882	990	1233	1119	1503	1368	1485	1143	915	1269	1116	1257	1143	1458	1113
Magnolia kichuana	831	1119	999	1209	1458	777	942	765	882	990	1143	1119	1503	1368	1404	1143	915	1269	1116	1254	1143	1461	1113
Magnolia zamorana	831	1119	999	1431	1458	885	942	945	882	990	1143	1119	1503	1368	1485	1089	915	1185	1116	1257	1143	1461	1113
Magnolia mercedesiarum	831	1119	999	1209	1458	885	942	765	882	990	1143	1119	1503	1455	1485	1086	915	1314	1116	1257	1143	1461	939
Magnolia mindoensis	831	1056	999	1209	1458	1074	942	945	882	990	1140	1119	1503	1455	1485	1089	915	1269	1116	1248	1143	1461	1113
Magnolia mexicana	825	1119	996	1431	1458	732	942	765	900	927	1143	1119	1503	1368	1404	1089	915	1170	1116	1257	1143	1461	1137
Manglietia conifera	825	1131	867	1107	1455	1107	918	765	852	972	1143	1119	1455	1368	1485	1089	915	1137	1122	1260	822	1497	1044
Manglietia insignis	825	1131	867	1107	1455	1245	918	765	852	972	1080	1119	1509	1368	1485	1146	840	1077	1122	1101	822	1497	1044
Manglietia duclouxii	825	1128	1005	1425	1455	1053	918	765	864	972	1152	1119	1509	1455	1485	1146	915	1200	1122	1248	822	1482	1044
Manglietia hookeri	825	1128	1002	1332	1455	1023	918	765	864	972	1152	1119	1455	1368	1485	1011	915	1302	1122	1101	822	1479	1044
Manglietia aromatica	825	1131	1005	1437	1455	915	918	765	864	975	1083	1119	1500	1368	1485	1089	915	1077	1122	1104	1143	1488	1044
Manglietia lucida	825	1131	870	1332	1203	1281	918	765	858	975	1554	1119	1500	1368	1485	1146	915	1200	1122	1260	1143	1479	1044
Manglietia grandis	825	1128	999	1332	1455	1143	918	765	858	975	1140	1119	1509	1368	1485	1014	915	1194	1122	1167	822	1479	1044
Manglietia megaphylla	825	1128	999	1332	1455	1017	918	948	858	969	1083	1119	1509	1368	1485	1008	915	1308	1122	1185	822	1479	1059
Manglietia rufibarbata	825	1125	666	1332	1455	987	918	765	864	972	1155	1119	1509	1368	1485	1146	840	1200	1122	1098	822	1479	1059
Manglietia ventii	825	1005	999	1332	1455	801	918	765	858	963	1083	1119	1509	1383	1488	1146	912	1077	1122	1101	1143	1488	915
Manglietia ovoidea	825	1131	1005	1332	1455	1119	918	765	858	975	1149	1119	1509	1368	1485	1089	912	1140	1122	1191	822	1494	1044
Manglietia kwangtungensis	825	1128	1005	1332	1455	915	918	765	879	975	1155	1119	1509	1368	1476	1146	822	1311	1122	1176	822	1482	915
Manglietia szechuanica	825	1131	999	1332	1455	1017	918	765	864	972	1074	1119	1509	1368	1476	1086	915	1140	1122	1188	822	1503	1044
Manglietia pachyphylla	828	1131	834	1215	1455	1020	918	765	864	975	1152	1119	1509	1368	1476	1146	915	1200	1122	1098	822	1473	1143
Manglietia fordiana	825	1131	870	1332	1455	990	918	765	864	972	1077	1119	1509	1368	1482	1086	915	1140	1122	1173	1050	1476	1143
Manglietia glauca	825	1128	993	1128	1455	1035	918	765	864	975	1158	1119	1503	1368	1476	1092	840	1200	1122	1191	1143	1485	1143
Manglietia utilis	825	1131	870	1215	1455	1104	918	765	864	975	1140	1119	1509	1368	1485	1089	840	1266	1119	1191	822	1476	1143
Manglietia caveana	789	1092	999	1332	1455	978	918	765	864	975	1140	1119	1509	1455	1485	942	780	1176	1104	1251	744	1479	1044
Manglietia garrettii	825	1116	999	1107	1455	1089	918	765	864	972	1140	1119	1509	1368	1485	1143	840	1143	1122	1260	822	1476	1044
Manglietia decidua	825	1131	990	1107	1455	1152	918	765	858	975	1140	1119	1509	1458	1485	1146	915	1278	1119	1101	1029	1479	1041
Magnolia obovata	825	1131	1104	1107	1455	912	942	765	864	954	1140	1119	1509	1371	1485	1089	915	1296	1122	1260	819	1479	969
Magnolia officinalis	825	1131	1011	1107	1455	906	918	765	864	975	1140	1119	1509	1458	1485	1089	915	1320	1122	1257	1143	1479	969
Magnolia tripetala	825	1131	1011	1107	1455	1116	918	768	864	537	1140	1119	1509	1371	1485	1146	915	1299	1122	1107	822	1488	1143
Magnolia wilsonii	825	1131	882	1332	1455	828	918	615	864	840	1263	1119	1509	1368	1404	1089	720	936	1026	1068	822	1497	969
Magnolia globosa	825	1131	999	1437	1455	999	918	765	831	978	1263	1119	1506	1368	1482	1089	915	1266	1122	1170	735	1476	1143
Magnolia sieboldii	816	1131	999	1332	1455	1020	918	765	864	861	1263	1119	1509	1368	1485	1143	915	1311	1122	1173	1140	1488	1140

Magnolia sieboldii subsp. *sinensis*	816	1128	999	1332	1455	1017	918	765	864	861	1263	1119	1509	1368	1485	1143	915	1266	1122	1257	957	1503	1140
Magnolia fraseri	804	1131	999	1215	1410	1011	918	765	864	1029	1002	1119	1509	1368	1485	1143	915	1311	1122	1260	822	1482	1143
Magnolia fraseri var. *pyrimidata*	804	1131	999	1437	1410	1083	918	831	864	978	1002	1119	1509	1368	1485	1086	915	1200	1122	1260	822	1479	1143
Magnolia splendens	825	1122	870	1437	1455	960	918	936	867	921	1137	1119	1509	1395	1401	1146	915	1143	1122	1233	1083	1482	1143
Magnolia portoricensis	825	1122	870	1437	1455	888	942	765	867	921	1137	1119	1506	1395	1482	1143	912	1266	1122	1236	1083	1482	1143
Magnolia cubensis	825	1122	1002	1437	1455	1080	918	645	867	921	1137	1119	1509	1395	1482	1146	915	1263	1122	1239	762	1479	1140
Magnolia bankardiorum	825	1122	1002	1434	1455	1200	942	765	867	978	1137	1119	1509	1395	1482	1134	771	1269	1122	1260	762	1479	1143
Liriodendron chinense	828	1131	663	1374	1449	603	921	750	864	987	1140	1041	1506	1359	1278	777	678	1209	1053	1263	735	1449	1125
Liriodendron tulipifera X *Liriodendron chinense*	828	1131	663	1374	1449	603	921	750	864	987	1140	1041	1506	1359	1398	777	594	1089	1053	1053	735	1440	1125
Liriodendron tulipifera	825	1131	663	1365	1449	435	921	762	864	987	1140	1119	1503	1359	1329	1011	858	1206	1053	1050	735	1449	1122
Ave.	805	1113	950	1316	1436	1005	913	768	764	943	1136	1106	1474	1357	1450	1070	850	1210	1103	1206	989	1463	1090

Appendix 29. (Continued)

Taxon name	MKT297810 _1_4_APOV	MKT299474 _1_4_APOV	MKT300606 _1_4_APOV	MKT301981 _1_4_APOV	MKT304100 _1_4_APOV	MKT307031 _1_4_APOV	MKT308997 _1_4_APOV	MKT310237 _1_4_APOV	MKT311863 _1_4_APOV	MKT312086 _1_4_APOV	MKT312523 _1_4_APOV	MKT312769 _1_4_APOV	MKT315244 _1_4_APOV	MKT316544 _1_4_APOV	MKT320490 _1_4_APOV	MKT323905 _1_4_APOV	MKT331516 _1_4_APOV	MKT332424 _1_4_APOV	MKT337520 _1_4_APOV	MKT341624 _1_4_APOV	MKT341643 _1_4_APOV	MKT346077 _1_4_APOV	MKT346845 _1_4_APOV
Length of the reference for each loci	1422	1395	966	1068	1629	1104	1494	1275	1005	1452	1464	966	918	1293	1458	1473	1041	972	1422	975	1287	1422	1632
Magnolia griffithii	1257	1227	954	831	1617	861	1410	1146	804	1437	1320	561	918	1299	1362	1464	1041	972	1410	888	1272	1416	1629
Michelia baillonii	1419	1227	954	921	1518	909	1407	1143	804	1437	1248	744	918	1299	1425	1464	1041	972	1407	888	1272	1416	1626
Michelia sirindhorniae	1422	1227	918	1065	1629	858	1488	1143	960	1452	1458	924	918	1299	1407	1464	1041	972	1422	885	1272	1422	1632
Michelia velutina	1422	1227	963	1065	1629	930	1488	1146	1002	1446	1296	858	918	1299	1458	1464	1041	933	1422	879	1272	1422	1629
Michelia masticata	1416	1227	966	1065	1419	822	1494	1146	771	1452	1461	855	918	921	1458	1467	1041	969	1422	888	1272	1422	1629
Michelia sphaerantha	1416	1227	771	1065	1629	930	1494	1146	1002	1452	1461	855	918	1299	1410	1464	1041	972	1422	888	1272	1422	1629
Michelia doltsopa	1422	1290	774	1065	1629	933	1494	1146	801	1452	1248	750	918	1299	1473	1002	1041	972	1344	888	1122	1422	1632
Michelia lacei	1422	1227	957	1065	1629	1014	1494	1146	1005	1452	1326	861	918	1299	1458	1002	1041	972	1422	888	1122	1422	1632
Michelia salicifolia	1422	1227	885	1065	1629	798	1494	1146	1005	1452	1248	912	912	921	1434	1464	1041	972	1344	714	1272	1416	1632
Michelia martini	1416	1227	834	1065	1629	849	1488	1146	1005	1452	1326	621	918	1299	1377	1002	1041	972	1422	840	1272	1422	1632
Michelia coriacea	1425	1227	957	984	1629	954	1494	1146	1005	1452	1461	744	918	1299	1458	924	1041	972	1422	888	1272	1422	1629
Michelia ingrata	1422	1227	774	1065	1629	867	1494	1146	1005	1452	1461	786	918	1299	1401	924	1041	972	1422	888	1272	1422	1632
Michelia wilsonii	1422	1227	954	1065	1629	813	1494	1146	1005	1452	1317	852	918	1299	1458	1464	1041	972	1332	888	1272	1422	1632
Michelia floribunda	1422	1227	957	1065	1629	762	1494	1146	573	1452	1281	912	918	1299	1365	1023	1041	972	1401	888	1272	1416	1632
Michelia chapensis	1398	1227	954	1032	1629	975	1488	1146	981	1452	1326	840	912	1296	1458	924	1041	972	1410	888	1272	1422	1635
Michelia chapensis	1422	1227	954	1032	1629	528	1488	1146	804	1452	1293	744	912	1296	1416	1470	1041	972	1410	888	1272	1422	1635
Michelia hypolampra	1422	1227	750	1065	1629	726	1488	1146	1005	1545	1248	615	918	1296	1404	1464	1041	972	1422	888	1272	1095	1629
Michelia viridipetala	840	1227	753	951	1629	921	1494	1143	387	1452	1269	489	765	1299	1449	1407	1041	876	1419	888	1272	1332	1632
Michelia balansae	1422	1227	957	1062	1620	918	1494	1143	1005	1452	1311	798	918	1299	1458	897	1041	972	1422	888	1272	1422	1632
Michelia guangxiensis	1422	1227	753	984	1629	861	1494	1146	1005	1452	1296	831	918	1299	1434	921	1041	972	1422	924	1272	1422	1632
Michelia figo	1416	1227	774	1065	1629	939	1494	1146	804	1452	1248	438	765	1299	1323	1350	1041	972	1350	777	1272	1422	1623
Michelia shiluensis	1407	1227	963	1119	1629	972	1491	1146	879	1443	1386	675	918	1290	1407	1452	1041	999	1350	861	1269	1422	1629
Michelia odora	1422	1227	957	1065	1629	930	1494	1146	879	1452	1248	744	915	1290	1458	1455	1041	972	1350	873	1272	1422	1632
Michelia montana	1419	1227	882	1062	1629	804	1488	1146	984	1452	1326	999	918	1290	1458	924	1041	972	1410	972	1272	1422	1632
Elmerrillia ovalis	1419	1227	885	1065	1629	900	1488	1146	846	1452	1458	687	918	1290	1398	1203	1041	1014	1422	846	1272	1422	1584
Michelia compressa	1422	1227	957	921	1518	867	1494	1146	804	1452	1419	588	918	1293	1458	1455	1041	966	1350	888	1272	1347	1632
Michelia macclurei	1422	1227	954	1065	1626	882	1494	1146	954	1452	1308	684	918	1299	1455	1464	1041	972	1422	888	1272	1422	1629
Michelia guangdongensis	840	1227	957	1065	1629	762	1494	1146	678	1452	1146	429	918	1299	1431	924	1041	972	1404	975	1272	1416	1629
Michelia maudiae	1311	1227	681	1065	1629	792	1494	1146	1056	1443	1461	645	918	1299	1446	924	1041	969	1347	888	1272	1422	1629
Michelia foveolata	1419	1227	957	1065	1629	828	1491	1146	1005	1452	1248	567	918	1290	1440	1464	1041	972	1410	558	1272	1422	1629
Michelia cavaleriei	1422	1227	957	1065	1629	840	1488	1146	804	1452	1326	690	918	1299	1458	1464	1041	972	1419	888	1272	1422	1629
Magnolia elegans	1419	1233	876	1023	1527	888	1491	1164	981	1452	1389	771	885	1284	1422	1185	1041	975	1422	804	1272	1422	1632
Magnolia borneensis	237	390	258	213	0	372	966	90	144	0	528	285	0	126	0	324	453	306	276	141	189	639	354
Magnolia carsonii	1422	1233	885	1068	1515	693	1491	1146	855	1338	1389	423	918	1293	1434	1461	1011	978	1413	888	1272	1221	1590
Magnolia cathcartii	1422	1227	885	1065	1608	876	1494	1146	804	1386	1386	621	918	1293	1422	924	1041	957	1356	888	1272	1422	1629
Magnolia zenii	1422	1227	885	1068	1629	951	1488	1170	1002	1452	1386	816	918	1293	1443	1464	1041	960	1419	885	1269	1422	1632
Magnolia biondii	876	1227	513	1068	1518	702	1494	936	966	1062	1281	381	918	1032	1359	708	1041	843	1419	612	1269	1164	1539

Magnolia amoena	1422	1227	885	1068	1629	1020	1488	1164	999	1449	1386	1170	918	1293	1440	1464	1041	966	1419	888	1272	1422	1629
Magnolia sinostellata	1272	1227	834	1068	1629	1086	1494	1167	1002	1452	1461	843	918	1293	1458	1464	1041	966	1419	888	1272	1422	1626
Magnolia stellata	1302	1227	885	1068	1629	975	1494	1164	1005	1452	1458	972	918	1293	1464	1464	1041	969	1350	975	1272	1422	1626
Magnolia kobus	1422	1227	885	1068	1629	861	1494	1164	906	1452	1389	918	918	1293	1440	1464	1041	972	1422	924	1272	1422	1632
Magnolia salicifolia	1422	1227	885	1068	1629	882	1494	1164	1005	1452	1386	966	918	1293	1458	1467	1041	969	1422	975	1272	1422	1626
Magnolia denudata	1269	1227	813	1068	1518	666	1494	1143	1002	1452	1386	585	918	1293	1404	1455	1026	972	1422	888	1266	1422	1617
Magnolia cylindrica	837	1227	885	1068	1629	747	1551	1146	966	1362	1359	804	918	1293	1332	1455	1026	969	1419	885	1272	1422	1647
Magnolia liliiflora	1260	1227	957	924	1518	570	1494	1164	387	1443	1386	285	765	1293	1164	1410	1041	1041	1404	825	1272	1422	1629
Magnolia sprengeri	987	1227	813	1068	1629	600	1494	1164	741	1452	1278	549	918	1293	1389	1410	1041	1041	1419	558	1164	1422	1632
Magnolia sargentiana	1422	1227	957	1068	1629	765	1494	1146	753	1398	1326	696	918	1293	1458	924	1041	972	1422	975	1272	1422	1632
Magnolia campbellii	1422	1227	957	1068	1629	627	1494	1146	1008	1452	1461	495	918	1293	1440	927	1041	972	1422	888	1272	1422	1632
Magnolia dawsoniana	978	1227	774	1068	1518	900	1494	1143	792	1449	1248	777	918	1170	1437	978	1041	1041	1422	888	1272	1347	1632
Magnolia acuminata var. *subcordata*	1422	1227	810	1068	1524	579	1494	1146	888	1452	1389	591	918	1293	1443	924	1017	621	1422	888	1272	1419	1626
Magnolia acuminata	1419	1224	957	924	1629	681	1416	1146	801	1452	1464	621	918	1293	1455	891	1041	972	1422	825	1272	1347	1626
Kmeria duperreana	1350	1227	882	978	1629	1077	1494	1143	969	1449	1386	918	918	1293	1416	897	1041	972	1422	798	1257	1422	1527
Kmeria septentrionalis	1023	1227	882	978	1605	726	1494	1143	1002	1449	1386	918	918	1293	1257	879	1041	972	1422	744	1242	1422	1527
Magnolia nitida var. lotungensis	867	1227	957	1068	1629	636	1494	1161	387	1446	1383	537	759	1173	1440	924	1041	972	1422	888	1269	1422	1632
Pachylarnax praecalva	132	237	0	159	0	90	0	93	0	0	0	0	222	93	0	183	0	0	0	0	105	0	0
Magnolia kachirachirai	1086	1227	891	1068	1605	891	1491	1158	789	1446	1383	825	915	1287	1452	1122	1041	972	1422	885	1245	1422	1635
Magnolia sinica	1110	1227	954	1065	1626	927	1494	1143	873	1452	1386	477	918	1293	1452	927	1041	963	1422	888	1266	1422	1632
Magnolia nitida	936	1227	885	984	1626	765	1494	807	1002	1452	1461	735	918	1293	1338	870	1041	972	1422	888	1248	1422	1632
Magnolia poasana	1347	1227	960	1068	1629	939	1491	1143	873	1470	1383	912	918	1293	1452	1146	1041	972	1422	855	1263	1416	1623
Magnolia panamensis	1347	1227	951	1068	1629	939	1491	1143	951	1470	1383	858	918	1293	1458	1464	1035	972	1422	855	1263	1422	1623
Magnolia sharpii	1347	1227	954	1068	1629	939	1491	1143	993	1470	1458	747	918	1293	1458	918	1041	972	1350	858	1263	1416	1620
Magnolia guatemalensis	1347	957	948	1068	1629	894	1491	1143	993	1470	1383	858	918	1293	1458	1140	1041	972	1422	858	1263	1422	1623
Magnolia iltisiana	1347	1227	957	1068	1629	909	1491	1143	1002	1470	1452	822	903	1293	1404	924	1041	972	1422	858	1263	1422	1614
Magnolia grandiflora	1224	1227	813	1029	1518	891	1080	1143	1002	1545	1386	789	918	1293	1458	1329	1041	972	1422	888	1245	1419	1647
Magnolia striatifolia	1347	1227	957	1494	1629	735	1491	1140	999	1449	1386	591	759	1293	1341	903	1041	972	1350	888	1263	1416	1479
Magnolia schiedeana	1338	1227	813	1068	1629	846	1494	1143	1002	1467	1464	612	918	1293	1446	1146	1041	972	1422	858	1263	1413	1632
Magnolia tamaulipana	1059	1227	885	918	1629	813	1488	1140	846	1452	1284	546	918	1293	1440	870	1041	972	1422	858	1263	1422	1626
Magnolia virginiana	885	1227	885	1035	1629	765	1494	1143	750	1392	1386	570	759	1293	1440	870	1041	972	1419	891	1143	1422	1632
Magnolia macrophylla	1299	1227	954	1068	1629	690	1458	1119	1002	1452	1461	690	891	1293	1440	1143	1095	972	1350	885	1272	1419	1632
Magnolia macrophylla var. *ashei*	1107	1227	882	1068	1629	690	1458	1140	798	1452	1461	660	891	1293	1416	870	1041	972	1350	885	1272	1419	1632
Magnolia dealbata	1107	1227	954	1068	1629	858	1458	1140	996	1452	1392	630	891	1293	1416	843	1041	972	1350	885	1272	1419	1629
Magnolia championii	1422	1227	960	1068	1608	906	1494	1143	1002	1452	1452	603	918	1293	1455	1464	1041	972	1338	858	1269	1419	1563
Magnolia coco	1134	1227	885	816	1608	783	1494	1143	846	1452	1371	627	918	1293	1437	927	1041	1068	1341	858	1164	1419	1635
Magnolia phanerophlebia	1134	1227	885	924	1503	903	1494	1146	750	1452	1386	663	759	1293	1458	924	1041	1065	1338	804	1272	1422	1635
Magnolia pterocarpa	1260	1227	957	801	1614	195	1392	807	504	1443	1293	630	918	1293	1416	978	918	966	1245	837	1272	1422	1620
Magnolia hodgsonii	1422	1227	957	1068	1614	1026	1488	1146	1002	1443	1284	663	918	1230	1326	1266	1041	966	1338	888	1251	1302	1614
Magnolia henryi	1149	1227	954	1068	1503	876	1494	1146	1002	1449	1458	795	900	1293	1404	1314	1041	966	1335	858	1272	1422	1620
Magnolia albosericea	987	1227	957	906	1509	693	1296	1140	771	1437	1383	684	759	1299	1407	924	1041	858	1335	714	1272	1158	1635
Magnolia liliifera	1083	1227	753	969	1503	867	1494	1146	966	1446	1278	309	918	1293	1494	924	1041	966	1335	852	1272	1236	1629
Magnolia delavayi	1422	1365	951	1065	1614	912	1494	1146	993	1449	1368	885	918	1293	1449	1458	1041	972	1335	978	1272	1422	1617
Magnolia pastazaensis	1083	1227	957	1065	1542	783	1470	1110	588	1449	1386	468	765	1161	1428	924	1041	963	1332	774	1272	1239	1629
Magnolia equatorialis	936	1227	882	921	1629	960	1470	1149	822	1341	1362	405	915	1290	1434	1089	1041	963	1332	444	1272	1419	1020
Magnolia ovata	1371	1227	954	1065	1518	873	1470	1107	717	1449	1293	645	915	1020	1386	1188	1041	963	1332	858	1272	1419	1632
Magnolia dodecapetala	1371	1227	957	1065	1629	903	1470	1146	798	1449	1461	1170	915	1290	1431	1461	1041	963	1335	858	1248	1419	1626
Magnolia kichuana	1284	1227	957	1062	1626	891	1470	1137	822	1449	1383	636	915	1290	1431	1146	1041	963	1332	858	1272	1419	1626
Magnolia zamorana	1080	1227	957	1065	1485	783	1470	1146	822	1449	1284	459	915	1290	1380	1251	1041	963	1332	858	1272	1419	1479
Magnolia mercedesiarum	1275	1227	960	1065	1626	945	1470	1146	969	1449	1284	912	915	1230	1380	1242	1041	963	1332	858	1251	1419	1623
Magnolia mindoensis	1398	1227	957	1065	1629	924	1455	1146	1002	1449	1395	645	915	1290	1416	1212	1041	963	1332	858	1272	1419	1626
Magnolia mexicana	1080	1224	957	984	1629	780	1470	1152	801	1452	1383	540	915	1146	1452	1374	1041	963	1332	885	1272	1419	1626
Manglietia conifera	1347	1227	879	1068	1629	936	1494	1143	1002	1452	1386	693	918	1293	1452	927	1041	969	1350	888	1251	1422	1638
Manglietia insignis	1347	1227	879	1068	1629	1035	1494	1143	1212	1452	1386	711	918	1293	1443	1305	1041	969	1350	888	1251	1422	1638
Manglietia duclouxii	1032	1227	699	1068	1629	615	1494	1146	771	1452	1461	621	918	1173	1263	1242	1041	726	1350	804	1266	1422	1632
Manglietia hookeri	1200	1227	879	1068	1629	954	1500	1146	1002	1452	1386	906	918	1173	1392	1464	1041	969	1350	888	1269	1422	1593
Manglietia aromatica	1203	1227	609	984	1419	726	1491	1146	927	1452	1386	426	759	1293	828	1125	1041	957	1419	888	1269	1422	1632
Manglietia lucida	1347	1227	879	1068	1629	864	1494	1146	912	1449	1380	729	918	1293	1431	1146	1041	966	1422	888	1269	1347	1617
Manglietia grandis	1347	1227	882	1068	1629	903	1494	1146	1002	1452	1386	900	918	1293	1455	1455	1041	969	1407	888	1269	1422	1632
Manglietia megaphylla	1200	1227	882	1068	1629	816	1494	1146	771	1452	1455	726	759	1173	1461	1461	1041	969	1422	888	1269	1422	1632
Manglietia rufibarbata	1341	1227	879	1068	1626	975	1500	1146	945	1449	1248	687	918	1293	1329	1458	1041	969	1350	888	1269	1422	1632
Manglietia ventii	873	1227	873	1068	1629	912	1491	1146	756	1452	1386	642	867	1299	1161	1371	1041	1020	1350	888	1161	1422	1629
Manglietia ovoidea	1032	1227	879	1068	1626	858	1398	1146	801	1452	1386	690	918	1173	1329	1464	1041	969	1422	888	1269	1422	1632
Manglietia kwangtungensis	1308	1227	879	1068	1572	1017	1491	1146	1002	1452	1461	645	918	1290	1443	1461	1041	969	1422	906	1269	1422	1632
Manglietia szechuanica	1035	1227	879	1068	1629	909	1494	1146	906	1452	1386	747	918	1293	1443	1464	1041	969	1422	888	1116	1422	1632

Manglietia pachyphylla	1062	1227	699	1017	1626	699	1491	1146	738	1452	1386	672	918	1293	1449	1461	1041	969	1422	888	1269	1422	1632
Manglietia fordiana	915	1227	879	1068	1551	744	1491	1146	801	1452	1461	618	759	1293	1443	1332	1041	969	1422	873	1269	1422	1632
Manglietia glauca	1350	1227	879	1068	1518	870	1494	1146	744	1449	1356	762	918	1293	1260	1464	1041	969	1395	885	1269	1302	1626
Manglietia utilis	1296	1227	882	1068	1629	867	1500	1146	645	1452	1464	912	918	1293	1431	1461	1041	969	1341	888	1272	1422	1632
Manglietia caveana	1227	1227	876	1068	1629	897	1491	1146	645	1452	1362	909	918	1293	1428	1539	1041	972	1419	861	1272	1239	1560
Manglietia garrettii	1170	1227	894	1068	1575	924	1494	1146	780	1452	1386	906	918	1293	1437	1146	1041	966	1422	888	1248	1422	1626
Manglietia decidua	1347	1227	879	984	1605	867	1491	1146	1002	1452	1461	813	918	1293	1404	1455	1041	939	1422	888	1272	1422	1632
Magnolia obovata	1350	1227	882	1068	1629	504	1437	1146	1044	1449	1359	645	759	1287	1380	1464	1041	954	1338	876	1251	1422	1632
Magnolia officinalis	1062	1227	882	1068	1629	564	1494	1146	987	1452	1389	918	918	1287	1413	1410	1041	1161	1422	876	1272	1422	1608
Magnolia tripetala	1347	1227	885	1068	1629	924	1494	1146	1053	1452	1461	945	918	1287	1449	1464	1041	969	1422	888	1251	1407	1632
Magnolia wilsonii	795	1227	696	984	1512	441	1497	1143	747	1449	1074	630	918	1023	1437	1182	1041	972	1347	888	1164	1422	1632
Magnolia globosa	1200	1227	951	1068	1554	969	1425	1143	801	1449	1386	906	918	1287	1329	1461	1041	966	1350	888	1272	1422	1632
Magnolia sieboldii	1347	1227	951	1065	1605	780	1497	1143	717	1452	1461	846	918	1293	1434	1461	1041	972	1350	888	1164	1422	1632
Magnolia sieboldii subsp. *sinensis*	1167	1227	954	1068	1395	777	1497	1143	717	1452	1389	912	915	1173	1260	1014	1041	972	1350	888	1164	1422	1632
Magnolia fraseri	1197	1227	885	1068	1599	789	1488	1146	798	1446	1380	966	918	1293	1440	927	1041	966	1422	888	1272	1422	1632
Magnolia fraseri var. pyrimidata	915	1227	813	1068	1563	870	1488	1146	933	1449	1380	744	918	1293	1440	990	1041	954	1422	888	1272	1422	1626
Magnolia splendens	1110	1227	885	1065	1575	753	1494	1146	777	1464	1386	744	918	1293	1452	1464	1041	927	1422	870	1272	1407	1617
Magnolia portoricensis	1398	1227	957	981	1575	912	1494	1146	798	1464	1386	693	918	1290	1332	1464	1041	927	1422	885	1272	1407	1617
Magnolia cubensis	1275	1227	882	1065	1581	849	1494	1146	1002	1464	1386	681	918	1173	1431	1464	1038	969	1350	885	1272	1224	1488
Magnolia bankardiorum	1392	1227	957	1065	1626	810	1494	1146	999	1464	1386	777	918	1293	1395	1455	1041	969	1323	885	1245	1287	1617
Liriodendron chinense	657	1227	783	816	1485	534	1434	1056	516	876	1236	420	768	963	1167	819	1041	912	1335	459	1167	1098	1272
Liriodendron tulipifera X *Liriodendron chinense*	585	1227	687	816	1410	654	1434	867	555	876	1146	420	768	921	1167	819	1041	819	1338	459	1149	1098	837
Liriodendron tulipifera	771	1227	774	777	1500	693	1434	867	744	876	1338	420	768	924	1026	828	1041	945	1407	459	1257	1098	1302
Ave.	1226	1212	874	1024	1570	819	1464	1117	861	1409	1349	705	883	1243	1380	1199	1027	952	1368	842	1238	1375	1581

Appendix 29. (Continued)

sample name	MKT348011 _1_4_APOV	MKT348660 _1_4_APOV	MKT351756 _1_4_APOV	MKT353296 _1_4_APOV	MKT353714 _1_4_APOV	MKT358559 _1_4_APOV	MKT358844 _1_4_APOV	MKT359827 _1_4_APOV	MKT362594 _1_4_APOV	MKT363416 _1_4_APOV	MKT363585 _1_4_APOV	MKT004172 _1_4	MKT004737 _1_4	MKT004964 _1_4	MKT005032 _1_4	MKT005265 _1_4	MKT006261 _1_4	MKT007960 _1_4	MKT012543 _1_4	MKT013138 _1_4	MKT014126 _1_4	MKT014815 _1_4	MKT014829 _1_4
Length of the reference for each loci	1005	1089	927	984	1119	1041	1263	1329	1620	1074	1287	441	834	309	342	282	597	195	885	870	465	744	402
Magnolia griffithii	963	1089	927	819	1116	765	1029	1080	1620	1071	1224	342	828	309	342	279	0	0	171	0	207	312	396
Michelia baillonii	963	1089	858	789	1116	765	1023	1149	1620	1071	1224	558	999	309	342	282	0	204	411	0	462	738	393
Michelia sirindhorniae	981	1086	672	984	1116	861	1143	1149	1479	1074	1224	0	426	309	342	282	0	75	408	210	462	675	402
Michelia velutina	993	1086	927	984	1116	861	1140	1149	1524	1074	1224	342	579	309	342	282	0	102	246	222	462	741	366
Michelia masticata	987	1089	927	810	1116	765	1023	1149	1047	1074	1224	219	963	309	342	279	0	0	453	0	462	705	378
Michelia sphaerantha	987	1089	927	984	1116	765	1029	1080	1047	1074	1224	219	831	309	342	279	0	102	297	270	462	312	390
Michelia doltsopa	984	1089	672	819	1116	765	1254	1149	1524	1074	1224	444	795	309	342	282	0	102	453	357	462	702	402
Michelia lacei	984	1089	672	984	1116	861	1143	1080	1524	1074	1224	219	831	309	342	282	0	102	453	279	462	642	402
Michelia salicifolia	645	1089	606	810	1116	861	1029	1149	1524	1074	1224	204	831	309	342	282	0	102	279	144	417	348	396
Michelia martini	954	1089	855	819	1116	768	1029	1080	1524	918	1224	501	267	309	219	282	0	102	237	0	309	741	402
Michelia coriacea	987	1089	858	810	891	768	1029	1080	1524	1074	1224	0	831	309	342	282	0	102	417	0	462	687	402
Michelia ingrata	957	1089	927	717	1116	765	1143	1080	1524	1038	1224	222	828	309	342	282	0	114	264	270	462	684	402
Michelia wilsonii	987	1089	927	984	1116	849	1140	1149	1524	1074	1224	219	831	309	342	282	0	102	237	174	462	690	402
Michelia floribunda	987	1089	672	810	1116	867	1029	1149	1524	978	1224	219	828	309	342	282	0	102	306	276	462	720	387
Michelia chapensis	963	1089	672	810	1116	765	1029	1086	1524	1038	1224	138	1017	309	342	270	0	75	492	264	411	720	402
Michelia chapensis	960	1089	930	810	1116	765	1023	1080	1524	1038	1224	90	831	309	342	282	0	75	423	0	309	657	390
Michelia hypolampra	963	1089	858	819	1110	765	1143	1149	1524	1017	1224	222	828	309	342	279	0	102	312	0	459	540	381
Michelia viridipetala	816	1089	921	819	1116	765	1254	1074	1524	1038	1224	183	828	309	342	279	0	0	309	0	120	363	375
Michelia balansae	987	1089	672	984	1116	765	1029	1080	1524	999	1224	219	834	309	342	282	0	102	369	0	462	708	321
Michelia guangxiensis	987	1089	828	810	1116	765	1143	1149	1524	1074	1224	357	1017	309	342	279	0	0	342	144	462	681	402
Michelia figo	819	1089	858	819	1116	765	1143	1080	1524	1038	1224	204	828	309	342	279	0	0	456	0	462	312	402
Michelia shiluensis	963	1089	660	810	1116	732	1143	1149	1524	1074	1224	432	1017	309	342	282	0	102	291	90	462	669	363
Michelia odora	987	1089	672	819	1116	834	1143	1149	1524	1074	1224	336	963	309	339	276	0	99	369	0	309	669	402
Michelia montana	963	1089	927	819	1116	765	1020	1080	1524	1038	1224	444	828	309	342	282	0	102	456	447	462	624	393

Elmerrillia ovalis	957	1089	648	834	1116	759	1146	1080	1524	489	1224	171	1014	309	342	282	0	186	72	0	462	447	399
Michelia compressa	963	675	924	819	1116	738	1143	1086	1524	1074	1224	432	828	309	342	282	0	102	285	0	291	312	402
Michelia macclurei	987	1089	927	810	1116	765	1143	1080	1524	1038	1224	138	957	309	342	282	0	180	321	0	411	588	396
Michelia guangdongensis	750	1089	858	810	1122	765	909	1080	1524	1038	1224	336	831	309	342	282	0	0	273	0	309	312	390
Michelia maudiae	987	1089	927	810	1116	765	1143	1149	1524	1017	1236	222	816	309	342	282	0	0	237	0	120	600	213
Michelia foveolata	819	1089	927	819	1116	765	1143	1080	1620	1038	1224	0	828	309	342	282	0	99	417	0	120	312	390
Michelia cavaleriei	963	1089	927	984	1116	768	1029	1080	1524	1074	1224	141	828	309	345	282	0	102	339	0	462	663	393
Magnolia elegans	981	1089	765	984	891	861	1119	1149	1524	1074	1224	180	729	309	342	279	0	198	330	0	441	399	396
Magnolia borneensis	102	261	438	147	216	84	645	504	807	186	456	171	624	192	129	0	0	0	0	0	99	168	213
Magnolia carsonii	819	1089	810	819	891	693	1095	1080	1524	1074	1224	435	954	309	342	222	0	0	291	0	438	312	402
Magnolia cathcartii	987	1089	672	816	999	759	1029	1149	1524	1074	1224	357	1017	309	336	279	0	195	453	174	447	663	384
Magnolia zenii	993	1089	828	984	1044	891	1029	1080	1524	1074	1224	0	828	309	342	282	0	195	300	84	465	615	402
Magnolia biondii	813	1089	927	591	1044	438	804	1080	1524	1059	1119	219	828	309	129	282	0	195	168	444	357	615	390
Magnolia amoena	987	1089	828	819	1116	771	1254	1080	1524	1074	1224	360	831	309	342	282	0	195	276	390	465	615	402
Magnolia sinostellata	987	1089	927	819	1116	912	1077	1080	1524	1074	1224	432	828	309	342	282	0	195	678	576	465	702	402
Magnolia stellata	966	1089	927	717	1116	900	1197	1149	1524	1071	1224	324	831	309	342	282	0	195	453	486	465	678	402
Magnolia kobus	960	1089	828	819	1116	762	1038	1080	1524	1074	1224	339	828	309	342	282	0	195	324	534	465	681	402
Magnolia salicifolia	960	1089	828	1005	1116	762	1152	1083	1524	1074	1224	0	825	309	342	282	0	192	273	516	465	315	402
Magnolia denudata	858	1089	789	810	1116	756	1143	1149	1524	1074	1224	357	825	309	342	279	0	195	321	192	465	615	249
Magnolia cylindrica	981	1089	792	984	1116	759	1143	1080	1524	1059	1107	357	828	309	339	282	0	195	363	192	465	615	399
Magnolia liliiflora	825	1086	798	819	1116	759	1149	1080	1524	1074	1224	459	828	309	342	270	0	0	420	192	465	312	402
Magnolia sprengeri	918	1089	873	717	1116	765	1038	1080	1524	918	1224	354	825	309	342	282	0	195	264	576	465	693	402
Magnolia sargentiana	864	1089	927	810	1056	765	1038	1080	1524	1074	1224	342	828	309	342	282	0	195	324	0	453	717	213
Magnolia campbellii	963	1089	828	810	1116	759	1038	1149	1524	1071	1224	420	573	309	342	282	0	195	249	567	462	468	402
Magnolia dawsoniana	969	1089	927	981	1116	765	1038	1149	1524	1071	1224	357	828	309	342	282	0	195	282	273	309	711	399
Magnolia acuminata var. *subcordata*	990	1089	630	819	1116	765	1086	1053	1515	1074	1224	357	1011	309	339	282	0	195	159	0	462	615	258
Magnolia acuminata	972	1089	810	717	1116	765	1137	1080	1515	1074	1224	357	822	309	339	282	0	177	375	0	354	312	231
Kmeria duperreana	963	1062	753	984	1116	975	1029	1080	1620	1074	1224	0	831	309	336	282	0	117	345	0	441	612	228
Kmeria septentrionalis	936	1062	672	810	1116	762	1143	1080	1527	1074	1224	0	831	309	336	282	0	0	345	0	291	615	282
Magnolia nitida var. *lotungensis*	783	1086	858	819	1056	762	1143	1080	1524	1074	1224	0	828	309	342	201	0	108	156	0	462	669	207
Pachylarnax praecalva	0	174	0	0	0	210	57	0	207	90	0	0	234	306	0	0	0	0	0	0	0	147	0
Magnolia kachirachirai	924	1071	912	984	873	762	1029	1080	1524	1074	1224	0	768	309	342	282	0	189	0	0	441	312	387
Magnolia sinica	462	1068	927	810	891	756	1029	1080	1524	1011	1224	0	579	309	342	279	0	0	234	93	435	687	360
Magnolia nitida	963	1071	927	717	891	762	1143	1080	1524	1071	1224	0	828	309	342	282	0	0	156	447	396	678	381
Magnolia poasana	975	1053	672	984	891	858	1143	1149	1530	1035	1224	333	993	309	336	288	0	105	87	192	444	546	384
Magnolia panamensis	984	1053	771	981	999	765	1254	1149	1527	1035	1284	354	957	309	336	288	0	198	87	192	444	624	357
Magnolia sharpii	963	1053	771	984	891	765	1191	1149	1524	1035	1224	216	831	309	339	288	0	195	87	177	444	717	384
Magnolia guatemalensis	963	1053	723	810	891	858	1143	1149	1524	1035	1227	354	831	309	339	288	0	198	87	225	444	657	375
Magnolia iltisiana	984	1053	657	819	891	765	1143	1080	1524	1035	1224	132	828	309	336	288	0	0	87	0	444	663	396
Magnolia grandiflora	981	1065	771	810	771	759	1143	1149	1524	1035	1269	78	990	309	339	285	0	108	87	192	444	624	399
Magnolia striatifolia	984	1065	765	981	891	759	1143	1080	1524	1035	1224	0	831	309	339	285	0	198	87	0	444	666	294
Magnolia schiedeana	939	1065	672	807	891	768	1143	1080	1524	972	1224	0	831	309	339	279	0	0	87	276	417	714	240
Magnolia tamaulipana	936	1065	645	816	891	768	1143	1080	1524	1074	1224	0	714	309	339	285	0	0	0	192	102	312	240
Magnolia virginiana	963	1065	846	810	888	732	1029	1080	1524	1038	1224	96	828	309	339	282	0	0	0	0	351	678	162
Magnolia macrophylla	963	1071	672	819	891	597	1143	1077	1527	1071	1224	99	828	309	339	282	0	108	162	0	345	651	360
Magnolia macrophylla var. *ashei*	963	1071	798	882	891	597	999	1059	1524	990	1224	0	828	309	339	282	0	108	162	0	345	672	378
Magnolia dealbata	963	1071	621	882	999	645	1140	1068	1527	1017	1224	87	828	309	339	282	0	108	234	0	201	612	384
Magnolia championii	957	1062	798	717	1113	597	1143	1086	1524	1056	1224	0	831	309	342	276	0	114	390	0	441	714	702
Magnolia coco	957	1062	660	819	1113	483	1131	1089	1524	993	1224	0	828	309	342	276	0	0	306	0	444	552	213
Magnolia phanerophlebia	981	1068	654	819	891	762	1143	1080	1524	1074	1224	0	828	309	342	276	0	0	387	0	300	312	282
Magnolia pterocarpa	945	1071	798	984	891	840	1113	1080	1524	1071	1224	0	831	309	342	276	0	0	396	192	279	312	276
Magnolia hodgsonii	954	1068	756	819	1110	888	1143	1080	1524	1026	1224	0	579	309	342	276	0	162	246	213	291	627	396
Magnolia henryi	981	1071	798	984	1113	309	1143	1080	1524	1074	1224	237	579	309	342	276	0	0	456	213	393	609	366
Magnolia albosericea	981	1086	843	708	1116	765	1143	1080	1524	960	1224	0	1008	309	219	279	0	0	135	0	162	483	294
Magnolia liliifera	945	1071	657	816	870	597	1143	1080	1524	1365	1224	0	831	309	336	279	0	0	438	252	0	630	192
Magnolia delavayi	954	1071	846	984	1113	810	1254	1137	1524	1074	1224	354	1014	309	342	279	0	114	168	171	444	612	387
Magnolia pastazaensis	915	1089	675	810	891	777	1146	1080	1524	1035	1224	0	621	309	339	282	0	114	0	0	327	312	384
Magnolia equatorialis	567	1089	675	708	891	723	1056	1080	1521	915	1224	0	450	309	339	282	0	0	0	0	348	312	345
Magnolia ovata	912	1089	885	984	1002	876	1095	1149	1524	1035	1224	0	831	309	339	282	0	114	0	0	441	639	342
Magnolia dodecapetala	915	1089	675	984	1119	777	1146	1149	1524	1071	1224	0	831	309	339	285	0	114	0	0	441	744	294
Magnolia kichuana	915	1089	675	810	1002	777	1146	1149	1524	1035	1224	0	831	309	339	282	0	114	0	0	441	618	0
Magnolia zamorana	915	1089	768	810	1119	777	1032	1080	1509	1032	1224	0	828	309	339	285	0	0	0	0	348	312	399
Magnolia mercedesiarum	903	1089	885	810	1056	777	1146	1080	1524	1035	1224	0	828	309	336	282	0	114	81	0	441	615	270
Magnolia mindoensis	915	1089	855	984	1119	876	1146	1149	1521	1035	1224	0	831	309	339	282	0	0	0	0	441	708	372
Magnolia mexicana	915	1092	768	810	0	777	1143	1080	1524	1071	1224	0	831	309	339	285	0	0	138	0	348	663	213
Manglietia conifera	795	1089	846	819	900	762	1029	1080	1524	1059	1239	339	741	312	342	288	0	126	0	333	444	423	390

Manglietia insignis	963	1089	915	819	900	762	1023	1080	1524	1056	1224	201	828	312	342	288	0	126	0	174	420	663	390
Manglietia duclouxii	963	1089	915	816	891	735	1140	1080	1524	975	1224	330	831	312	342	297	0	0	156	0	444	510	351
Manglietia hookeri	969	1089	915	816	1020	762	1029	1149	1527	969	1224	204	1011	312	342	297	0	126	0	0	444	735	348
Manglietia aromatica	795	900	915	819	891	762	1029	1080	1524	975	1224	330	828	312	342	285	0	0	0	174	102	669	258
Manglietia lucida	963	1089	846	963	891	867	1029	1149	1602	975	1224	336	1011	312	342	288	0	195	0	273	444	741	399
Manglietia grandis	963	1089	915	882	891	765	1143	1080	1524	1056	1224	219	828	312	342	297	0	126	156	177	444	657	396
Manglietia megaphylla	963	1089	915	819	891	855	1029	1080	1524	900	1224	414	831	312	342	261	0	126	0	255	441	354	399
Manglietia rufibarbata	963	1089	915	819	891	765	1143	1080	1611	900	1224	330	828	312	342	297	0	126	0	510	441	702	339
Manglietia ventii	966	1089	846	717	978	762	996	1080	1569	975	1224	210	828	312	342	288	0	0	0	180	441	732	384
Manglietia ovoidea	984	1086	840	819	891	846	1131	1086	1653	975	1224	348	822	312	342	297	0	129	0	0	291	741	288
Manglietia kwangtungensis	963	1089	915	819	999	762	1140	1086	1524	900	1224	330	822	312	342	0	0	126	0	333	438	762	399
Manglietia szechuanica	963	1089	915	819	978	858	1029	1080	1524	1017	1224	315	831	312	342	291	0	126	156	180	441	618	342
Manglietia pachyphylla	963	1089	915	978	891	762	1143	1080	1524	975	1224	330	828	312	342	291	0	0	159	0	441	762	393
Manglietia fordiana	936	1089	828	819	891	762	1143	1080	1524	972	1224	216	768	312	342	285	0	126	0	0	351	693	270
Manglietia glauca	963	1089	792	984	891	756	1143	1080	1524	1050	1224	138	825	312	342	225	0	195	0	201	348	741	399
Manglietia utilis	963	1089	846	801	891	765	1143	1077	1521	969	1224	138	828	312	342	288	0	198	147	282	435	513	399
Manglietia caveana	867	1089	819	717	978	765	978	1080	1524	975	1200	318	1008	312	324	285	0	126	0	378	444	615	399
Manglietia garrettii	963	1089	915	819	891	759	1029	1080	1524	900	1224	330	834	312	342	297	0	195	0	183	444	522	390
Manglietia decidua	963	1089	879	807	999	765	1029	1080	1524	1050	1239	336	831	312	342	225	0	126	159	0	444	621	390
Magnolia obovata	963	1089	915	819	891	861	1029	1080	1524	1053	1224	330	828	309	339	291	0	195	0	177	447	702	360
Magnolia officinalis	963	1089	915	819	891	765	1143	1080	1524	972	1224	216	828	309	339	276	0	138	156	543	384	312	390
Magnolia tripetala	957	1089	915	984	891	762	1143	1149	1524	1053	1224	330	831	309	339	225	0	195	156	387	444	738	390
Magnolia wilsonii	948	1089	927	792	978	762	1011	1080	1617	918	1224	0	828	309	342	282	0	195	156	513	0	741	297
Magnolia globosa	951	1089	858	819	1002	765	1020	1080	1524	1074	1239	0	828	309	342	282	0	195	156	429	441	711	399
Magnolia sieboldii	951	1089	927	819	891	699	1143	1149	1524	1038	1224	75	825	309	339	282	0	195	156	339	441	660	393
Magnolia sieboldii subsp. *sinensis*	951	1089	927	819	891	699	1029	1080	1524	1038	1224	99	825	309	339	282	0	195	156	402	441	690	387
Magnolia fraseri	966	1083	846	819	996	765	1143	1080	1524	1083	1224	0	831	312	339	282	0	120	273	0	441	747	396
Magnolia fraseri var. pyrimidata	963	1083	915	975	978	765	1143	1080	1524	1176	1224	96	834	312	339	282	0	120	276	0	441	723	354
Magnolia splendens	936	1089	915	819	1002	765	1140	1080	1524	1074	1224	0	633	309	339	291	0	180	171	0	441	312	363
Magnolia portoricensis	957	1089	915	717	891	765	1146	1080	1524	1074	1239	216	633	309	339	291	0	180	210	0	441	312	294
Magnolia cubensis	936	1089	915	819	891	765	1119	1080	1524	1074	1224	129	831	309	339	297	0	174	255	0	189	312	363
Magnolia bankardiorum	966	1089	912	819	891	765	1143	1149	1524	1074	1224	174	477	309	339	288	0	174	246	0	441	738	393
Liriodendron chinense	750	1014	672	717	891	633	1131	1059	1515	1041	1224	0	69	312	129	0	0	0	0	0	348	621	0
Liriodendron tulipifera X *Liriodendron chinense*	834	1014	648	714	891	630	1233	1059	1515	1041	1224	0	0	312	129	0	0	0	0	0	117	618	0
Liriodendron tulipifera	954	1014	672	717	885	645	1026	1044	1515	1023	1224	0	0	315	339	0	0	0	0	0	393	621	0
Ave.	920	1063	810	831	987	754	1089	1085	1506	1021	1208	189	796	309	329	267	0	106	205	142	386	581	345

Appendix 29. (Continued)

Taxon name	MKT0151 33_1_4	MKT0172 47_1_4	MKT0178 88_1_4	MKT0180 03_1_4	MKT0181 04_1_4	MKT0214 41_1_4	MKT0231 39_1_4	MKT0245 81_1_4	MKT0248 77_1_4	MKT0257 34_1_4	MKT0258 45_1_4	MKT0270 74_1_4	MKT0306 37_1_4	MKT0333 63_1_4	MKT0350 91_1_4	MKT0355 34_1_4	MKT0355 42_1_4	MKT0392 88_1_4	MKT0419 66_1_4	MKT0421 75_1_4	MKT0428 73_1_4	MKT0430 00_1_4	MKT0431 57_1_4	MKT0443 98_1_4	MKT0444 50_1_4	MKT0445 48_1_4	MKT0464 52_1_4	MKT0475 15_1_4	MKT0494 57_1_4
Length of the reference for each loci	303	1146	612	561	762	423	867	282	891	1014	1242	492	375	1110	1137	519	750	432	261	675	1353	579	240	330	2178	921	732	213	2682
Magnolia griffithii	300	1143	612	90	642	399	864	276	882	1014	1242	492	375	1110	1032	519	750	0	207	675	1155	0	231	315	2130	633	732	213	2265
Michelia baillonii	300	1143	612	78	642	399	864	276	882	1014	1242	492	375	1110	1032	519	750	0	207	675	1260	426	231	315	2181	723	735	213	2487
Michelia sirindhorniae	300	1140	612	222	642	393	864	255	882	1011	1242	492	375	1110	1032	519	750	0	180	633	1359	351	237	297	2139	711	732	213	2418
Michelia velutina	303	1140	609	216	642	399	864	276	882	1014	1242	486	375	1107	1032	519	750	0	207	669	1359	426	237	330	2130	711	621	213	2493
Michelia masticata	303	1143	612	90	642	249	573	276	834	1014	1242	492	375	1107	1032	519	750	0	207	669	1119	432	237	315	2130	213	732	213	2685
Michelia sphaerantha	303	1143	612	144	642	249	858	276	834	1014	1242	492	375	1107	1032	519	750	0	207	669	1269	432	237	315	2190	885	738	213	2490
Michelia doltsopa	303	1143	612	90	642	423	864	276	870	1014	1242	492	375	1110	1032	519	750	0	144	669	1359	423	231	315	2139	300	729	213	2490
Michelia lacei	303	1143	612	90	642	399	864	276	870	1014	1242	492	375	1110	1032	519	750	0	207	669	1359	549	231	315	2139	882	732	213	2685
Michelia salicifolia	303	1143	612	147	642	399	864	276	870	1014	1164	492	375	1110	1032	519	750	0	159	627	1356	0	195	300	2004	858	735	213	2034
Michelia martini	303	1143	609	90	642	399	828	255	834	1014	1242	489	375	1110	1014	519	750	0	141	669	1149	426	225	315	2127	678	399	213	2457
Michelia coriacea	303	1143	612	156	642	399	864	276	567	1014	1242	492	375	1110	1032	519	750	0	207	669	1359	432	231	315	2133	783	735	213	2511

Michelia ingrata	303	1143	612	165	642	399	861	255	834	1014	1242	492	375	1110	1032	519	750	0	207	675	1356	423	237	315	2136	477	732	213	2424
Michelia wilsonii	303	1146	612	144	642	396	864	276	834	1014	1236	492	375	1110	312	510	750	0	207	669	1359	582	231	315	2136	711	639	213	2676
Michelia floribunda	303	1143	612	90	642	399	864	276	882	1014	1023	492	375	1110	1032	519	750	0	207	669	1260	432	234	315	2139	312	732	213	2265
Michelia chapensis	303	1140	612	141	642	396	864	276	834	1014	1242	492	375	1110	1032	519	750	0	207	669	1359	558	231	330	2130	888	399	213	2685
Michelia chapensis	303	1143	612	78	642	396	864	276	834	1014	1080	492	375	1110	1032	519	750	0	207	669	1149	426	231	330	2130	474	282	213	2325
Michelia hypolampra	303	642	612	150	642	399	864	276	834	1014	1242	492	375	1110	1032	510	750	0	207	663	1311	570	231	300	2127	0	732	213	2367
Michelia viridipetala	303	1023	612	78	642	270	864	276	834	1008	1035	492	375	1110	1032	384	750	0	192	669	1311	567	237	324	2109	225	732	213	2655
Michelia balansae	303	1143	612	201	642	402	855	276	834	1008	1242	492	375	1110	1032	519	750	0	192	669	1359	0	237	324	2136	723	393	213	2481
Michelia guangxiensis	303	1143	612	90	642	402	864	276	834	1008	1242	492	375	1110	1032	519	750	0	192	669	1356	0	237	324	2142	873	732	213	2481
Michelia figo	303	1143	612	0	642	399	864	276	567	1014	1242	492	375	1110	1032	186	750	0	207	627	852	426	237	315	2139	417	399	213	2487
Michelia shiluensis	303	1143	612	90	642	396	861	276	882	1014	1242	492	375	1110	1032	519	750	0	207	675	1260	426	240	315	2136	645	732	213	2463
Michelia odora	303	1023	612	90	642	396	864	276	882	1014	1242	492	360	1110	1032	519	750	0	165	669	1116	0	237	315	2016	870	735	213	2679
Michelia montana	303	1143	612	57	642	396	858	276	882	1014	1242	492	375	1110	1032	516	750	0	207	669	1254	438	231	336	2265	732	732	213	2181
Elmerrillia ovalis	300	1143	612	90	642	426	858	276	834	1014	1242	492	375	1110	1299	357	750	0	186	627	1260	570	237	294	2142	636	723	213	2586
Michelia compressa	303	1143	612	0	642	396	864	276	882	1014	1242	492	375	1110	984	519	750	0	192	669	1260	438	237	285	2130	897	732	213	2265
Michelia macclurei	303	1143	612	138	642	420	864	276	882	1014	1242	492	375	1110	1032	519	750	0	207	675	1260	426	231	336	2130	588	732	213	2265
Michelia guangdongensis	303	1020	612	69	642	267	864	276	735	1014	1080	492	375	1110	1032	519	750	0	141	633	1260	0	231	315	2085	204	282	213	2460
Michelia maudiae	303	1143	612	156	642	381	864	276	882	1014	1242	492	375	1110	1032	519	750	0	207	669	1254	537	231	330	2133	456	399	213	2460
Michelia foveolata	303	1140	612	132	642	396	864	276	729	1014	612	492	375	1110	1032	384	750	0	207	669	1260	570	231	300	2136	240	282	213	2262
Michelia cavaleriei	303	1143	612	216	642	396	864	276	882	1014	1242	492	375	1110	1032	519	750	0	207	675	1323	579	231	306	2136	480	732	213	2685
Magnolia elegans	297	1137	612	132	642	420	804	276	885	1014	1230	486	375	1101	969	468	750	0	111	633	1203	774	237	492	2130	573	732	213	2682
Magnolia borneensis	0	441	207	0	351	132	633	123	228	342	213	87	0	264	969	0	465	0	0	549	228	330	0	285	726	225	246	0	1233
Magnolia carsonii	303	1143	612	231	642	360	807	276	885	1014	1230	492	375	1101	987	477	750	0	0	633	1191	438	237	300	1998	474	732	213	2676
Magnolia cathcartii	303	1143	522	270	642	393	798	276	885	1014	1230	492	375	1104	966	105	750	0	111	633	1359	666	234	285	2130	684	282	213	2490
Magnolia zenii	303	1143	612	333	642	423	864	276	891	1014	1242	492	375	1110	1950	519	750	0	207	675	1353	579	240	300	2136	714	732	213	2685
Magnolia biondii	0	894	522	138	303	270	864	276	888	1005	888	492	375	1110	1950	519	750	0	261	633	651	249	240	285	2043	888	732	213	2424
Magnolia amoena	303	1143	612	333	642	423	834	276	891	1014	1242	492	375	1110	1950	519	750	0	207	675	1353	447	240	300	2136	714	732	213	2424
Magnolia sinostellata	303	1146	612	333	642	423	843	276	891	1014	1242	492	375	1110	1122	519	750	0	201	675	1353	447	240	315	2178	711	732	213	2685
Magnolia stellata	303	1146	612	333	642	423	864	276	891	1014	1242	492	375	1107	1296	519	750	0	261	675	1353	450	240	330	2178	441	732	213	2682
Magnolia kobus	303	1146	612	333	642	423	867	276	891	1014	1242	492	366	1107	1623	513	750	0	207	633	1122	420	240	330	2139	900	621	213	2679
Magnolia salicifolia	303	1149	522	138	642	423	837	276	891	1014	1242	492	375	1107	1623	519	750	0	204	633	1350	792	240	330	2142	861	732	213	2640
Magnolia denudata	303	1107	612	177	642	423	858	276	891	1014	1242	492	375	1089	1623	531	750	0	195	633	1206	0	240	300	2136	633	732	204	2262
Magnolia cylindrica	303	1143	576	177	642	423	864	276	891	1014	1182	489	375	1110	1161	519	750	0	207	669	1212	420	240	279	2184	183	732	213	2328
Magnolia liliiflora	303	1143	612	135	642	423	864	276	738	1014	1023	492	375	1110	1182	519	750	0	207	675	1353	570	240	300	2136	246	732	213	2424
Magnolia sprengeri	303	1143	612	177	642	423	858	276	891	1014	1242	492	375	1104	1950	384	750	0	225	675	1266	426	240	285	1791	207	732	213	2628
Magnolia sargentiana	303	1143	612	267	642	429	852	276	891	1017	1242	492	375	1104	1167	519	750	0	207	675	1353	420	237	285	2136	789	399	213	2247
Magnolia campbellii	303	1143	612	336	642	423	855	276	732	1014	1242	492	375	1104	1182	519	750	0	207	675	1182	426	237	315	2136	792	732	213	2487
Magnolia dawsoniana	303	1143	612	141	642	423	996	276	891	1014	1203	492	375	1104	1413	519	750	0	207	633	1353	0	237	285	2136	732	399	213	2319
Magnolia acuminata var. *subcordata*	300	1146	612	300	642	420	864	276	885	1014	1242	492	375	1110	984	384	750	0	207	633	1194	0	237	300	2133	621	621	213	2349
Magnolia acuminata	300	1143	612	264	642	423	864	276	639	1014	1242	492	375	1104	1089	519	750	0	207	675	1356	567	237	315	2100	465	732	213	2685
Kmeria duperreana	303	1140	612	252	642	420	864	276	885	1014	1242	492	375	1101	987	519	747	0	231	675	1227	0	237	330	2139	450	399	213	2688
Kmeria septentrionalis	303	1140	612	141	642	420	1179	276	717	1014	1083	492	375	1104	987	519	750	0	213	675	996	135	237	300	2136	147	732	213	2640
Magnolia nitida var. *lotungensis*	303	1143	612	273	642	423	858	276	732	1011	1242	492	375	1104	963	387	750	0	207	675	831	429	234	300	2016	249	729	213	2469
Pachylarnax praecalva	0	117	0	0	0	0	0	0	0	180	0	0	0	0	0	0	0	0	165	0	108	237	0	0	0	0	0	0	216
Magnolia kachirachirai	303	1143	594	93	642	423	864	276	885	1011	1242	492	375	1101	963	522	750	0	246	675	1359	0	234	285	2139	528	396	213	2676
Magnolia sinica	303	1143	594	273	642	423	852	276	885	1011	1242	492	375	1104	966	525	750	0	204	675	1383	426	234	300	2127	639	729	213	2673
Magnolia nitida	303	1137	612	273	642	267	846	276	882	1011	1080	492	375	1104	969	522	750	0	204	633	1005	570	234	258	2139	135	729	213	2646
Magnolia poasana	303	1140	612	387	642	0	864	276	885	1014	1242	492	375	1104	987	519	750	0	204	675	1359	0	0	300	1923	876	237	213	2676
Magnolia panamensis	303	1140	612	252	642	0	888	276	885	1014	1242	492	375	1104	987	519	750	0	234	675	1296	0	0	300	1923	456	360	213	2508
Magnolia sharpii	303	1140	612	231	642	0	852	276	885	1014	1242	492	375	1104	987	504	750	0	204	675	1230	0	0	330	1923	564	387	213	2481
Magnolia guatemalensis	303	1143	612	231	642	0	864	276	885	1014	1242	492	375	1104	987	504	750	0	258	675	1290	429	0	300	1923	471	399	213	2562
Magnolia iltisiana	303	1137	612	231	642	0	864	276	885	1014	1242	492	375	1104	987	519	750	0	258	675	1359	132	0	330	1794	477	387	213	2679
Magnolia grandiflora	303	1143	612	279	642	405	864	276	885	1014	1242	492	375	1104	987	519	744	0	165	624	1281	297	0	300	2136	525	399	213	2487
Magnolia striatifolia	303	1143	612	249	642	393	864	276	885	1014	1242	492	375	1104	987	519	750	0	219	675	1362	0	0	285	1962	399	735	210	2493
Magnolia schiedeana	303	1143	612	231	642	0	831	276	885	1014	1242	492	375	1104	987	519	750	0	255	633	1131	246	0	300	1776	603	399	213	2346
Magnolia tamaulipana	303	1143	612	231	642	393	864	276	885	1014	1242	492	375	1104	987	519	750	0	204	675	705	135	0	285	1794	219	366	210	2490
Magnolia virginiana	303	1143	561	141	642	393	861	276	888	1014	1242	492	375	1104	984	519	750	0	225	675	1257	438	0	285	1794	336	729	213	2241
Magnolia macrophylla	291	1143	522	270	642	423	864	276	738	1014	1242	492	375	1104	987	522	750	0	210	675	1290	570	0	285	2085	162	396	213	2463
Magnolia macrophylla var. *ashei*	291	1143	612	270	642	423	864	276	738	1014	1242	492	375	1104	987	522	750	0	255	675	969	423	0	285	1998	297	729	213	2682
Magnolia dealbata	291	1143	609	141	642	417	864	276	732	978	1242	492	375	1104	975	522	750	0	171	675	1131	423	0	300	1998	405	399	213	2679
Magnolia championii	303	1143	594	225	642	0	855	276	885	1014	1242	501	372	1101	978	522	750	0	186	675	1311	426	237	285	2130	483	732	213	2487
Magnolia coco	195	1143	594	141	642	0	729	276	888	1014	1080	417	372	1101	978	327	750	0	186	633	1191	570	237	285	2016	114	621	213	2520
Magnolia phanerophlebia	300	1143	594	231	642	423	855	276	738	1014	1182	501	372	1104	987	387	750	0	147	633	1272	579	0	300	2130	165	624	213	2682
Magnolia pterocarpa	303	1113	648	0	642	270	855	276	762	1008	1104	282	372	1101	969	513	750	0	258	675	1209	570	291	270	1728	249	465	213	2373
Magnolia hodgsonii	303	1113	594	219	642	270	486	276	885	1011	1236	492	372	1101	969	522	750	0	162	633	1311	0	237	306	2136	465	732	213	2373
Magnolia henryi	303	1143	594	288	642	423	1191	276	885	1014	1236	492	372	1101	987	522	750	0	258	675	1344	0	237	294	2136	261	621	213	2682

Magnolia albosericea	303	1143	504	228	642	423	852	276	570	1014	1242	492	375	1104	978	525	750	0	204	675	1257	570	231	300	1959	0	282	210	2460
Magnolia liliifera	303	1143	594	384	642	423	852	276	738	1014	1242	492	375	1101	987	387	750	0	207	672	1182	426	0	285	2130	396	621	213	2250
Magnolia delavayi	303	1143	594	297	642	423	864	276	780	1014	1242	492	375	1104	969	522	750	0	258	681	1140	429	201	285	2067	648	735	213	2523
Magnolia pastazaensis	303	1143	612	231	642	0	846	276	870	1014	1233	492	375	1101	960	528	744	0	201	675	1359	576	237	300	1776	225	396	210	2643
Magnolia equatorialis	303	1143	612	0	642	0	846	276	573	1014	1233	489	375	1101	960	528	750	0	138	663	981	570	0	330	1995	0	279	213	2673
Magnolia ovata	303	1143	612	231	642	0	720	276	873	1014	1071	492	375	1101	960	528	750	0	201	237	1359	570	237	300	2136	165	354	213	2352
Magnolia dodecapetala	303	1143	612	195	642	0	846	276	879	1014	1233	492	375	1101	960	528	744	0	258	279	1359	438	0	330	2082	492	399	213	2676
Magnolia kichuana	303	1143	612	231	642	0	846	276	873	1014	1233	492	375	1101	960	525	744	0	258	675	1311	438	237	300	1995	108	732	213	2682
Magnolia zamorana	303	1143	612	153	642	0	846	276	876	1014	1062	492	375	1101	960	393	750	0	246	675	1215	576	237	300	1998	165	729	213	2682
Magnolia mercedesiarum	303	1143	612	231	642	0	846	276	876	1014	1233	489	375	1101	960	522	744	0	192	675	1359	570	0	330	1971	207	288	213	2520
Magnolia mindoensis	303	1143	612	231	642	0	846	276	741	1014	1233	492	375	1101	960	519	744	0	204	279	1359	576	237	300	2136	372	399	213	2421
Magnolia mexicana	303	1143	612	231	642	0	846	255	885	1014	1233	492	375	1101	978	390	750	0	243	279	1233	567	237	288	2136	600	732	213	2679
Manglietia conifera	303	1143	612	141	642	402	1167	273	720	1014	1242	492	375	1110	984	519	750	0	207	675	1188	0	0	294	2130	228	621	213	2463
Manglietia insignis	303	1143	612	141	642	402	852	273	885	1014	1242	492	375	1110	984	519	750	0	261	675	1359	132	0	324	2130	501	738	213	2463
Manglietia duclouxii	303	1143	612	141	642	402	831	273	885	1014	1242	492	375	1110	987	519	750	0	246	675	1029	132	0	324	2136	204	732	213	2685
Manglietia hookeri	303	1143	612	141	642	402	861	273	885	1014	1242	492	375	1110	987	519	750	0	261	675	1305	132	0	324	2130	636	732	213	2640
Manglietia aromatica	303	1140	612	147	642	402	864	273	738	1014	1242	492	375	1110	987	519	750	0	237	675	1035	426	0	294	2142	240	621	213	2682
Manglietia lucida	303	1140	612	141	642	402	861	273	885	1011	1176	492	300	1110	987	519	750	0	204	675	1185	135	0	324	2142	738	729	213	2451
Manglietia grandis	303	1143	612	141	642	402	864	273	885	1014	1242	492	375	1110	969	369	750	0	204	675	1359	426	0	324	2136	429	732	213	2412
Manglietia megaphylla	303	1143	612	0	642	402	846	273	720	1014	996	492	300	1110	987	519	750	0	207	675	1359	426	0	294	2112	225	627	213	2328
Manglietia rufibarbata	303	1143	612	0	642	402	1155	273	888	1014	1176	492	300	1110	987	519	750	0	141	675	1221	426	0	324	2016	177	624	201	2517
Manglietia ventii	303	1143	612	141	642	402	861	273	885	1011	1173	492	375	1104	987	519	750	0	207	675	771	570	0	324	2130	225	627	213	2598
Manglietia ovoidea	303	1143	612	141	642	402	861	273	885	1014	1242	492	138	1110	984	519	750	0	186	633	1359	426	0	324	2130	504	735	213	2508
Manglietia kwangtungensis	303	1023	612	141	642	402	846	273	885	1014	1242	492	138	1110	987	438	750	0	237	675	1353	426	0	324	2136	630	738	213	2469
Manglietia szechuanica	303	1143	612	0	642	402	864	273	858	1014	1176	492	300	1110	987	516	750	0	219	675	987	426	0	324	2169	222	732	213	2421
Manglietia pachyphylla	303	1143	612	141	642	402	831	273	897	1014	1242	489	138	1107	987	522	750	0	186	675	1086	426	0	324	1794	516	723	213	2466
Manglietia fordiana	303	1143	612	0	642	402	864	273	894	1014	1242	489	375	1107	987	528	750	0	222	675	1005	426	0	324	2136	162	621	213	2682
Manglietia glauca	303	1143	612	0	642	402	864	273	741	1014	1242	489	375	1110	987	519	750	0	180	633	1359	0	0	294	2124	501	738	213	2421
Manglietia utilis	303	1143	612	141	642	402	864	273	885	1014	1176	492	300	1107	987	519	750	0	261	675	1029	579	0	324	2139	249	621	213	2466
Manglietia caveana	303	1143	477	141	639	402	864	273	732	1011	1023	492	375	1110	987	516	750	0	153	633	1359	570	0	258	2130	411	621	213	2262
Manglietia garrettii	303	1143	612	129	642	402	864	273	885	1014	1176	492	300	1110	987	519	750	0	204	675	1296	426	0	324	2169	510	729	213	2670
Manglietia decidua	288	1143	612	141	642	402	864	273	885	1014	1242	492	375	1110	987	516	750	0	261	675	1359	570	0	324	2133	384	729	213	2487
Magnolia obovata	303	1143	612	141	642	420	846	276	843	1014	1242	492	375	1104	987	522	750	0	252	672	1359	570	0	285	2142	363	732	213	2466
Magnolia officinalis	303	1143	612	141	642	420	858	276	690	1014	1080	492	375	1104	987	522	750	0	261	633	1260	567	0	300	2019	348	732	213	2349
Magnolia tripetala	303	1143	612	141	642	420	864	276	843	1014	1242	492	378	1104	1962	522	750	0	261	675	1359	423	0	315	2109	702	732	213	2487
Magnolia wilsonii	303	1143	522	0	642	267	789	276	567	1014	1182	492	375	1104	987	387	750	0	258	675	849	426	0	0	1878	144	729	168	2682
Magnolia globosa	303	1143	612	273	642	420	864	276	735	1014	1242	492	375	1104	987	522	750	0	141	675	1281	426	0	330	2136	609	729	213	2439
Magnolia sieboldii	303	1143	612	273	642	420	864	276	882	1014	1242	492	375	1104	987	519	750	0	141	675	1359	495	0	294	1965	729	828	213	2466
Magnolia sieboldii subsp. sinensis	303	1143	612	234	642	420	864	276	882	1014	1080	492	375	1104	987	519	750	0	234	633	1359	183	0	294	1926	330	735	213	2457
Magnolia fraseri	303	1134	612	138	642	420	855	255	882	1014	1242	492	375	1107	987	519	750	0	264	675	1332	426	228	324	1923	249	729	213	2493
Magnolia fraseri var. *pyrimidata*	303	1134	612	126	642	420	855	255	882	1014	1242	492	375	1107	987	519	750	0	0	675	1065	426	228	315	1923	345	618	213	2682
Magnolia splendens	297	1143	612	228	642	408	873	276	735	1014	1242	495	366	1104	987	519	750	0	198	630	936	570	237	300	1875	156	729	213	2610
Magnolia portoricensis	297	1143	612	228	642	408	873	276	888	1014	1242	495	366	1104	969	519	744	0	255	630	1137	570	237	330	2127	249	729	213	2484
Magnolia cubensis	294	1143	612	228	642	408	885	276	888	1014	1242	492	369	1104	987	519	750	0	201	630	1098	780	237	300	1998	360	729	213	2346
Magnolia bankardiorum	297	1143	612	294	642	378	885	276	891	1014	1242	492	369	1104	969	516	750	0	219	675	1194	426	231	300	2136	603	729	213	2676
Liriodendron chinense	261	813	498	0	642	0	612	192	882	1005	1182	324	345	1092	981	309	750	0	198	675	963	0	0	279	1656	0	582	186	2007
Liriodendron tulipifera X *Liriodendron chinense*	261	930	375	0	642	0	654	276	570	1005	912	357	345	1092	963	309	750	0	207	675	780	162	0	279	1653	0	471	0	1992
Liriodendron tulipifera	261	981	612	0	642	0	735	276	882	1005	1182	456	345	1092	963	210	750	0	78	675	1122	162	0	279	1656	0	621	201	2094
Ave.	293	1113	594	167	632	327	847	270	823	1001	1184	480	358	1090	1049	483	741	0	202	645	1208	379	141	303	2037	448	613	207	2468

Appendix 29. (Continued)

Taxon name	MKT049_1_4	MKT049_1_4	MKT052_1_4	MKT052_1_4	MKT054_1_4	MKT054_1_4	MKT055_1_4	MKT056_1_4	MKT058_1_4	MKT061_1_4	MKT062_1_4	MKT062_1_4	MKT063_1_4	MKT066_1_4	MKT074_1_4	MKT074_1_4	MKT075_1_4	MKT076_1_4	MKT077_1_4	MKT077_1_4	MKT080_1_4	MKT082_1_4	MKT083_1_4	MKT085_1_4	MKT086_1_4	MKT087_1_4	MKT088_1_4	MKT093_1_4	MKT094_1_4	MKT095_1_4	MKT097_1_4	MKT099_1_4	MKT100_1_4	MKT102_1_4
	MKT049 743_1_4	MKT049 745_1_4	MKT052 493_1_4	MKT052 654_1_4	MKT054 153_1_4	MKT054 712_1_4	MKT055 769_1_4	MKT056 344_1_4	MKT058 531_1_4	MKT061 112_1_4	MKT062 212_1_4	MKT062 775_1_4	MKT063 487_1_4	MKT066 774_1_4	MKT074 616_1_4	MKT074 911_1_4	MKT075 332_1_4	MKT076 221_1_4	MKT077 685_1_4	MKT077 735_1_4	MKT080 632_1_4	MKT082 329_1_4	MKT083 137_1_4	MKT085 635_1_4	MKT086 183_1_4	MKT087 337_1_4	MKT088 403_1_4	MKT093 444_1_4	MKT094 099_1_4	MKT095 310_1_4	MKT097 806_1_4	MKT099 267_1_4	MKT100 456_1_4	MKT102 398_1_4

Length of the reference for each loci	1332	840	2007	297	666	297	240	645	579	639	1344	204	633	348	1431	465	480	393	531	390	1554	327	291	786	357	1659	531	303	384	768	228	501	378	1590
Magnolia griffithii	1302	585	1965	297	666	300	216	636	573	243	930	0	546	336	1431	321	174	393	513	390	1542	327	291	570	357	1581	531	0	384	0	216	501	366	1566
Michelia baillonii	1311	408	1965	297	660	300	216	648	573	390	444	0	573	291	1431	132	171	393	528	387	1398	327	291	570	357	1656	531	0	384	237	216	501	366	1566
Michelia sirindhorniae	1293	588	1968	297	666	294	216	648	573	648	936	0	573	297	1431	180	174	393	531	390	1548	327	291	786	279	1656	531	0	384	231	216	501	366	1566
Michelia velutina	1305	183	1617	297	666	291	216	648	573	633	990	0	573	297	1431	321	171	393	531	390	1419	327	291	720	357	1569	531	0	384	231	216	501	366	1566
Michelia masticata	1302	588	1965	297	660	0	216	648	573	201	948	207	573	342	1431	321	171	393	348	387	1539	327	291	570	273	1572	531	0	384	156	216	501	366	1569
Michelia sphaerantha	1302	588	1965	297	660	294	216	648	573	387	822	207	561	297	1431	426	171	393	348	387	1410	327	291	570	357	1572	531	0	384	150	216	471	366	1569
Michelia doltsopa	1308	408	1617	297	666	300	216	648	573	510	1014	0	570	342	1431	420	171	393	531	390	1551	327	291	783	357	1521	531	0	378	231	216	501	366	1569
Michelia lacei	1308	408	1842	297	666	273	216	648	573	639	1008	204	573	342	1431	321	171	393	528	390	1479	327	291	762	339	1521	531	0	384	150	216	501	366	1569
Michelia salicifolia	1305	588	1860	297	651	300	216	585	573	141	831	204	540	252	1431	90	171	378	348	390	1413	327	291	678	357	1572	531	0	384	237	216	486	366	1569
Michelia martini	1305	588	1962	297	666	93	195	648	573	318	609	0	570	336	1431	321	174	393	348	390	1551	327	291	570	357	1659	531	0	384	231	216	501	366	1572
Michelia coriacea	1293	564	1845	297	666	300	216	648	573	213	1047	204	573	285	1431	318	171	393	531	390	1551	327	291	570	357	1572	531	0	384	237	216	501	366	1569
Michelia ingrata	1290	0	1965	297	666	285	216	648	573	213	996	189	573	291	1431	321	171	393	531	390	1548	327	291	570	357	1479	531	0	384	150	216	498	366	1572
Michelia wilsonii	1305	588	1602	297	660	300	216	648	573	324	1074	204	573	291	1431	321	174	393	531	390	1602	327	288	570	357	1656	531	0	384	156	216	501	366	1569
Michelia floribunda	1308	405	1959	297	645	300	216	648	573	387	816	204	573	195	1431	321	171	393	531	390	1551	327	291	570	357	1653	531	0	384	135	216	498	366	1569
Michelia chapensis	1314	408	1962	297	666	300	216	648	573	594	1071	204	570	291	1431	321	174	393	531	390	1551	327	291	540	273	1569	531	0	384	156	216	435	366	1563
Michelia chapensis	1326	405	1962	237	666	93	216	648	573	204	738	0	570	291	1431	132	174	393	531	390	1482	327	291	570	126	1569	531	0	384	150	216	447	366	1566
Michelia hypolampra	1314	405	1965	297	660	294	216	648	573	0	648	183	567	291	1431	123	174	393	531	390	1404	327	291	681	357	1656	531	0	384	150	216	501	366	1563
Michelia viridipetala	1293	588	1614	297	660	93	216	648	573	186	699	0	573	288	1431	132	174	393	348	384	1548	327	291	570	264	1572	465	0	384	0	216	501	366	1572
Michelia balansae	1302	840	1965	297	666	177	216	648	573	0	960	0	573	291	1431	321	174	393	348	390	1548	327	291	570	273	1572	531	0	384	156	216	465	366	1581
Michelia guangxiensis	1302	588	1617	297	663	300	216	648	573	492	990	0	573	336	1431	321	174	393	348	390	1551	327	291	468	357	1572	531	0	384	231	216	501	366	1572
Michelia figo	1290	588	1500	297	657	93	216	648	573	318	990	0	570	291	1431	132	174	393	348	390	1551	327	291	558	357	1656	531	0	384	231	216	501	366	1563
Michelia shiluensis	1305	840	1965	297	666	93	216	648	573	195	900	0	573	297	1431	321	174	393	531	390	1551	324	291	570	273	1569	531	0	384	237	216	501	366	1572
Michelia odora	1305	588	1965	297	663	300	183	546	573	183	921	0	570	285	1431	174	174	393	516	390	1548	321	288	570	351	1566	531	0	384	237	216	462	366	1572
Michelia montana	1302	585	1887	297	657	300	216	648	573	186	960	0	573	291	1431	321	174	393	531	390	1548	327	291	570	273	1656	531	0	384	237	216	501	366	1563
Elmerrillia ovalis	1302	588	1860	297	660	240	216	570	573	195	573	195	573	243	1431	129	174	393	531	390	1548	327	261	567	273	1494	531	0	123	231	216	405	366	1554
Michelia compressa	1293	405	1962	297	660	93	219	504	570	414	717	204	570	300	1431	228	174	393	531	390	1551	327	291	573	357	1566	531	0	390	231	216	501	366	1557
Michelia macclurei	1296	183	1962	297	666	300	216	648	573	159	846	207	573	297	1431	132	174	393	348	390	1551	327	291	552	339	1572	531	0	384	156	216	501	366	1572
Michelia guangdongensis	1302	588	1830	297	666	267	216	585	573	297	669	0	546	279	1431	177	174	384	345	387	1545	327	291	501	273	1398	531	0	384	156	216	405	366	1563
Michelia maudiae	1302	588	1971	297	660	93	216	648	573	171	459	0	573	342	1431	129	0	393	531	390	1548	327	291	570	357	1395	531	0	384	237	213	501	366	1569
Michelia foveolata	1290	408	1890	297	666	0	216	645	573	384	243	0	576	291	1431	132	174	393	531	390	1401	324	291	570	273	1587	531	0	384	150	213	447	366	1566
Michelia cavaleriei	1302	408	1962	297	660	300	195	648	573	414	957	0	573	318	1431	147	174	384	348	390	1551	327	291	570	210	1572	531	0	378	237	216	501	366	1572
Magnolia elegans	1314	588	1965	297	666	300	219	582	573	192	783	195	555	0	1431	129	174	369	348	390	1422	327	285	570	360	1572	531	0	234	156	216	405	366	1572
Magnolia borneensis	141	258	588	0	210	0	216	576	0	0	159	0	0	0	219	0	0	0	0	0	243	153	0	135	0	102	261	0	258	0	63	147	264	210
Magnolia carsonii	1317	183	1818	297	666	300	219	726	573	0	957	195	528	273	1431	132	174	387	348	381	1407	327	264	567	345	1575	528	0	243	222	216	447	366	1572
Magnolia cathcartii	1320	588	1836	297	666	93	219	645	573	204	714	201	546	0	1431	234	174	393	486	390	1554	321	291	681	0	1632	531	0	246	156	216	456	366	1590
Magnolia zenii	1344	588	1914	90	666	300	240	645	573	516	1281	195	540	300	1431	420	261	393	531	390	1551	327	291	666	360	1647	531	0	384	0	216	501	366	1596
Magnolia biondii	1344	405	1728	297	666	0	240	645	573	639	1026	204	555	348	1431	135	255	393	531	390	1464	327	291	573	279	1575	531	0	384	312	216	405	264	1596
Magnolia amoena	1332	588	1965	90	666	300	240	645	573	639	1278	204	570	297	1431	330	261	393	528	390	1551	327	291	570	360	1575	531	0	384	150	216	501	366	1596
Magnolia sinostellata	1344	588	1965	297	666	279	240	645	573	639	1344	204	534	348	1428	204	255	393	531	390	1554	327	291	570	360	1575	531	0	384	156	216	498	264	1596
Magnolia stellata	1344	591	1965	297	666	300	240	645	573	639	1233	204	576	303	1431	414	255	393	531	390	1554	327	291	570	360	1662	531	0	384	156	216	501	366	1587
Magnolia kobus	1332	840	1965	297	666	297	240	726	573	606	1104	204	552	303	1431	387	255	393	531	390	1554	327	291	570	360	1575	531	0	384	0	216	405	366	1587
Magnolia salicifolia	1338	588	1968	297	666	90	240	645	573	633	1341	204	570	303	1431	420	261	393	531	390	1554	327	291	570	354	1662	531	0	384	156	216	468	366	1587
Magnolia denudata	1344	588	1800	297	666	96	240	726	573	630	1236	204	522	234	1431	423	261	348	531	390	1554	327	291	570	270	1488	531	0	384	156	207	405	366	1593
Magnolia cylindrica	1338	588	1965	297	660	96	240	726	573	363	1230	204	534	0	1431	237	174	393	531	390	1551	327	291	567	273	1641	531	0	384	156	216	426	366	1581
Magnolia liliiflora	1338	840	1965	297	666	192	240	726	573	627	1344	204	558	0	1431	195	261	393	531	390	1554	327	291	570	147	1572	531	0	375	72	216	471	366	1593
Magnolia sprengeri	1332	588	1827	237	666	201	237	645	573	318	1164	204	546	348	1431	330	255	393	522	390	1554	327	291	570	99	1623	465	0	384	156	216	501	366	1596
Magnolia sargentiana	1332	588	1965	297	660	300	240	642	573	633	1203	204	561	0	1431	306	174	393	531	390	1554	327	291	570	210	1524	531	0	381	78	216	501	366	1581
Magnolia campbellii	1320	588	1926	297	666	294	240	240	573	315	1230	204	543	348	1431	267	174	393	531	390	1554	327	291	570	357	1482	531	0	384	156	216	501	366	1581
Magnolia dawsoniana	1332	588	1887	297	666	243	240	642	573	627	1257	204	564	264	1431	132	174	393	531	390	1554	327	291	570	273	1482	531	0	384	108	216	492	366	1581
Magnolia acuminata var. *subcordata*	1317	588	1833	297	666	258	222	582	573	633	1074	204	543	513	1431	132	174	375	522	390	1467	327	291	684	273	1587	528	0	384	78	216	405	366	1545
Magnolia acuminata	1308	588	1962	297	666	0	222	645	573	627	732	0	573	0	1431	135	174	393	525	390	1557	327	291	573	273	1476	465	0	384	0	216	489	264	1563
Kmeria duperreana	1308	183	1443	297	666	300	240	645	573	639	1158	210	534	135	1431	132	174	393	531	390	1551	321	291	852	273	1650	531	0	0	156	216	489	366	1596
Kmeria septentrionalis	1308	183	1740	297	666	300	240	645	573	642	1191	0	564	210	1431	132	174	393	531	390	1422	321	291	570	357	1569	531	0	0	156	216	405	366	1593
Magnolia nitida var. *lotungensis*	1308	588	1962	297	666	300	240	726	576	195	783	0	573	0	1431	132	174	393	531	387	1329	327	291	570	273	1635	531	0	384	156	216	501	366	1596
Pachylarnax praecalva	189	255	102	0	0	0	0	0	0	0	0	0	0	0	207	0	0	0	0	0	0	0	0	0	0	189	0	0	0	0	0	0	0	0
Magnolia kachirachirai	1296	588	1860	297	666	279	240	642	576	195	1104	0	573	285	1431	228	261	393	348	387	1209	327	291	570	273	1662	531	0	384	159	216	474	366	1587
Magnolia sinica	1308	588	1962	297	666	96	240	642	576	201	792	0	573	0	1431	186	165	327	501	387	1338	321	291	570	114	1665	531	0	384	156	216	501	366	1602
Magnolia nitida	1308	588	1842	297	666	96	180	645	576	201	777	0	573	228	1431	132	174	393	531	387	1191	327	291	570	273	1659	531	0	384	156	216	501	366	1596
Magnolia poasana	1254	588	1962	297	666	210	240	582	570	639	1191	0	573	297	1431	132	174	393	345	390	1335	324	288	570	273	1569	531	0	384	231	216	498	366	1545
Magnolia panamensis	1254	588	1965	297	666	300	240	648	570	633	1230	0	573	342	1431	129	174	393	345	390	1335	324	288	570	273	1653	531	0	384	231	216	498	366	1545
Magnolia sharpii	1254	588	1965	297	666	300	240	645	570	633	1290	0	84	333	1431	132	174	393	348	390	1335	324	288	570	273	1659	531	0	384	234	216	501	366	1545
Magnolia guatemalensis	1254	588	1965	297	666	297	240	645	570	639	1179	0	84	333	1431	132	174	372	348	390	1335	324	288	756	273	1659	531	0	384	165	216	492	366	1545
Magnolia iltisiana	1320	588	1965	297	666	300	240	642	570	339	1125	0	84	288	1431	132	171	393	348	390	1209	324	288	468	273	1659	531	0	159	0	216	498	366	1545
Magnolia grandiflora	1326	408	1857	237	666	300	240	645	573	624	1191	0	570	342	1431	132	174	393	348	390	1209	327	288	714	273	1575	531	0	384	210	216	468	366	1572

Magnolia striatifolia	1257	408	1965	237	666	300	240	645	330	744	1113	0	570	303	1431	198	174	393	348	390	1335	327	288	495	273	1575	531	0	384	0	216	501	366	1557
Magnolia schiedeana	1317	588	1965	297	666	93	240	645	561	639	1008	0	537	339	1431	132	174	393	528	390	1335	327	288	570	273	1659	531	0	384	231	216	486	366	1551
Magnolia tamaulipana	1236	840	1965	237	666	150	240	645	564	630	918	0	558	279	1431	162	174	393	348	390	1332	327	288	570	273	1575	531	0	384	231	216	465	366	1569
Magnolia virginiana	1263	588	1803	297	666	96	240	642	573	639	1227	0	573	348	1431	132	171	393	348	390	1332	327	291	567	273	1335	531	0	384	156	216	501	366	1590
Magnolia macrophylla	1332	591	1968	297	666	294	219	645	573	633	1014	0	546	324	1431	147	174	375	519	390	1185	327	291	570	198	1656	531	0	384	165	216	501	366	1590
Magnolia macrophylla var. *ashei*	1332	588	1965	297	666	294	219	645	573	636	957	0	555	342	1431	312	174	381	519	390	1185	327	291	570	273	1653	528	0	384	234	207	471	366	1590
Magnolia dealbata	1335	588	1905	237	666	96	219	645	573	633	717	0	534	297	1431	312	174	381	519	390	1185	327	291	570	273	1647	531	0	384	234	216	465	366	1563
Magnolia championii	1323	588	1962	297	666	93	216	747	570	630	1101	0	573	297	1431	129	195	393	531	390	963	327	291	552	273	1656	531	0	384	105	216	405	366	1557
Magnolia coco	1323	588	1692	297	666	93	216	582	570	591	663	0	573	0	1431	129	195	393	531	390	1104	327	291	549	273	1656	531	0	384	0	216	297	366	1557
Magnolia phanerophlebia	1278	840	1941	297	666	93	216	645	570	636	861	0	573	297	1431	228	195	393	525	384	1194	327	291	567	273	1458	531	0	378	0	216	474	366	1557
Magnolia pterocarpa	1323	825	1962	297	555	276	213	579	570	606	1029	0	516	0	1431	96	195	324	528	390	1338	327	291	603	0	1500	531	0	381	0	0	474	366	1557
Magnolia hodgsonii	1323	183	1812	297	555	300	216	579	570	570	1305	0	540	0	1431	132	195	393	525	390	1200	327	291	570	273	1644	531	0	384	0	117	297	366	1584
Magnolia henryi	1323	588	1938	297	669	297	213	579	570	570	1071	0	573	294	1431	315	195	393	348	390	1332	312	249	570	273	1560	531	0	384	156	216	474	366	1557
Magnolia albosericea	1317	840	1761	297	666	93	216	645	570	507	1077	0	573	0	1431	132	195	393	348	390	1338	327	288	462	273	1467	465	0	384	156	216	336	264	1557
Magnolia liliifera	1284	588	1872	294	666	0	219	618	570	429	1182	0	567	0	1431	216	195	393	348	390	1041	312	291	570	0	1653	531	0	384	0	216	474	375	1551
Magnolia delavayi	1329	408	1956	297	564	297	213	519	570	627	1317	207	573	342	1431	390	195	393	345	390	1338	327	291	720	273	1572	531	0	384	156	216	474	366	1557
Magnolia pastazaensis	1329	843	1959	297	666	93	216	645	573	0	942	111	573	0	1428	132	174	393	345	384	1158	327	288	570	273	1221	531	0	381	180	216	495	366	1551
Magnolia equatorialis	1329	588	1833	237	666	93	216	642	573	0	330	0	573	0	1428	132	0	393	348	384	1191	327	288	570	273	1479	531	0	381	156	216	501	366	1551
Magnolia ovata	1329	588	1797	237	666	237	216	645	573	0	882	0	573	0	1431	315	174	393	531	384	1323	327	282	567	273	1653	531	0	234	156	216	465	366	1551
Magnolia dodecapetala	1326	588	1962	297	666	300	216	639	573	192	1062	111	573	0	1431	315	174	390	531	384	1191	327	288	783	273	1566	531	0	381	156	216	501	366	1551
Magnolia kichuana	1320	585	1962	297	666	285	216	645	573	0	783	111	573	0	1428	132	174	393	531	384	1323	327	288	570	273	1662	531	0	381	150	216	405	366	1551
Magnolia zamorana	1329	588	1956	297	672	93	216	645	573	204	1014	111	537	0	1428	132	174	372	531	384	1323	327	288	570	273	1656	531	0	381	156	216	501	366	1551
Magnolia mercedesiarum	1305	183	1782	297	672	237	216	645	573	192	882	0	573	0	1428	132	174	393	531	384	1323	327	288	570	273	1500	531	0	381	156	216	501	366	1551
Magnolia mindoensis	1326	588	1860	297	672	279	231	645	573	198	942	0	573	0	1428	132	174	393	531	384	1323	327	288	570	273	1656	531	0	381	156	216	501	366	1551
Magnolia mexicana	1335	447	1962	297	672	93	216	642	573	207	951	0	570	0	1431	132	162	366	525	384	1317	327	291	570	273	1647	531	0	348	156	216	459	366	1548
Manglietia conifera	1263	588	1899	297	588	96	219	645	573	519	651	0	573	297	1431	234	0	393	531	390	1554	312	291	570	279	1572	531	0	387	237	216	405	366	1605
Manglietia insignis	1263	588	1899	297	588	339	219	645	573	399	477	0	573	342	1431	258	81	393	348	390	1554	312	291	468	279	1572	531	0	387	237	216	501	366	1605
Manglietia duclouxii	1272	588	1899	234	588	96	216	645	573	318	447	0	564	333	1431	285	81	393	525	390	1449	312	291	570	342	1590	531	0	384	237	216	501	366	1593
Manglietia hookeri	1266	588	1899	297	594	207	219	591	573	318	999	0	573	297	1431	132	81	393	531	390	1554	312	291	570	273	1635	531	0	384	237	216	432	366	1593
Manglietia aromatica	1260	840	1899	237	594	96	219	582	573	522	255	0	573	513	1431	234	0	393	531	390	1554	312	291	570	273	1326	531	0	384	156	216	501	366	1593
Manglietia lucida	1269	588	1899	237	663	297	219	582	573	522	588	204	573	297	1431	132	153	393	348	390	1554	312	291	567	273	1593	531	0	384	156	216	489	366	1587
Manglietia grandis	1257	588	1899	357	594	303	219	642	570	522	477	204	573	342	1431	300	81	393	348	390	1554	312	291	570	363	1593	531	0	381	156	216	501	366	1593
Manglietia megaphylla	1257	588	1899	294	594	99	219	645	570	522	1155	0	573	297	1431	234	0	393	348	390	1554	312	291	567	273	1620	438	0	384	228	216	501	366	1596
Manglietia rufibarbata	1260	588	1899	297	594	300	204	642	570	318	714	0	573	297	1431	387	0	393	504	390	1554	312	291	567	273	1575	507	0	384	156	216	501	366	1587
Manglietia ventii	1266	588	1899	294	594	204	219	645	570	0	1050	0	573	297	1431	384	81	348	348	390	975	312	291	570	273	1443	531	0	384	156	216	483	366	1593
Manglietia ovoidea	1263	588	1818	297	594	300	216	582	570	522	327	0	570	297	1431	417	81	393	348	390	1554	312	291	570	279	1356	531	0	384	237	216	501	366	1605
Manglietia kwangtungensis	1251	408	1899	297	594	201	219	645	570	522	783	0	573	342	1431	417	81	393	348	390	1554	312	291	570	357	1575	531	0	384	237	216	501	366	1605
Manglietia szechuanica	1248	588	1902	237	594	411	219	645	573	522	588	150	573	297	1431	315	78	393	348	390	1662	312	291	570	345	1575	531	0	384	237	216	501	366	1608
Manglietia pachyphylla	1263	588	1836	297	663	207	216	582	570	630	579	0	573	297	1431	312	195	393	348	384	1605	312	291	567	363	1590	531	0	384	237	216	501	366	1605
Manglietia fordiana	1266	588	1896	297	570	285	219	645	570	621	321	0	573	261	1431	411	0	393	348	390	1530	312	285	468	363	1341	531	0	384	237	216	501	366	1605
Manglietia glauca	1263	405	1887	297	660	273	378	582	570	339	390	0	546	534	1431	129	195	342	348	390	1524	312	288	573	363	1488	531	0	384	0	216	447	366	1605
Manglietia utilis	1251	588	1896	297	663	300	219	645	573	633	1212	0	573	0	1431	234	195	390	348	390	1524	312	291	570	363	1647	531	0	384	237	216	501	366	1599
Manglietia caveana	1260	588	1893	237	663	291	219	591	570	510	903	0	522	267	1431	126	0	393	348	390	1548	312	291	681	270	1488	531	0	438	156	216	405	366	1593
Manglietia garrettii	1260	618	1899	297	657	96	219	645	573	633	600	180	555	297	1431	234	0	393	348	390	1551	312	291	570	273	1530	531	0	375	237	216	501	366	1596
Manglietia decidua	1260	588	1902	297	663	300	219	642	573	336	591	0	573	330	1431	414	195	393	348	390	1554	312	285	570	267	1596	531	0	384	156	216	498	366	1611
Magnolia obovata	1254	588	1860	297	660	96	219	582	573	519	1053	204	552	297	1431	426	0	393	531	390	1419	312	291	570	357	1665	531	0	384	237	216	471	366	1587
Magnolia officinalis	1254	588	1968	297	666	267	219	789	573	519	966	0	552	270	1431	234	0	393	531	390	1554	312	291	570	273	1416	531	0	384	237	216	435	366	1590
Magnolia tripetala	1254	588	1959	297	660	300	219	645	573	633	1269	0	552	342	1431	471	195	393	531	390	1551	312	291	570	147	1596	531	0	384	156	216	504	366	1590
Magnolia wilsonii	1320	840	1716	237	669	0	219	495	573	351	177	0	558	0	1431	168	0	393	501	390	1419	312	291	567	273	1296	531	0	384	156	0	405	366	1593
Magnolia globosa	1260	588	1962	294	669	300	219	582	573	330	1089	0	573	297	1431	420	195	390	495	390	1548	312	291	570	273	1575	531	0	384	156	216	501	366	1605
Magnolia sieboldii	1314	588	1845	297	600	300	219	564	573	510	1041	0	552	285	1431	231	195	393	501	390	1548	312	291	567	273	1578	531	0	384	156	216	441	366	1602
Magnolia sieboldii subsp. *sinensis*	1332	588	1962	297	600	300	219	564	573	504	1245	0	573	285	1431	480	195	393	501	390	1542	312	291	570	273	1665	531	0	384	156	216	501	366	1602
Magnolia fraseri	1326	405	1854	294	669	300	222	645	573	201	1011	0	570	297	1431	423	174	393	348	390	1554	312	252	570	246	1650	531	0	384	72	213	501	366	1608
Magnolia fraseri var. *pyrimidata*	1326	588	1896	294	669	300	222	645	573	201	828	0	573	297	1431	306	174	384	516	390	1554	312	252	570	273	1566	531	0	384	78	213	405	366	1608
Magnolia splendens	1329	180	1833	294	666	300	219	642	573	0	1068	0	573	279	1431	132	174	393	525	390	1326	312	285	570	342	1572	531	0	384	0	216	477	366	1578
Magnolia portoricensis	1329	519	1962	297	666	300	219	642	573	213	912	0	573	330	1431	228	174	393	525	390	1236	312	285	570	342	1572	531	0	384	0	216	405	366	1578
Magnolia cubensis	1329	588	1836	297	666	300	219	579	573	177	798	0	531	279	1431	132	174	393	504	390	1338	312	291	699	357	1572	531	0	384	0	216	405	366	1575
Magnolia bankardiorum	1323	585	1914	297	666	297	219	642	573	195	978	0	555	114	1431	282	174	393	534	390	1326	312	285	570	357	1572	531	0	384	156	216	474	366	1569
Liriodendron chinense	1308	171	1683	297	0	186	219	210	573	0	333	0	579	0	1431	0	168	393	264	390	885	312	261	255	0	1155	531	0	0	0	216	495	366	1563
Liriodendron tulipifera X *Liriodendron chinense*	1314	408	1788	297	0	0	219	399	249	0	111	0	582	0	1428	0	168	393	333	390	885	312	261	216	0	1152	531	0	351	0	216	453	366	1551
Liriodendron tulipifera	1299	588	1842	297	0	0	213	423	570	0	333	0	582	0	1428	0	168	393	333	390	885	312	258	513	0	1149	531	0	357	0	216	495	366	1572
Ave.	1283	543	1860	283	628	214	221	619	559	392	889	64	543	234	1411	227	158	383	448	383	1403	318	283	570	276	1539	521	0	361	151	209	466	359	1553

Appendix 29. (Continued)

Taxon name	MKT102671_14	MKT103416_14	MKT103490_14	MKT103582_14	MKT104268_14	MKT104669_14	MKT105275_14	MKT106281_14	MKT106488_14	MKT107466_14	MKT109897_14	MKT110690_14	MKT110961_14	MKT111920_14	MKT114467_14	MKT115640_14	MKT116135_14	MKT116443_14	MKT117762_14	MKT118146_14	MKT120644_14	MKT120725_14	MKT121246_14	MKT125069_14	MKT125823_14	MKT126189_14	MKT126264_14	MKT126492_14	MKT126679_14	MKT127979_14	MKT131170_14	MKT131706_14	MKT131785_14	MKT132265_14
Length of the reference for each loci	444	588	1017	756	216	165	234	255	351	708	504	516	273	582	744	339	804	288	1242	531	261	771	516	180	591	1086	393	924	714	654	1281	210	441	363
Magnolia griffithii	444	573	768	756	210	165	231	255	351	708	495	513	0	582	465	342	798	285	717	528	219	708	516	180	591	0	393	924	711	654	231	210	423	99
Michelia baillonii	444	441	768	756	210	165	231	255	351	0	495	504	0	582	561	342	801	285	768	612	219	702	516	180	591	219	393	924	651	654	195	210	423	99
Michelia sirindhorniae	447	588	771	756	210	165	228	255	351	708	495	513	0	582	558	342	798	288	984	522	219	708	516	180	591	96	393	924	585	654	219	210	423	99
Michelia velutina	447	588	768	756	210	165	231	255	348	708	495	513	0	153	660	342	801	288	984	528	177	708	447	180	591	330	393	924	714	654	207	210	423	120
Michelia masticata	441	588	657	756	210	165	231	255	351	708	495	513	0	363	567	342	801	285	567	528	177	468	447	180	591	84	393	924	729	654	411	210	423	123
Michelia sphaerantha	441	588	765	756	210	165	231	255	351	90	495	513	0	363	567	342	801	285	849	528	219	702	447	180	591	99	393	924	714	654	408	210	423	306
Michelia doltsopa	444	573	771	756	210	165	231	255	351	708	495	513	0	582	777	342	801	288	777	534	219	777	516	180	591	294	393	924	714	654	186	210	423	162
Michelia lacei	192	573	771	756	210	165	231	255	351	708	495	513	0	582	633	342	801	207	936	534	219	627	516	180	591	507	393	924	714	654	207	210	423	0
Michelia salicifolia	192	588	771	756	210	165	231	255	351	705	495	513	0	579	567	342	759	288	579	387	177	771	516	180	591	135	393	915	651	642	261	210	423	306
Michelia martini	192	588	939	753	210	165	234	255	351	93	495	504	0	582	567	342	801	288	762	297	219	612	447	180	591	117	393	924	714	654	204	210	423	303
Michelia coriacea	471	588	1014	756	210	165	231	255	351	0	495	513	0	582	567	342	801	288	849	126	219	690	516	180	591	186	393	924	714	654	219	210	423	330
Michelia ingrata	429	588	771	756	210	165	246	255	351	702	495	510	0	153	567	348	801	288	975	162	219	468	447	180	591	0	393	924	714	654	0	210	423	327
Michelia wilsonii	444	588	771	756	210	165	234	144	351	708	495	513	0	582	489	342	801	288	333	531	255	678	513	180	591	108	393	924	714	654	213	210	423	123
Michelia floribunda	444	573	771	756	210	165	231	255	351	705	495	513	0	582	567	342	801	288	276	171	219	708	516	180	591	183	393	921	714	654	126	210	423	81
Michelia chapensis	192	588	765	756	210	165	234	255	351	90	495	513	0	471	567	342	801	288	789	417	219	696	447	171	591	207	393	924	714	654	213	210	423	306
Michelia chapensis	444	588	657	756	210	165	123	255	351	90	477	492	0	582	567	342	801	288	843	396	177	696	390	180	591	0	393	924	651	654	261	210	420	162
Michelia hypolampra	444	585	657	756	210	129	234	255	351	705	495	513	0	582	456	342	801	288	849	528	177	624	516	180	591	132	393	924	714	654	204	210	417	306
Michelia viridipetala	429	588	771	756	210	165	234	255	351	90	495	492	0	582	591	342	801	288	570	324	219	399	516	180	591	0	390	924	522	654	258	210	423	261
Michelia balansae	441	588	771	738	210	165	234	255	351	90	495	513	0	153	558	342	798	288	924	528	177	771	564	180	591	207	393	924	714	654	213	210	423	273
Michelia guangxiensis	444	588	771	756	210	165	234	219	351	90	495	510	0	582	591	342	798	288	183	528	219	477	516	180	591	345	393	546	714	654	270	210	423	330
Michelia figo	444	582	657	759	210	165	234	255	351	708	495	510	0	582	468	342	801	288	846	396	255	612	516	141	591	0	390	924	714	654	231	210	423	186
Michelia shiluensis	192	588	771	756	210	165	108	255	351	696	495	510	0	153	567	342	798	288	714	528	219	552	516	180	591	87	393	924	651	654	204	207	420	330
Michelia odora	444	588	657	756	210	165	108	255	351	708	495	510	0	582	567	342	759	288	855	420	177	624	384	180	591	0	390	924	654	654	213	210	423	306
Michelia montana	447	588	771	756	189	165	108	255	351	705	483	513	0	153	567	342	801	282	855	531	219	696	516	180	591	111	390	924	714	654	213	210	423	282
Elmerrillia ovalis	444	588	771	756	210	165	228	255	354	0	489	504	0	582	567	342	759	288	747	468	177	738	264	180	591	0	393	924	714	654	198	210	423	306
Michelia compressa	444	588	771	756	210	165	228	255	351	90	495	489	0	582	567	345	801	273	798	528	219	771	465	180	591	207	393	921	714	654	213	210	417	306
Michelia macclurei	387	585	1014	756	210	165	234	255	351	705	495	513	0	582	471	342	801	288	936	531	219	624	447	180	591	135	393	924	714	654	261	210	420	87
Michelia guangdongensis	429	585	1014	756	210	165	234	255	351	0	495	315	0	579	567	342	801	288	846	525	177	537	513	180	591	0	363	924	651	654	213	210	423	249
Michelia maudiae	444	585	1014	750	210	165	234	255	351	90	495	510	0	582	471	342	801	288	147	303	219	624	327	180	591	0	393	924	651	654	261	210	423	162
Michelia foveolata	444	585	900	756	210	165	246	255	351	66	495	513	0	582	564	342	801	288	762	387	219	468	447	180	591	0	390	924	585	654	207	210	423	90
Michelia cavaleriei	438	585	771	756	210	165	234	255	351	705	495	513	0	579	567	342	801	288	918	525	177	696	447	180	591	114	393	924	714	654	261	210	420	162
Magnolia elegans	444	585	1014	756	207	165	231	255	348	0	504	417	0	582	591	339	801	288	147	261	219	738	465	180	591	0	393	897	714	654	228	210	423	360
Magnolia borneensis	144	123	150	306	0	0	219	255	0	0	348	0	0	0	177	0	0	228	0	189	81	309	372	0	273	0	0	543	138	0	204	0	207	93
Magnolia carsonii	444	582	1017	753	207	165	231	255	348	0	504	381	0	492	558	345	762	288	234	297	177	738	465	180	591	294	393	927	711	654	222	210	423	366
Magnolia cathcartii	444	585	900	756	207	165	231	255	348	708	504	516	0	582	591	339	804	282	147	357	177	771	516	180	591	141	393	924	714	654	210	210	423	342
Magnolia zenii	444	588	1017	756	216	165	234	228	351	90	504	516	0	582	585	339	804	288	912	531	219	714	513	180	591	510	393	924	714	654	204	210	420	366
Magnolia biondii	444	420	255	750	216	165	234	255	351	0	504	516	0	582	495	339	609	288	990	453	219	309	516	180	576	207	393	924	384	654	465	210	420	0
Magnolia amoena	444	585	1017	756	216	165	234	255	351	90	504	516	0	582	585	315	792	288	1017	420	219	714	516	180	591	606	393	918	711	654	207	210	420	366
Magnolia sinostellata	444	588	1017	756	216	165	234	255	351	90	504	516	0	582	585	339	804	288	864	531	219	714	516	180	591	291	393	924	714	654	258	210	420	198
Magnolia stellata	444	585	1017	756	216	165	234	255	351	708	504	513	0	582	591	339	804	288	864	531	255	696	516	180	591	606	393	924	714	654	201	210	438	366
Magnolia kobus	444	588	1017	756	216	165	234	231	351	708	504	516	0	582	495	339	804	288	750	531	219	774	516	180	591	627	393	924	648	654	207	210	438	366
Magnolia salicifolia	444	585	1014	756	216	165	234	255	351	708	504	513	0	582	591	339	762	288	864	531	219	630	516	180	591	207	393	924	651	654	261	207	438	366
Magnolia denudata	444	588	1017	756	210	165	231	255	351	591	504	333	0	582	471	342	804	288	777	450	177	696	516	141	591	510	393	924	678	654	210	210	372	198
Magnolia cylindrica	192	588	1017	756	210	165	231	255	351	591	504	504	0	582	591	342	801	288	990	405	219	633	516	180	591	180	393	924	636	654	210	210	420	357
Magnolia liliiflora	141	588	900	756	210	165	246	255	351	591	504	504	0	582	585	342	648	288	1089	348	219	630	516	180	591	207	393	924	651	654	210	210	420	189
Magnolia sprengeri	444	588	900	687	216	165	234	255	351	591	504	477	0	543	495	342	648	288	774	273	219	468	516	180	591	0	393	924	522	654	258	210	420	189
Magnolia sargentiana	444	588	1017	756	210	165	231	144	351	0	501	393	0	570	576	342	795	288	843	273	219	561	516	180	591	180	393	924	714	654	231	210	420	366
Magnolia campbellii	444	588	900	756	210	165	231	144	351	0	501	456	0	705	576	342	795	288	702	171	177	468	519	180	591	180	393	921	714	654	258	210	420	189
Magnolia dawsoniana	444	588	1017	756	210	0	234	255	351	708	504	513	0	543	576	342	801	288	837	168	177	729	516	180	591	0	393	924	651	654	204	210	420	198
Magnolia acuminata var. *subcordata*	444	588	900	756	210	165	231	255	351	708	504	504	0	540	591	342	759	288	714	417	177	717	447	180	591	249	390	924	615	654	207	210	423	339

Magnolia acuminata	444	588	900	756	210	165	231	144	351	702	504	507	0	780	678	342	762	288	849	531	219	495	447	180	591	0	393	924	522	654	195	210	420	189
Kmeria duperreana	447	588	1017	753	216	165	231	255	351	708	504	507	0	579	111	240	804	285	750	528	213	465	516	180	591	150	393	924	714	651	198	210	423	366
Kmeria septentrionalis	447	588	900	756	210	165	231	255	351	705	504	513	0	579	0	249	804	288	714	360	177	708	516	180	591	0	393	921	522	651	123	210	423	363
Magnolia nitida var. *lotungensis*	444	582	1017	756	0	165	225	144	351	708	495	507	0	582	576	342	864	288	681	0	219	561	516	180	591	96	378	924	651	654	210	210	420	174
Pachylarnax praecalva	0	0	0	0	0	0	0	0	0	0	0	117	0	0	0	0	0	117	0	0	0	0	0	0	0	0	0	231	129	0	0	0	216	0
Magnolia kachirachirai	447	588	1017	756	0	165	225	255	351	708	495	507	0	582	576	339	804	0	1098	225	177	771	516	180	588	96	381	924	651	654	0	210	423	342
Magnolia sinica	447	588	1017	756	0	165	225	255	351	708	495	480	0	582	480	342	651	288	858	531	219	771	513	180	591	96	381	912	651	651	213	210	423	354
Magnolia nitida	447	450	1017	756	0	165	225	255	351	708	495	459	0	579	480	342	804	288	948	372	177	723	516	180	591	0	387	924	714	654	0	210	423	174
Magnolia poasana	441	588	1017	756	210	165	231	255	351	0	0	489	0	582	492	330	804	288	840	294	177	738	447	141	684	231	393	921	714	651	0	207	423	255
Magnolia panamensis	189	588	1017	756	210	165	231	255	351	708	0	489	0	582	492	330	804	288	948	528	219	735	447	144	657	309	393	921	714	651	0	207	423	255
Magnolia sharpii	444	588	1017	759	210	159	231	255	351	0	0	489	0	582	585	327	804	288	852	558	213	771	447	141	591	309	393	921	585	651	0	207	423	252
Magnolia guatemalensis	189	588	1017	759	210	165	231	255	351	0	0	486	0	582	585	327	609	288	1080	531	210	729	447	141	591	225	393	921	714	651	0	207	423	252
Magnolia iltisiana	189	588	1017	756	210	165	231	255	351	708	0	462	0	582	582	327	804	288	903	519	177	729	447	141	591	96	393	921	714	651	0	207	423	255
Magnolia grandiflora	183	588	1017	756	210	165	231	255	351	705	504	459	0	582	672	327	804	288	717	531	219	738	480	141	591	96	393	918	714	651	189	207	423	318
Magnolia striatifolia	441	588	1017	756	210	165	231	255	351	0	504	432	0	582	582	327	804	288	726	534	219	486	543	141	591	309	375	666	714	651	189	207	423	267
Magnolia schiedeana	444	588	900	756	210	165	231	255	351	705	0	477	0	582	585	327	651	288	768	450	177	738	480	141	591	96	393	921	585	651	0	210	423	99
Magnolia tamaulipana	435	588	1017	756	210	165	231	255	351	84	504	0	0	582	489	327	651	282	711	513	177	639	480	141	585	0	393	921	714	651	0	207	423	360
Magnolia virginiana	195	588	1017	756	210	165	231	144	351	708	501	516	0	582	465	327	651	288	720	531	177	624	447	141	591	0	291	921	714	651	195	210	423	123
Magnolia macrophylla	447	588	1017	756	207	165	231	255	351	708	378	0	0	582	585	399	804	288	846	366	177	708	516	180	591	225	393	876	714	651	0	210	420	318
Magnolia macrophylla var. *ashei*	447	588	900	756	207	165	231	255	351	708	378	384	0	582	492	399	804	288	858	333	177	708	516	180	591	225	393	882	642	651	0	210	420	318
Magnolia dealbata	447	588	900	756	207	165	231	198	351	0	378	483	0	582	492	309	804	288	852	0	177	708	516	180	591	225	393	879	714	651	0	210	420	342
Magnolia championii	447	585	900	702	210	165	231	255	351	708	504	438	0	582	564	327	801	288	135	363	177	714	516	180	591	93	390	924	714	654	0	201	420	360
Magnolia coco	444	447	900	756	210	165	231	255	351	618	504	438	0	492	474	327	801	288	183	279	177	777	480	141	549	0	390	924	714	654	0	201	420	360
Magnolia phanerophlebia	447	588	1017	759	210	165	231	255	351	618	504	507	0	582	474	327	648	288	135	126	219	309	516	180	591	93	390	921	714	651	0	201	420	120
Magnolia pterocarpa	450	588	900	621	210	165	225	255	351	0	501	132	0	609	474	327	648	264	132	420	174	648	516	180	591	0	390	633	513	651	198	207	420	198
Magnolia hodgsonii	450	588	1017	741	210	165	231	255	351	0	501	498	0	567	474	321	750	264	138	456	177	708	516	180	591	93	390	954	714	651	195	210	420	294
Magnolia henryi	237	588	1017	756	210	165	210	255	351	675	504	498	0	582	549	327	801	264	195	171	177	642	516	180	591	138	390	921	714	651	201	210	420	198
Magnolia albosericea	168	582	672	756	210	162	231	144	351	618	504	0	0	558	474	300	798	288	147	363	177	612	516	0	591	0	393	840	717	648	0	210	423	321
Magnolia liliifera	195	588	942	696	210	165	231	255	351	459	504	480	0	582	495	327	648	288	774	357	177	654	387	141	591	183	387	936	522	651	0	210	423	360
Magnolia delavayi	195	588	1017	759	210	159	231	255	333	708	504	486	0	579	591	327	804	288	726	450	219	738	516	180	591	189	390	921	714	654	195	177	423	360
Magnolia pastazaensis	441	585	1017	747	210	165	228	255	351	708	501	405	0	246	492	342	726	288	576	345	177	630	447	177	591	0	390	858	492	648	0	210	438	351
Magnolia equatorialis	441	585	1017	747	210	165	231	144	351	702	501	327	0	0	492	342	651	288	585	528	177	447	354	180	591	0	390	858	585	648	0	210	438	192
Magnolia ovata	444	315	1017	723	210	165	231	255	351	699	504	489	0	246	594	339	729	288	735	303	219	630	477	180	591	0	390	918	456	648	0	210	438	348
Magnolia dodecapetala	444	579	1017	747	210	165	231	255	351	708	504	510	0	246	594	342	771	288	858	534	219	630	93	180	591	96	390	834	714	648	0	210	423	288
Magnolia kichuana	441	582	1017	747	210	165	231	255	351	708	504	501	0	246	492	342	771	288	645	387	177	633	477	171	591	0	390	915	714	648	0	210	423	354
Magnolia zamorana	444	585	1017	747	210	165	231	255	351	462	504	510	0	246	492	342	771	288	570	321	177	633	477	180	588	0	390	834	651	648	0	210	438	339
Magnolia mercedesiarum	441	315	1017	747	210	165	228	171	351	708	504	510	0	246	594	342	771	288	723	534	219	612	477	180	591	0	390	927	714	648	0	210	438	354
Magnolia mindoensis	441	585	1017	714	210	165	231	255	351	702	504	510	0	192	477	342	771	288	327	429	177	630	483	180	591	0	390	834	714	648	0	210	438	339
Magnolia mexicana	438	183	1017	747	210	162	231	255	351	699	504	489	0	582	555	309	762	288	636	303	177	708	543	180	591	0	390	891	651	648	0	210	438	360
Manglietia conifera	189	588	900	753	210	165	231	255	351	90	501	480	0	462	489	336	804	264	258	0	177	723	579	180	591	87	390	312	651	630	210	210	423	186
Manglietia insignis	441	588	1017	756	210	165	231	255	351	0	501	432	0	462	585	336	804	264	651	93	177	723	516	180	591	174	390	801	714	621	210	210	423	186
Manglietia duclouxii	441	588	900	669	210	165	231	255	351	0	501	483	0	462	489	339	762	264	456	0	177	624	423	180	591	0	390	558	513	621	138	210	423	186
Manglietia hookeri	189	588	1017	669	210	165	231	255	351	93	501	432	0	462	585	339	804	264	822	0	177	654	516	180	591	81	390	600	714	642	207	207	423	186
Manglietia aromatica	420	588	1017	669	210	165	231	255	351	90	504	0	0	462	474	339	804	288	831	0	177	624	468	180	591	81	390	729	651	762	261	210	423	186
Manglietia lucida	441	588	1017	756	156	165	234	255	351	90	504	507	0	462	561	339	804	288	606	66	177	693	582	180	591	216	390	729	714	651	204	210	423	186
Manglietia grandis	441	588	1017	909	210	165	231	216	351	90	504	483	0	462	585	339	804	264	798	309	177	633	516	180	591	87	390	729	585	753	210	210	423	186
Manglietia megaphylla	189	588	900	669	210	165	234	144	351	90	504	468	0	579	378	339	804	288	588	93	177	552	516	180	591	87	390	759	714	651	258	210	423	84
Manglietia rufibarbata	441	582	900	756	210	165	234	144	351	90	504	483	0	579	489	339	792	288	117	93	177	468	516	180	591	180	390	645	714	651	207	210	423	186
Manglietia ventii	441	588	1017	669	210	165	231	144	351	66	501	504	0	582	582	339	804	285	0	0	177	468	582	180	591	213	390	312	651	651	210	210	423	0
Manglietia ovoidea	423	588	1017	753	210	165	231	249	351	90	504	468	0	501	585	336	717	288	465	174	177	723	516	180	591	177	390	615	714	642	207	210	423	0
Manglietia kwangtungensis	441	588	1017	753	210	165	231	255	351	0	504	468	0	462	585	336	804	288	252	405	177	468	516	180	591	87	390	720	714	621	207	210	423	0
Manglietia szechuanica	441	588	1017	759	210	165	231	255	351	90	504	417	0	582	585	336	804	288	531	204	177	723	513	180	591	129	390	636	714	630	345	210	423	159
Manglietia pachyphylla	441	588	1017	735	210	165	231	255	351	90	504	432	0	582	582	336	801	288	684	0	177	468	582	180	591	309	390	558	639	630	210	210	423	0
Manglietia fordiana	441	582	1017	735	210	165	231	255	351	0	504	453	0	582	582	339	804	288	135	0	177	612	513	180	591	87	390	618	651	642	207	210	423	0
Manglietia glauca	189	588	1017	669	210	165	231	249	351	90	504	504	0	582	441	339	762	288	405	291	177	633	468	180	564	87	390	558	585	651	210	210	423	0
Manglietia utilis	189	591	1017	756	210	165	231	243	351	0	504	489	0	576	585	327	804	288	519	171	177	633	489	180	591	180	390	843	714	630	210	210	423	186
Manglietia caveana	441	588	1017	669	210	165	231	255	351	90	498	504	0	462	450	336	762	288	603	162	177	771	513	180	591	87	390	558	651	651	411	210	423	183
Manglietia garrettii	441	588	1017	669	210	165	231	225	351	90	504	483	0	582	480	327	651	288	516	135	177	714	516	180	591	180	390	735	651	651	210	210	423	186
Manglietia decidua	189	588	1017	753	210	165	231	255	351	90	501	453	0	459	585	336	804	288	693	0	177	708	489	180	591	90	390	0	714	651	204	210	423	0
Magnolia obovata	438	522	1017	762	210	165	231	255	351	90	504	504	0	579	567	339	804	288	711	369	177	633	516	180	591	222	390	918	636	651	195	210	420	168
Magnolia officinalis	438	522	900	759	210	165	231	249	351	90	504	504	0	516	567	339	762	288	627	324	219	633	834	180	591	87	390	918	714	651	198	210	420	0
Magnolia tripetala	438	588	1017	756	210	165	234	255	351	90	495	504	0	579	567	339	804	288	849	396	177	771	516	180	591	171	390	879	714	651	180	210	420	0
Magnolia wilsonii	189	450	1017	759	210	165	231	255	351	84	504	423	0	561	438	339	651	288	777	0	219	468	477	180	591	0	390	924	600	651	198	210	423	0
Magnolia globosa	441	588	1017	759	210	165	231	255	351	0	504	483	0	579	534	339	801	285	705	186	198	771	516	180	591	423	390	924	714	651	189	210	423	189
Magnolia sieboldii	447	582	1017	744	210	165	231	144	351	90	504	177	0	558	534	339	807	288	747	186	198	729	447	180	591	423	390	924	711	651	213	210	381	0
Magnolia sieboldii subsp.	447	582	1017	753	210	165	231	255	351	687	504	444	0	576	534	339	804	288	831	186	198	729	447	180	591	114	390	924	648	651	204	210	381	0

sinensis																																			
Magnolia fraseri	0	588	825	750	207	165	228	255	351	0	504	510	0	582	492	342	804	288	999	423	177	633	516	180	591	183	390	951	585	651	144	192	423	99
Magnolia fraseri var. pyrimidata	0	588	942	762	207	165	231	255	351	708	504	504	0	582	567	342	804	288	714	255	219	630	516	180	591	0	390	840	522	651	0	192	417	99
Magnolia splendens	195	588	900	756	210	165	231	171	333	705	504	480	0	0	492	342	804	288	897	186	177	708	579	180	597	123	390	924	642	651	0	210	423	198
Magnolia portoricensis	444	588	1017	756	210	165	231	198	333	705	504	453	0	270	492	342	804	288	588	363	177	708	579	180	597	96	390	924	642	651	0	210	423	198
Magnolia cubensis	447	588	1017	756	210	165	231	255	348	681	468	432	0	405	588	342	750	288	771	291	177	708	381	141	591	96	390	921	651	651	0	210	423	198
Magnolia bankardiorum	447	588	1014	759	210	165	231	255	348	0	504	432	0	429	588	342	804	285	993	261	207	708	579	180	591	420	390	924	714	651	0	210	423	198
Liriodendron chinense	0	237	789	669	0	144	237	255	351	0	0	0	0	0	0	0	756	252	0	0	177	456	447	141	603	0	393	876	519	645	0	198	417	0
Liriodendron tulipifera X *Liriodendron chinense*	0	507	789	660	117	144	234	168	351	0	0	0	0	0	0	0	759	252	0	0	177	294	447	141	600	0	393	879	384	645	0	105	417	0
Liriodendron tulipifera	0	507	942	660	117	144	234	255	351	0	0	0	0	0	0	0	879	273	0	0	177	294	447	141	600	0	393	714	519	645	0	198	417	0
Ave.	370	560	913	735	196	160	226	238	345	364	456	444	0	492	517	323	764	281	652	332	193	635	486	170	585	140	384	847	654	642	158	205	419	210

(cont. Appendix 29)

Taxon name	MKT132_814_1_4	MKT136_353_1_4	MKT136_846_1_4	MKT137_064_1_4	MKT137_339_1_4	MKT138_013_1_4	MKT138_505_1_4	MKT138_586_1_4	MKT138_835_1_4	MKT138_928_1_4	MKT138_751_1_4	MKT139_784_1_4	MKT143_856_1_4	MKT145_857_1_4	MKT147_312_1_4	MKT148_301_1_4	MKT153_988_1_4	MKT153_109_1_4	MKT155_265_1_4	MKT155_305_1_4	MKT155_057_1_4	MKT159_286_1_4	MKT161_029_1_4	MKT164_244_1_4	MKT164_313_1_4	MKT164_391_1_4	MKT164_315_1_4	MKT165_824_1_4	MKT166_213_1_4	MKT168_891_1_4	MKT169_456_1_4	MKT170_042_1_4	MKT176_331_1_4	MKT176_812_1_4
Length of the reference for each loci	438	579	222	285	489	1206	501	696	228	408	546	510	465	960	879	1113	1056	900	852	453	519	393	351	648	291	279	1305	1149	1641	861	1110	960	1263	996
Magnolia griffithii	279	576	222	285	468	1218	375	678	228	390	0	459	462	960	879	885	915	894	666	453	519	390	198	648	0	267	1305	237	1578	618	1110	753	855	177
Michelia baillonii	297	576	222	285	180	1014	426	669	228	390	0	426	462	960	879	888	906	894	666	453	519	390	240	648	198	267	1305	348	1578	660	1110	753	1029	165
Michelia sirindhorniae	297	576	222	285	456	1014	426	678	228	390	543	444	462	960	876	888	897	894	852	453	519	312	330	642	282	270	1308	636	1578	675	1110	753	1074	273
Michelia velutina	294	579	222	285	474	1218	426	690	228	219	351	510	462	960	879	888	1056	807	852	453	519	387	285	648	282	270	1308	336	1578	714	1110	753	1077	291
Michelia masticata	297	576	222	285	462	1215	426	690	228	219	468	444	462	960	879	888	915	894	666	453	519	387	198	648	240	270	1308	138	1338	666	1110	753	1011	285
Michelia sphaerantha	297	501	222	285	180	1014	426	690	228	390	468	474	465	960	879	888	900	807	852	453	519	387	198	645	0	270	1305	357	1578	720	1110	753	990	276
Michelia doltsopa	438	576	222	285	438	1218	426	681	228	390	540	453	462	960	879	1029	909	894	852	453	519	390	222	648	279	270	1308	393	1578	717	1002	753	1260	561
Michelia lacei	297	576	222	285	630	1218	426	687	228	390	540	504	462	960	879	882	915	894	852	453	519	390	231	648	279	270	1311	429	1578	720	1110	753	1125	267
Michelia salicifolia	294	573	222	285	291	1014	375	690	228	390	0	450	429	960	633	888	924	807	666	453	519	390	198	648	282	270	1308	444	1578	885	1110	753	1023	237
Michelia martini	222	576	219	285	447	1014	477	672	228	390	0	447	462	960	879	825	1059	894	852	453	519	390	198	648	0	270	1308	288	1578	669	1110	753	1263	0
Michelia coriacea	294	576	222	285	456	1218	426	681	228	219	0	495	462	960	879	888	1056	894	852	453	519	387	333	648	0	270	1308	234	1578	441	1110	753	1260	183
Michelia ingrata	291	576	222	285	630	1014	231	678	228	390	540	441	462	960	879	888	1050	807	831	453	519	390	198	648	0	270	1284	213	1578	591	1110	753	1146	324
Michelia wilsonii	297	576	222	285	438	1014	300	678	228	219	0	459	462	960	882	888	1050	894	852	453	519	390	333	648	282	270	1308	525	1575	711	1110	753	1029	270
Michelia floribunda	297	483	222	285	456	1014	426	678	228	219	288	444	462	960	873	888	906	894	852	453	519	381	198	648	282	270	1308	351	1578	684	1110	753	1029	276
Michelia chapensis	288	576	222	285	360	1023	387	690	228	219	0	444	462	960	879	888	837	894	828	450	519	390	198	648	279	270	1308	183	1578	672	1110	753	1023	552
Michelia chapensis	213	576	222	276	459	1014	375	672	228	57	0	444	462	960	879	888	924	804	828	450	519	390	198	648	279	270	1290	342	1338	696	1110	753	1029	0
Michelia hypolampra	297	501	222	285	474	1014	426	690	228	390	0	507	462	960	879	825	1059	807	828	450	519	390	198	639	261	270	1308	186	1578	672	1110	744	1029	0
Michelia viridipetala	216	576	222	285	459	1218	300	672	228	405	543	462	462	960	879	888	750	807	666	453	327	390	198	648	0	267	1275	204	1641	723	1110	753	1026	0
Michelia balansae	294	576	213	285	279	1014	426	678	228	390	540	453	429	960	879	888	1056	807	852	453	519	390	198	648	279	270	1308	390	1578	669	1110	753	1131	291
Michelia guangxiensis	294	576	222	285	441	1218	495	678	228	390	543	450	462	960	876	888	1056	783	666	453	519	384	246	648	297	267	1308	399	1578	708	1110	420	855	255
Michelia figo	222	486	222	285	330	1014	300	678	228	393	0	444	462	960	879	885	924	894	852	453	519	384	261	648	0	264	1308	192	1578	528	1110	747	1029	0
Michelia shiluensis	240	576	222	285	180	1218	300	690	228	390	0	438	462	960	879	744	813	894	852	450	519	387	198	648	0	267	1308	408	1578	624	1110	753	855	0
Michelia odora	210	576	222	285	297	1218	300	678	228	390	543	471	462	960	879	744	915	894	852	453	519	384	198	648	294	270	1308	312	1578	705	1110	747	1089	0
Michelia montana	300	576	222	285	417	1212	495	678	228	390	390	438	459	960	879	819	891	894	852	453	519	390	198	648	282	270	1290	237	1578	582	1110	753	1128	288
Elmerrillia ovalis	210	501	222	285	180	1218	291	582	228	384	0	420	462	960	879	885	537	894	840	453	519	390	198	648	273	267	1233	228	1578	438	939	753	1026	225
Michelia compressa	246	576	222	285	372	1014	495	681	228	393	279	423	462	960	879	888	900	894	666	453	519	390	198	648	0	270	1308	408	1578	564	1110	753	855	255
Michelia macclurei	297	576	222	285	651	1014	231	678	228	387	456	453	462	960	879	885	915	870	852	453	519	390	351	648	282	267	1308	357	1512	720	1110	753	1191	291
Michelia guangdongensis	0	576	222	285	327	1218	426	678	228	219	357	366	462	774	879	888	909	894	666	453	519	390	327	648	240	270	1296	234	1641	639	873	753	1029	0
Michelia maudiae	291	576	222	285	444	1218	231	675	228	219	519	441	462	960	879	888	909	894	774	453	519	390	351	648	0	270	1302	0	1578	480	1110	753	855	0
Michelia foveolata	294	576	222	285	483	1014	231	675	219	219	408	426	462	960	879	888	1047	870	798	453	519	390	288	648	0	270	1308	312	1512	720	963	753	1029	264
Michelia cavaleriei	294	576	222	285	456	1218	426	675	228	390	543	489	465	960	879	888	1038	771	852	453	519	390	246	648	0	273	1308	492	1578	669	1110	753	1320	291
Magnolia elegans	438	576	219	285	306	1218	498	696	228	390	456	453	462	960	879	891	879	807	666	417	519	390	198	642	303	258	1296	369	1512	297	1110	732	1008	0
Magnolia borneensis	0	201	0	228	156	594	0	144	0	177	0	195	186	960	396	474	390	411	246	0	0	261	0	207	0	0	570	114	261	0	864	192	0	0
Magnolia carsonii	432	576	222	285	306	1014	390	693	228	390	0	381	462	960	879	891	915	894	666	402	519	390	198	642	279	267	1287	384	1485	297	1110	336	990	0
Magnolia cathcartii	432	576	222	285	180	1014	408	696	228	384	0	438	462	960	879	891	846	783	849	453	519	390	198	642	198	267	1308	393	1512	477	1110	753	1029	0
Magnolia zenii	438	579	222	285	144	1014	501	696	228	393	507	447	465	960	879	930	915	813	852	453	519	393	198	648	120	279	1296	681	1629	669	1110	753	1137	291
Magnolia biondii	438	318	222	285	144	942	501	690	228	393	546	441	459	960	879	933	528	900	852	453	519	393	198	393	0	279	1305	879	1401	639	1110	726	552	267

Magnolia amoena	438	579	222	285	336	1014	501	696	228	393	540	441	465	960	879	942	909	813	852	453	519	393	198	648	0	279	1305	600	1578	669	1110	753	1125	258
Magnolia sinostellata	438	576	222	285	474	1206	378	696	228	393	501	441	465	960	879	981	852	900	666	453	519	393	255	648	0	279	1209	912	1563	552	1110	753	1011	321
Magnolia stellata	438	579	222	285	441	1014	501	672	228	393	546	507	465	960	879	1017	915	798	852	453	519	393	198	648	210	279	1305	678	1641	645	1110	753	1323	273
Magnolia kobus	438	579	222	285	189	1014	501	696	228	393	543	444	465	960	879	1053	903	798	852	453	519	393	198	648	0	279	1305	588	1575	513	1110	753	1029	294
Magnolia salicifolia	438	579	222	285	327	1014	501	696	228	393	543	444	465	960	879	996	1056	798	852	453	519	393	198	648	0	279	1305	600	1575	699	1110	753	1029	255
Magnolia denudata	297	579	222	285	336	924	306	696	228	393	822	441	396	960	879	1044	906	894	852	453	486	393	198	648	201	273	1203	303	1434	567	1104	741	1092	174
Magnolia cylindrica	420	579	222	285	189	1014	387	696	228	390	546	468	465	960	879	984	837	798	666	453	519	393	198	648	0	279	1308	0	1335	615	1110	753	855	246
Magnolia liliiflora	297	579	222	285	162	1014	408	696	228	393	486	441	435	960	876	978	900	762	666	453	519	393	198	648	0	279	1305	429	1335	720	1110	753	1026	270
Magnolia sprengeri	297	486	222	285	144	1014	0	696	228	393	543	441	465	960	879	927	1056	807	666	453	519	393	198	648	0	270	1305	540	1335	714	1110	549	837	186
Magnolia sargentiana	291	579	222	285	303	1218	303	696	228	390	543	438	465	960	879	1053	1056	792	666	453	519	393	351	636	0	270	1272	78	1575	714	873	672	1029	243
Magnolia campbellii	483	411	219	285	189	1218	402	696	228	393	516	429	462	960	879	984	1056	894	666	453	519	390	198	648	0	270	1272	204	1575	588	822	753	1089	480
Magnolia dawsoniana	474	579	222	285	459	1014	501	696	228	393	531	513	465	960	879	1008	975	894	852	453	519	393	198	642	0	279	1422	510	1404	678	1062	753	1173	291
Magnolia acuminata var. *subcordata*	432	576	222	285	180	1014	414	696	228	219	501	411	462	960	717	1071	915	807	852	450	519	387	198	648	0	270	1209	204	1584	615	1101	753	1029	222
Magnolia acuminata	291	501	222	285	363	1218	297	696	228	393	432	384	462	960	879	930	1041	807	666	450	519	393	198	648	0	270	1305	381	1404	672	1110	753	855	0
Kmeria duperreana	429	576	222	285	366	1014	501	702	228	333	546	441	462	960	876	900	915	891	852	429	381	393	198	648	303	270	1281	0	1512	363	1110	753	1179	0
Kmeria septentrionalis	423	576	222	285	327	1014	306	699	228	333	543	450	462	960	876	882	915	867	666	429	516	393	198	648	0	267	1308	0	1338	369	1110	753	1011	0
Magnolia nitida var. *lotungensis*	435	408	222	285	216	1218	312	702	225	390	0	495	462	960	789	816	909	894	666	447	519	393	228	648	0	258	1308	0	1578	582	1110	663	852	0
Pachylarnax praecalva	144	0	0	144	0	0	0	0	0	96	0	0	0	960	0	0	0	0	78	0	0	0	0	0	0	0	207	0	87	123	0	0	0	0
Magnolia kachirachirai	429	576	222	285	474	1212	501	702	225	390	0	510	462	960	789	813	534	894	666	447	519	393	198	645	210	270	1308	0	1512	516	1110	753	1290	0
Magnolia sinica	297	576	222	285	336	1218	306	702	225	390	0	453	462	960	789	894	1056	894	852	453	519	393	198	648	0	270	1365	0	1578	618	1110	753	957	0
Magnolia nitida	432	576	222	285	336	1218	501	702	225	390	0	447	462	960	876	891	810	894	573	450	513	393	198	648	0	156	1263	0	1338	399	1110	753	1029	0
Magnolia poasana	435	576	222	285	381	1014	501	702	228	393	540	438	462	960	876	1116	933	870	852	453	519	399	198	645	273	246	1308	78	1512	705	1110	720	1158	0
Magnolia panamensis	435	576	222	285	567	1014	489	702	228	393	540	468	462	960	876	1002	918	870	852	453	519	441	228	648	279	246	1308	378	1575	582	1110	813	1257	0
Magnolia sharpii	435	576	222	285	192	1014	501	702	228	393	540	438	462	960	876	984	1014	783	852	483	519	393	333	648	282	246	1308	192	1578	690	1110	738	1257	0
Magnolia guatemalensis	435	576	222	285	402	1014	501	702	228	393	531	438	462	960	576	1002	876	783	852	453	519	393	198	648	282	246	1296	390	1512	567	1110	738	1257	0
Magnolia iltisiana	435	576	222	285	567	1014	501	702	228	393	537	438	462	960	861	942	876	783	774	453	519	390	198	648	276	246	1308	210	1509	669	1110	735	1086	0
Magnolia grandiflora	432	576	222	285	381	1218	432	699	228	393	543	450	462	960	663	924	726	783	852	453	519	393	198	648	285	267	1308	411	1578	672	933	753	1029	0
Magnolia striatifolia	435	576	222	285	387	1218	306	699	228	360	537	450	462	960	876	1068	873	783	666	453	519	396	423	648	0	270	1308	231	1512	378	1110	753	1023	0
Magnolia schiedeana	435	576	222	285	381	1218	306	693	228	393	0	354	462	960	687	960	1017	783	666	453	285	393	207	648	282	267	1308	186	1512	669	1110	735	1023	0
Magnolia tamaulipana	435	576	222	285	477	1014	306	699	228	336	408	432	462	960	687	957	876	864	852	453	516	393	198	648	0	267	1308	0	1512	585	807	735	660	0
Magnolia virginiana	423	576	222	285	528	1215	393	0	228	390	483	510	447	960	789	1071	1056	894	666	453	495	393	198	633	0	264	1308	81	1338	564	1110	753	1023	0
Magnolia macrophylla	432	576	222	279	198	1215	282	138	228	393	543	477	462	960	789	1110	945	894	852	453	474	393	252	648	0	267	1308	189	1512	669	1110	753	1026	0
Magnolia macrophylla var. *ashei*	432	576	222	285	189	1215	426	0	228	393	543	456	462	960	789	936	975	894	852	453	336	393	198	648	288	267	1308	159	1512	639	1110	753	1218	0
Magnolia dealbata	432	576	222	279	333	1218	384	138	228	393	543	450	462	960	789	1053	945	894	852	453	324	393	198	648	264	267	1308	189	1578	615	1110	753	1026	0
Magnolia championii	432	501	213	285	189	1215	336	702	228	393	0	480	429	960	843	1113	747	765	666	438	450	393	198	648	0	270	1293	0	1449	495	1110	753	894	0
Magnolia coco	279	384	213	285	147	1215	429	702	228	393	0	423	459	960	717	894	888	870	573	453	327	393	198	648	0	270	1281	0	1338	486	1110	753	663	0
Magnolia phanerophlebia	432	576	213	285	189	1218	234	702	228	393	0	441	462	960	687	894	912	894	663	453	450	393	198	648	0	270	1308	0	1338	483	1110	672	834	0
Magnolia pterocarpa	183	576	213	285	498	1218	489	672	228	393	0	0	462	960	687	1113	1023	894	768	420	417	390	246	648	0	267	1308	0	1404	402	1110	639	924	0
Magnolia hodgsonii	132	576	213	285	0	1218	396	693	228	387	0	420	462	960	576	882	888	888	756	453	510	393	198	648	279	267	1239	114	1512	438	1110	672	834	0
Magnolia henryi	429	576	213	285	501	1218	354	693	222	393	0	456	462	960	876	744	915	894	852	453	327	393	330	648	0	270	1308	0	1578	615	1110	753	1086	0
Magnolia albosericea	432	318	213	285	372	1218	240	702	228	393	0	447	399	960	870	888	753	870	666	450	522	393	198	648	294	270	1308	0	1500	354	1110	603	660	0
Magnolia liliifera	471	576	210	285	375	1143	222	702	228	393	0	0	462	960	789	744	912	870	549	453	327	390	198	639	0	270	1293	0	1533	483	1110	675	837	0
Magnolia delavayi	432	576	213	285	204	1014	477	702	228	393	0	504	462	825	876	1110	534	894	774	453	477	393	198	648	282	270	1299	186	1512	543	1110	750	1263	0
Magnolia pastazaensis	300	570	222	285	282	1218	363	612	228	393	0	432	462	960	564	648	1056	900	666	453	519	393	198	645	282	270	1308	0	1533	417	1110	753	846	0
Magnolia equatorialis	225	318	222	285	483	1074	219	702	228	393	345	489	462	960	564	879	621	900	573	453	519	393	198	645	0	273	1308	0	1578	387	1110	753	663	0
Magnolia ovata	423	570	222	285	189	1074	372	531	228	393	486	387	429	960	564	879	1059	900	666	453	519	393	198	645	282	270	1287	0	1509	285	1110	753	1020	0
Magnolia dodecapetala	423	570	222	285	429	1218	429	705	228	393	489	462	462	960	567	873	1056	900	843	453	519	393	261	645	282	0	1308	204	1578	576	1110	753	846	0
Magnolia kichuana	432	576	222	285	342	1074	372	702	228	393	222	435	462	960	783	891	1056	810	573	453	519	393	354	645	282	273	1308	192	1578	285	1110	753	1020	0
Magnolia zamorana	426	576	222	285	372	1218	429	702	228	393	453	492	462	960	777	894	534	900	666	453	519	297	198	645	0	270	1308	186	1569	366	1110	753	1020	0
Magnolia mercedesiarum	432	576	222	285	189	1203	372	702	228	393	249	498	462	960	462	894	915	810	774	453	519	393	198	645	282	270	1263	0	1578	366	1110	753	1020	0
Magnolia mindoensis	432	576	222	285	216	1218	336	702	228	336	405	480	462	960	570	894	915	900	843	453	519	393	198	645	267	270	1308	0	1578	531	1110	753	1020	0
Magnolia mexicana	426	576	222	285	399	1074	429	702	228	390	270	438	462	960	468	891	822	810	666	453	519	393	198	645	0	270	1308	0	1581	468	1110	741	843	0
Manglietia conifera	297	576	222	285	387	1218	303	702	228	390	543	450	462	960	876	1074	1056	894	759	453	519	393	198	639	0	270	1269	0	1596	582	1110	753	1089	0
Manglietia insignis	303	576	222	285	333	1218	303	702	228	390	543	450	462	960	876	1116	1056	894	852	453	519	393	225	639	0	270	1308	0	1596	558	1110	753	1008	0
Manglietia duclouxii	294	501	222	285	321	1218	303	702	228	390	543	426	462	960	876	1053	1056	894	852	453	519	393	198	648	0	270	1308	153	1335	513	1110	753	852	147
Manglietia hookeri	426	501	222	285	147	1218	327	702	228	390	543	420	462	960	876	951	1056	894	852	453	519	393	198	648	0	270	1308	192	1509	594	1110	750	855	198
Manglietia aromatica	0	501	222	285	375	1218	306	702	228	387	531	444	462	960	876	1077	507	894	759	453	516	393	198	639	0	270	1308	153	1575	468	1110	555	855	0
Manglietia lucida	429	576	222	285	555	1206	501	702	228	393	522	501	462	960	879	891	915	894	852	456	519	393	198	639	303	270	1308	204	1512	510	1110	753	1011	0
Manglietia grandis	300	576	222	285	519	1014	156	702	228	390	543	438	462	960	876	1110	945	894	852	453	519	393	321	645	201	270	1308	189	1512	576	1110	753	1092	0
Manglietia megaphylla	294	546	222	285	168	1206	279	702	228	390	543	456	462	960	879	960	1020	807	852	453	519	393	198	648	0	270	1308	153	1398	513	1110	753	1143	0
Manglietia rufibarbata	297	576	222	285	333	1218	276	702	228	162	543	447	462	960	879	957	888	894	759	453	516	393	351	648	201	270	1308	192	1575	465	1110	750	855	0
Manglietia ventii	303	576	222	285	375	1014	306	702	228	219	543	426	462	960	885	999	912	894	849	453	519	393	198	648	0	270	1305	0	1512	465	1110	753	975	0
Manglietia ovoidea	303	576	222	285	189	1218	399	702	228	390	543	438	462	960	876	891	984	894	852	450	522	393	198	648	0	270	1254	0	1641	465	1110	753	975	0
Manglietia kwangtungensis	303	576	222	285	519	1218	306	708	228	390	543	453	429	960	876	1017	915	894	666	453	519	393	243	648	0	270	1302	84	1575	474	1110	753	1095	0
Manglietia szechuanica	303	576	222	279	375	1014	303	702	228	390	543	414	462	960	876	1110	972	870	852	453	519	393	333	648	171	270	1308	234	1593	582	1110	753	1188	0

Manglietia pachyphylla	0	576	222	285	189	1218	399	702	228	390	543	426	462	960	879	975	1047	807	852	456	519	393	198	648	0	267	1239	189	1512	501	1110	753	1005	0
Manglietia fordiana	0	501	207	285	519	1218	303	702	228	393	543	447	462	960	876	1047	909	894	666	456	327	393	198	648	0	270	1308	0	1521	708	1110	753	855	0
Manglietia glauca	291	501	222	285	375	1218	399	702	228	390	507	417	429	960	879	978	909	792	852	450	516	390	198	648	288	270	1227	0	1521	606	1110	753	1008	0
Manglietia utilis	297	501	222	285	576	1218	306	702	228	390	543	462	462	960	879	957	951	894	852	453	519	393	198	636	0	270	1305	90	1575	546	1110	753	1008	0
Manglietia caveana	288	375	222	285	189	1218	234	702	228	390	513	411	393	960	876	735	915	807	666	453	519	390	198	642	285	270	1248	234	1509	474	1110	753	816	0
Manglietia garrettii	300	576	222	285	333	1206	501	699	228	390	543	507	462	960	879	1023	777	870	852	453	519	0	198	651	0	270	1308	198	1575	543	1110	753	1005	0
Manglietia decidua	429	576	222	285	189	1218	501	699	228	333	543	444	462	951	822	930	906	894	852	453	507	393	198	648	0	267	1308	351	1401	543	1110	753	1011	0
Magnolia obovata	438	576	225	285	333	1218	408	702	228	390	543	417	462	960	879	984	771	894	852	453	519	393	333	648	0	0	1305	0	1512	615	1110	747	1023	0
Magnolia officinalis	264	576	225	285	189	1014	408	702	228	390	300	432	462	960	879	1023	1047	780	759	453	519	393	198	648	0	0	1305	192	1434	552	1110	672	1020	0
Magnolia tripetala	426	576	222	285	336	1218	456	702	228	390	543	453	462	960	879	1053	909	870	852	453	519	393	330	648	285	0	1314	228	1575	594	1110	753	975	0
Magnolia wilsonii	246	408	222	285	144	1218	306	702	228	333	543	456	462	960	879	894	924	765	666	453	519	393	198	648	0	270	1308	201	1338	486	1110	753	852	0
Magnolia globosa	429	576	222	285	189	1014	306	702	228	393	543	438	462	960	879	1038	1056	894	837	453	519	393	354	648	234	207	1308	201	1404	549	1110	753	1200	0
Magnolia sieboldii	426	411	222	285	336	1215	501	690	225	393	543	444	462	960	879	1197	1056	894	834	453	519	393	198	648	219	267	1308	231	1512	627	1110	753	1029	0
Magnolia sieboldii subsp. *sinensis*	426	486	222	285	336	1011	306	690	225	393	543	432	462	960	879	1116	918	792	771	453	519	393	198	648	0	267	1308	126	1512	525	1110	753	1029	0
Magnolia fraseri	429	486	222	285	459	1014	501	702	228	393	543	441	462	960	885	1116	903	894	849	453	519	393	198	648	0	270	1308	372	1512	432	1110	753	1029	0
Magnolia fraseri var. pyrimidata	429	486	222	285	189	1014	306	702	228	393	0	375	462	960	885	1041	1056	894	849	453	519	393	198	648	0	270	1308	90	1338	549	1110	750	1029	0
Magnolia splendens	435	576	222	285	333	1218	300	702	228	390	0	444	462	960	879	891	1053	873	753	453	519	393	198	648	0	264	1308	0	1506	297	1110	672	846	0
Magnolia portoricensis	435	576	222	285	333	1218	300	702	228	390	0	489	462	960	879	891	909	870	852	453	519	393	198	648	0	264	1308	0	1332	399	1110	636	846	0
Magnolia cubensis	291	576	222	285	333	1014	468	702	228	390	0	414	408	960	879	885	909	870	852	453	519	393	198	648	261	264	1287	114	1332	297	1110	639	846	0
Magnolia bankardiorum	435	576	222	285	333	1218	303	612	222	393	0	414	435	960	717	888	942	870	849	453	519	393	354	648	258	264	1308	201	1398	402	1110	753	1119	0
Liriodendron chinense	0	486	144	0	465	990	225	111	228	336	0	324	417	960	624	918	1053	789	675	369	0	351	276	597	0	0	1317	0	1506	285	1110	336	570	0
Liriodendron tulipifera X *Liriodendron chinense*	0	486	144	0	333	930	225	0	228	336	0	459	438	960	612	918	1053	789	675	291	0	351	276	576	285	0	1305	0	1281	285	1110	336	378	0
Liriodendron tulipifera	0	411	144	0	333	930	291	0	228	336	0	387	447	960	621	921	1053	789	663	291	0	351	276	573	0	0	1317	0	1455	285	1110	336	378	0
Ave.	333	540	216	276	338	1111	368	645	224	363	345	434	451	957	815	930	911	846	764	441	481	382	224	634	120	248	1285	214	1492	548	1085	713	979	86

Appendix 29. (Continued)

Taxon name	MKT187982_1_4	MKT190355_1_4	MKT191419_1_4	MKT192708_1_4	MKT192907_1_4	MKT193152_1_4	MKT193254_1_4	MKT197215_1_4	MKT198187_1_4	MKT198537_1_4	MKT198585_1_4	MKT199319_1_4	MKT199612_1_4	MKT200802_1_4	MKT201180_1_4	MKT202963_1_4	MKT203107_1_4	MKT203672_1_4	MKT204768_1_4	MKT204875_1_4	MKT205230_1_4	MKT206470_1_4	MKT208916_1_4	MKT208959_1_4	MKT210746_1_4	MKT213884_1_4	MKT214027_1_4	MKT214507_1_4	MKT216653_1_4	MKT217609_1_4	MKT217917_1_4	MKT221190_1_4	MKT223227_1_4	MKT537_1_4
Length of the reference for each loci	438	222	378	216	258	1056	432	1659	708	474	1125	441	930	534	606	354	723	747	399	1206	378	495	375	399	213	267	366	210	222	354	261	273	1068	711
Magnolia griffithii	360	222	378	216	258	1104	369	1464	588	462	708	435	939	537	588	348	720	0	360	459	270	483	375	225	213	267	366	210	201	354	261	273	738	567
Michelia baillonii	360	222	378	216	258	1104	432	1464	588	462	555	435	867	537	582	336	720	561	360	837	378	483	375	225	213	267	366	210	219	354	261	273	570	567
Michelia sirindhorniae	414	222	378	213	258	1101	432	1464	588	468	1050	432	942	534	573	336	720	624	360	228	378	495	375	225	213	267	354	210	219	354	261	273	738	567
Michelia velutina	426	222	378	216	258	1056	432	1464	588	465	981	435	939	534	588	333	720	750	399	417	378	495	375	225	213	267	366	210	219	354	261	273	741	567
Michelia masticata	426	222	372	216	258	1104	432	1464	588	156	681	435	930	534	588	342	720	303	399	147	111	495	375	225	213	267	366	210	225	354	261	273	705	495
Michelia sphaerantha	426	222	378	216	258	1104	417	1464	588	468	1065	435	930	534	444	342	720	405	399	231	378	495	375	225	213	267	366	210	219	354	261	273	648	567
Michelia doltsopa	429	222	372	216	258	1194	432	1464	588	477	1032	414	942	534	570	333	720	987	399	0	108	495	375	225	213	267	366	210	219	354	261	270	738	711
Michelia lacei	429	222	372	216	258	1104	369	1464	624	477	1020	435	942	534	444	381	720	990	399	477	108	495	375	225	204	267	366	210	219	354	261	270	738	567
Michelia salicifolia	426	222	378	216	258	1065	369	1464	588	468	939	435	900	534	588	345	723	528	399	231	108	489	375	177	213	267	366	210	219	354	261	207	603	567
Michelia martini	426	222	378	216	258	1107	429	1464	588	462	408	432	930	534	603	333	723	477	399	444	378	495	375	225	204	267	366	210	219	354	261	273	705	567
Michelia coriacea	423	222	378	216	258	1197	432	1464	588	468	552	435	858	534	597	333	723	375	399	255	378	495	375	0	213	267	366	210	219	354	261	273	705	567
Michelia ingrata	426	222	378	216	258	1197	411	1464	624	468	411	435	930	534	588	333	720	333	399	234	378	495	375	231	204	267	366	210	219	354	261	273	741	639
Michelia wilsonii	423	222	372	216	258	957	432	1464	624	477	807	432	939	534	588	342	723	1071	399	456	378	495	375	225	213	267	366	210	219	354	261	270	585	567
Michelia floribunda	426	222	378	216	258	1194	369	1464	585	462	1062	435	747	534	582	333	723	0	360	459	378	495	375	225	213	267	366	210	162	354	261	273	738	495
Michelia chapensis	426	222	378	216	258	1104	429	1464	588	468	861	432	930	534	588	333	723	591	399	138	378	495	375	192	204	267	366	210	219	354	261	273	666	495
Michelia chapensis	426	222	372	216	258	1197	369	1464	588	468	903	432	930	534	585	333	723	267	399	222	378	495	375	192	204	267	366	210	219	354	261	273	714	495
Michelia hypolampra	426	222	378	216	252	1065	414	1464	588	462	690	435	930	534	639	333	723	303	360	222	378	495	375	192	213	267	366	210	219	354	261	273	666	567
Michelia viridipetala	429	222	378	216	258	1104	429	1464	573	468	702	441	705	399	504	333	720	480	360	447	372	495	375	192	213	267	357	210	189	159	261	273	531	711
Michelia balansae	426	222	378	216	258	1104	432	1464	579	468	708	441	930	534	576	333	720	534	360	231	372	495	375	192	213	267	366	210	219	354	261	273	717	711
Michelia guangxiensis	330	222	378	216	258	1104	432	1464	705	468	912	441	480	534	576	333	720	420	399	240	372	495	375	192	213	267	366	210	219	354	261	273	738	636
Michelia figo	330	222	378	216	249	1104	429	1464	588	468	813	435	903	534	582	354	720	294	399	228	372	495	375	225	213	267	366	210	219	354	261	273	630	567
Michelia shiluensis	426	222	378	216	258	1101	369	1464	588	468	879	435	924	534	594	333	723	294	360	219	378	495	375	225	213	267	357	210	219	354	261	273	609	711
Michelia odora	426	222	378	213	258	1104	408	1464	588	468	1017	435	930	534	558	354	723	315	399	405	300	495	375	225	213	249	357	210	222	354	261	210	729	711

Michelia montana	426	222	378	216	258	1056	393	1464	588	468	954	435	939	534	573	333	723	366	360	438	378	495	375	225	213	267	366	210	219	351	261	273	735	567
Elmerrillia ovalis	426	222	378	216	255	1065	369	1455	588	468	894	435	870	534	591	333	696	216	360	183	378	492	375	222	213	267	366	210	207	354	261	210	609	567
Michelia compressa	426	219	378	216	258	1194	408	1464	588	468	714	435	939	534	588	330	720	312	399	372	378	495	375	225	204	267	357	210	219	354	0	210	636	567
Michelia macclurei	351	222	378	216	258	1197	432	1464	624	468	825	435	939	534	444	333	723	297	360	189	378	495	375	225	213	267	366	210	222	258	261	273	735	495
Michelia guangdongensis	423	222	378	216	258	1155	432	1464	588	468	714	435	867	534	600	333	723	177	360	228	378	495	375	186	207	267	366	210	219	153	261	273	543	567
Michelia maudiae	348	222	372	216	258	1101	432	1464	588	468	696	435	867	399	588	333	720	222	360	147	378	483	375	225	213	267	366	210	219	0	261	273	717	495
Michelia foveolata	426	222	378	216	258	1101	426	1464	588	468	741	435	867	534	570	333	723	321	360	357	378	495	375	225	213	267	366	210	165	258	261	273	594	567
Michelia cavaleriei	351	222	378	216	258	1104	432	1464	705	468	807	435	936	534	588	333	723	336	360	228	378	495	375	186	204	267	366	210	219	354	261	273	714	711
Magnolia elegans	384	216	381	216	258	1194	312	1464	588	471	498	438	705	534	687	189	720	255	399	603	378	480	375	225	207	267	366	195	219	360	261	273	714	708
Magnolia borneensis	72	222	378	0	90	996	96	246	0	306	0	405	312	0	330	0	63	324	198	258	375	477	0	0	0	96	0	195	198	93	255	0	0	246
Magnolia carsonii	429	216	381	216	258	1194	363	1419	585	471	726	432	801	534	579	351	723	333	399	459	378	486	375	222	207	267	366	204	207	354	261	273	648	708
Magnolia cathcartii	429	222	381	216	258	1098	369	1464	588	471	255	435	930	534	591	300	720	303	399	456	378	492	375	225	207	267	366	195	219	351	261	273	627	567
Magnolia zenii	429	222	378	216	258	1194	369	1464	705	471	825	438	927	534	576	354	720	333	399	927	378	495	375	252	204	267	366	210	219	354	261	273	819	711
Magnolia biondii	429	222	351	0	255	1056	369	1464	588	420	1122	438	765	534	576	354	450	330	0	627	378	495	375	0	204	267	366	204	222	354	261	210	312	495
Magnolia amoena	429	222	378	216	258	1146	417	1464	705	471	807	435	942	534	576	354	720	891	399	924	378	495	375	0	198	267	366	210	216	354	261	273	708	711
Magnolia sinostellata	429	222	378	216	258	1116	414	1464	705	471	825	441	735	534	576	354	720	333	399	927	378	495	375	252	204	267	366	210	219	354	261	210	780	711
Magnolia stellata	429	222	372	216	258	1008	432	1464	708	471	1014	441	927	534	576	354	723	360	399	954	378	495	375	225	207	267	366	210	219	354	261	273	654	711
Magnolia kobus	429	222	372	216	258	1194	432	1464	708	471	1014	441	927	534	576	354	720	384	399	954	378	495	375	225	213	267	366	210	219	327	261	273	726	567
Magnolia salicifolia	429	222	378	216	258	1194	369	1464	588	471	1047	414	882	534	576	354	720	333	399	954	378	495	375	225	192	267	366	210	219	354	261	273	732	711
Magnolia denudata	429	222	345	216	258	1203	369	1419	705	471	711	438	849	534	573	354	720	369	399	954	270	483	375	219	204	267	366	189	219	354	261	273	300	567
Magnolia cylindrica	429	222	378	216	258	1059	369	1464	705	471	819	441	693	534	582	354	720	216	399	957	378	486	375	219	192	267	366	204	219	288	261	66	585	636
Magnolia liliiflora	429	222	378	195	258	1170	369	1464	705	471	261	435	927	534	576	354	720	222	399	957	270	495	372	0	198	267	366	210	219	354	261	273	756	711
Magnolia sprengeri	429	222	372	216	258	1152	369	1464	705	471	612	438	933	534	597	354	720	222	399	957	378	495	372	225	192	267	366	210	222	0	261	273	801	495
Magnolia sargentiana	330	222	378	216	258	1194	369	1464	588	471	408	414	939	534	576	354	720	615	399	639	378	504	375	225	213	267	363	207	219	354	264	273	822	570
Magnolia campbellii	105	222	378	216	258	1053	369	1464	705	420	417	438	876	534	576	354	720	369	399	1269	372	504	375	225	213	267	366	210	219	354	261	273	558	711
Magnolia dawsoniana	429	222	345	216	258	1194	369	1437	705	543	819	414	924	534	576	354	669	615	399	954	270	495	375	225	192	267	366	207	219	354	261	273	783	714
Magnolia acuminata var. *subcordata*	429	222	378	216	258	1194	369	1443	588	471	906	441	858	534	573	354	669	255	396	951	378	495	375	225	213	267	366	189	216	354	261	273	477	708
Magnolia acuminata	429	222	363	216	258	1056	324	1464	681	471	408	441	873	399	567	354	720	174	396	975	378	495	375	225	192	267	366	189	219	354	261	225	633	567
Kmeria duperreana	423	222	378	216	255	1194	390	1464	588	471	819	441	933	528	576	354	720	327	363	465	375	492	375	225	213	267	327	186	186	354	243	273	717	711
Kmeria septentrionalis	423	222	378	216	255	1194	330	1464	588	465	954	441	597	528	573	354	720	0	363	456	378	501	375	225	213	267	330	207	0	192	243	273	753	711
Magnolia nitida var. *lotungensis*	429	222	378	216	267	1101	390	1464	600	480	993	432	927	534	582	354	720	0	399	612	378	495	375	225	213	267	363	210	174	192	261	273	756	567
Pachylarnax praecalva	102	0	0	0	0	147	135	0	0	0	168	0	96	0	0	0	123	0	0	0	0	0	0	0	207	96	0	0	0	0	0	0	0	0
Magnolia kachirachirai	429	222	378	216	267	1101	429	1464	588	480	1011	438	927	534	582	354	669	0	399	900	378	495	375	225	207	267	366	210	204	264	261	273	705	708
Magnolia sinica	429	222	378	216	288	1104	423	1464	705	480	723	438	924	399	579	354	720	0	399	954	378	495	375	243	213	267	366	210	219	354	261	273	864	711
Magnolia nitida	429	222	378	216	234	1056	366	1464	588	480	1110	438	816	534	597	354	720	0	399	879	378	495	375	243	192	267	366	210	219	192	261	273	771	711
Magnolia poasana	429	222	378	216	258	1104	390	1437	588	471	936	441	918	534	567	351	720	0	399	957	378	495	375	225	207	267	366	210	219	354	261	273	756	711
Magnolia panamensis	429	222	378	216	258	1050	390	1437	705	471	939	441	918	534	573	351	720	120	399	1152	378	495	375	225	207	267	363	210	216	354	261	273	660	711
Magnolia sharpii	429	222	378	216	258	1104	393	1437	588	471	1026	441	915	534	570	351	717	0	399	1152	378	495	375	312	207	267	366	210	216	354	261	273	675	711
Magnolia guatemalensis	429	222	378	216	255	1104	393	1437	705	471	966	441	849	534	582	351	720	0	363	1257	378	495	375	225	207	267	366	210	222	354	261	273	699	711
Magnolia iltisiana	429	222	378	216	258	1104	393	1437	588	471	690	441	918	534	576	354	720	141	399	951	378	495	375	225	207	267	366	210	210	354	261	273	645	711
Magnolia grandiflora	429	222	378	216	249	1101	390	1464	621	465	954	438	348	534	597	354	720	153	399	951	378	495	279	225	201	267	366	210	210	354	255	273	687	708
Magnolia striatifolia	429	222	348	216	249	1101	369	1419	588	471	960	423	126	534	555	354	720	0	399	639	378	483	375	222	207	267	366	210	219	354	261	273	726	711
Magnolia schiedeana	429	222	378	216	249	1104	432	1464	588	465	1155	438	921	534	582	354	720	0	399	951	348	399	375	225	207	267	357	210	0	354	261	273	756	636
Magnolia tamaulipana	429	222	372	216	249	1104	369	1437	588	465	399	441	870	534	576	354	720	0	399	957	378	492	375	225	207	267	357	210	0	192	261	273	756	639
Magnolia virginiana	429	222	378	216	249	1104	369	1464	588	471	1017	441	927	399	573	354	720	0	399	645	270	492	375	225	207	267	366	210	0	354	258	273	726	495
Magnolia macrophylla	429	222	384	216	258	1104	396	1464	588	456	759	426	858	534	585	345	720	0	396	1170	378	495	372	225	204	267	366	207	207	354	261	273	693	711
Magnolia macrophylla var. *ashei*	429	222	378	216	258	1062	432	1464	624	456	972	426	858	534	585	345	720	0	396	1116	378	495	372	225	204	267	366	207	219	354	261	273	741	711
Magnolia dealbata	429	222	372	216	258	1104	369	1443	588	456	759	426	849	534	585	345	720	138	396	954	378	495	372	225	204	267	366	207	219	354	261	273	717	711
Magnolia championii	426	222	378	213	0	1053	432	1464	612	480	642	441	681	534	600	354	720	0	363	906	378	486	375	225	213	267	366	210	186	354	261	276	642	567
Magnolia coco	426	222	378	213	0	1155	369	1419	612	480	402	441	636	534	573	351	729	0	363	375	270	486	351	225	213	267	366	210	0	228	261	273	639	567
Magnolia phanerophlebia	426	222	219	213	0	1191	399	1461	612	429	387	441	558	534	591	351	723	0	363	849	378	456	375	210	213	267	366	210	219	258	174	273	702	567
Magnolia pterocarpa	327	222	378	210	0	1065	432	1464	612	477	624	441	633	534	585	354	327	111	363	627	378	495	375	219	192	264	366	210	0	0	261	207	705	495
Magnolia hodgsonii	426	222	378	216	0	1044	351	1455	612	429	801	441	813	534	573	354	720	210	363	948	339	492	342	219	192	264	366	210	204	354	261	273	621	567
Magnolia henryi	426	222	378	216	0	1065	393	1464	612	480	792	438	660	534	618	354	720	0	363	471	378	489	351	225	192	264	366	210	0	354	261	273	741	711
Magnolia albosericea	420	222	378	216	0	1062	369	1464	612	480	519	438	552	534	597	351	723	0	363	453	375	459	375	0	213	267	366	210	219	213	261	270	663	495
Magnolia liliifera	426	222	378	216	0	1059	432	1464	612	480	495	441	519	387	579	351	723	0	363	822	372	522	375	225	213	267	351	210	0	192	258	0	366	618
Magnolia delavayi	429	222	372	216	0	1194	258	1464	612	480	693	438	852	534	597	351	702	0	363	453	378	489	375	225	192	267	366	210	219	354	261	273	663	690
Magnolia pastazaensis	417	222	378	216	198	1098	369	1464	588	468	768	438	930	534	405	354	720	0	399	921	345	495	372	0	207	267	363	204	219	258	261	273	696	711
Magnolia equatorialis	426	222	378	216	198	1098	369	1464	588	417	243	438	930	534	579	354	720	0	399	924	243	495	372	219	207	267	363	204	0	0	261	273	522	567
Magnolia ovata	426	222	378	216	198	1098	456	1461	588	468	768	438	927	534	606	354	720	0	399	918	369	495	372	219	207	267	363	204	0	354	261	273	609	711
Magnolia dodecapetala	426	222	378	216	201	1110	432	1464	0	468	942	438	930	534	579	354	720	0	399	1062	369	495	375	219	198	267	360	204	0	354	261	273	654	711
Magnolia kichuana	426	222	378	216	204	1098	369	1464	585	468	453	438	915	534	417	354	720	0	399	924	345	492	372	219	207	267	363	198	219	354	261	273	672	711
Magnolia zamorana	426	222	378	216	195	1098	432	1464	588	468	768	438	939	534	573	354	720	0	399	879	369	495	372	288	207	267	363	204	0	354	261	273	585	567
Magnolia mercedesiarum	426	222	378	216	201	1098	432	1464	576	468	768	438	930	534	579	354	723	0	399	921	345	495	372	288	198	267	363	204	189	354	261	273	681	711
Magnolia mindoensis	426	222	378	216	204	1098	432	1464	588	468	969	438	930	534	579	354	720	0	399	879	369	495	372	171	207	258	363	204	219	354	261	273	693	711
Magnolia mexicana	426	222	384	216	204	1101	423	1464	588	465	771	438	936	534	576	354	720	0	399	918	378	495	375	225	198	267	363	207	219	354	261	210	696	711

Manglietia conifera	432	222	378	216	258	1104	342	1464	588	471	699	411	939	534	576	354	720	300	363	462	378	501	375	228	213	267	366	207	222	258	0	273	705	711
Manglietia insignis	432	222	378	216	249	1014	432	1464	624	471	699	411	942	534	591	354	720	177	363	237	378	501	375	228	213	264	348	207	219	303	0	273	756	567
Manglietia duclouxii	432	222	378	216	258	1104	426	1464	588	471	612	438	936	534	567	354	720	333	363	453	378	399	375	228	213	267	366	207	219	303	0	273	753	711
Manglietia hookeri	426	222	378	216	258	1368	342	1464	588	471	705	438	870	534	585	354	720	222	363	237	378	498	366	228	213	267	366	207	180	258	0	273	678	711
Manglietia aromatica	429	222	378	216	252	1104	342	1464	588	471	609	441	939	534	585	351	720	222	363	630	270	498	372	228	213	267	366	207	0	192	0	273	711	714
Manglietia lucida	432	222	378	204	258	1053	342	1464	603	471	1002	438	939	531	573	354	720	219	363	804	378	471	351	228	213	267	360	207	219	303	0	273	663	711
Manglietia grandis	429	222	378	216	252	1107	417	1464	588	471	939	441	927	534	588	354	720	333	363	933	378	498	375	228	213	267	360	207	222	303	0	273	585	711
Manglietia megaphylla	432	222	378	216	249	1059	441	1464	588	471	633	438	939	534	552	354	723	333	363	924	378	495	372	228	213	267	366	207	210	0	0	210	678	711
Manglietia rufibarbata	429	222	378	216	252	1104	342	1464	624	471	411	435	816	534	567	354	720	0	363	789	378	501	366	228	213	261	366	207	222	192	0	273	693	711
Manglietia ventii	432	219	378	216	252	1104	396	1464	588	420	411	438	942	534	576	354	720	222	363	609	270	498	366	228	213	264	366	207	219	0	0	273	852	711
Manglietia ovoidea	429	222	378	216	252	1104	342	1464	588	471	783	438	939	534	579	354	723	219	363	924	378	498	375	228	213	264	366	210	0	192	0	273	639	711
Manglietia kwangtungensis	429	222	378	216	252	1104	432	1464	588	471	987	411	942	534	636	354	720	282	363	921	378	498	375	228	213	267	366	207	219	303	0	273	729	711
Manglietia szechuanica	432	222	378	216	258	1065	432	1464	588	471	705	426	939	534	573	348	720	222	363	933	378	498	366	228	213	96	366	207	207	303	0	273	657	711
Manglietia pachyphylla	432	222	378	216	252	1104	342	1464	588	453	258	441	933	534	564	354	720	0	363	1071	378	498	366	228	213	267	360	207	0	192	0	273	678	711
Manglietia fordiana	432	222	375	216	252	1101	342	1464	588	453	702	441	939	534	585	354	720	222	363	585	270	501	366	225	213	267	360	207	171	303	0	273	522	711
Manglietia glauca	429	222	378	216	258	1053	342	1464	588	453	882	441	870	534	573	354	720	198	363	597	378	477	375	228	213	264	366	207	210	192	0	279	624	711
Manglietia utilis	429	222	378	216	252	1104	432	1464	588	471	825	432	927	534	591	354	720	297	363	978	378	528	375	228	213	267	366	207	222	216	261	273	756	711
Manglietia caveana	429	222	378	216	0	1104	342	1419	579	471	1002	441	873	534	582	324	720	0	363	450	378	501	372	228	213	267	366	207	207	303	0	210	612	711
Manglietia garrettii	429	222	378	216	258	1050	432	1464	684	471	591	435	870	534	573	354	720	261	363	828	378	498	366	228	213	267	366	207	0	303	0	273	792	711
Manglietia decidua	429	222	378	141	252	1104	432	1464	624	471	897	438	942	534	579	354	723	333	363	870	378	483	375	222	213	267	366	201	219	303	261	273	756	711
Magnolia obovata	429	222	378	216	258	1104	363	1464	588	462	954	441	927	534	441	267	723	0	363	231	378	501	375	225	204	258	366	201	132	303	255	270	753	711
Magnolia officinalis	429	222	354	216	258	1308	366	1455	588	462	411	441	927	534	585	267	723	0	363	222	270	501	375	225	213	267	366	201	222	192	255	207	726	711
Magnolia tripetala	429	222	378	216	258	1431	390	1464	588	462	714	438	927	534	600	267	723	210	363	234	378	498	375	225	213	267	366	201	222	303	261	270	705	711
Magnolia wilsonii	429	222	378	216	0	1104	432	1464	588	507	426	426	630	534	579	354	720	0	363	375	270	492	375	207	0	267	366	201	219	0	261	210	564	711
Magnolia globosa	429	222	378	216	258	1410	423	1464	705	471	1008	441	795	534	582	354	723	534	363	957	378	501	375	207	213	267	366	201	219	303	261	273	630	711
Magnolia sieboldii	429	222	378	216	0	1053	369	1464	588	468	984	438	939	534	603	354	723	543	363	462	375	495	375	210	213	267	366	201	219	258	261	210	783	711
Magnolia sieboldii subsp. *sinensis*	429	222	378	216	0	1101	423	1464	588	468	906	438	939	534	582	354	723	429	363	234	378	402	375	210	213	267	366	192	99	249	261	273	789	711
Magnolia fraseri	429	222	372	216	0	1056	408	1464	585	468	1107	438	726	534	588	354	720	0	363	468	378	495	375	225	213	267	351	207	132	303	261	273	672	711
Magnolia fraseri var. pyrimidata	429	222	372	216	0	1101	366	1464	588	468	1107	438	933	534	588	351	720	0	363	483	378	495	375	225	213	267	351	207	219	303	261	273	720	711
Magnolia splendens	420	222	378	216	195	1053	432	1464	588	471	933	438	933	534	582	339	723	0	399	450	378	495	375	225	213	264	366	210	195	354	261	273	669	699
Magnolia portoricensis	420	222	378	216	195	1182	348	1464	588	420	954	438	933	534	585	339	723	129	399	477	378	495	375	225	213	264	363	210	219	354	261	273	630	699
Magnolia cubensis	420	222	378	216	195	1104	369	1464	588	471	699	438	867	534	579	339	723	0	399	555	378	495	375	201	213	264	366	210	219	351	261	273	591	699
Magnolia bankardiorum	426	222	372	216	195	1224	432	1464	627	471	792	438	915	534	582	339	723	174	399	960	378	495	375	219	213	267	360	210	210	354	261	273	708	699
Liriodendron chinense	0	222	375	210	0	894	0	1464	579	375	366	435	879	534	459	162	729	0	201	420	111	354	363	138	225	276	0	210	0	258	0	249	621	492
Liriodendron tulipifera X *Liriodendron chinense*	0	222	375	210	0	894	0	1464	579	399	261	438	909	525	417	210	729	0	201	213	111	489	363	0	225	276	0	210	0	240	0	249	477	492
Liriodendron tulipifera	0	222	375	210	0	894	0	1464	579	369	360	438	924	534	417	210	723	0	174	441	0	489	363	138	0	120	0	210	0	222	0	249	501	495
Ave.	403	220	372	210	210	1105	380	1439	596	458	752	432	853	519	565	335	704	224	369	630	346	486	366	206	204	261	349	205	177	292	212	257	665	638

Appendix 29. (Continued)

Taxon name	MKT225_133_1_4	MKT228_111_1_4	MKT228_199_1_4	MKT228_412_1_4	MKT228_574_1_4	MKT228_912_1_4	MKT229_513_1_4	MKT231_174_1_4	MKT231_614_1_4	MKT232_553_1_4	MKT233_179_1_4	MKT233_393_1_4	MKT235_083_1_4	MKT235_691_1_4	MKT235_890_1_4	MKT238_438_1_4	MKT239_674_1_4	MKT240_204_1_4	MKT241_546_1_4	MKT242_935_1_4	MKT243_378_1_4	MKT244_181_1_4	MKT244_595_1_4	MKT246_045_1_4	MKT248_146_1_4	MKT248_845_1_4	MKT249_944_1_4	MKT250_663_1_4	MKT253_344_1_4	MKT253_397_1_4	MKT255_591_1_4	MKT255_595_1_4	MKT257_161_1_4	MKT257_387_1_4
Length of the reference for each loci	381	1284	669	441	234	1344	447	885	462	1485	1347	444	777	297	489	468	327	405	849	846	243	723	342	570	657	516	306	1473	231	213	309	237	726	369
Magnolia griffithii	255	978	612	441	234	423	0	759	459	1482	711	444	774	297	489	468	327	402	516	846	240	720	225	567	654	423	189	1335	231	213	309	237	726	324
Michelia baillonii	255	1284	612	438	234	471	0	759	459	1482	633	444	813	339	327	468	324	405	630	846	240	720	201	567	654	465	195	1956	231	213	309	237	726	324
Michelia sirindhorniae	255	1197	669	438	234	468	0	759	450	1482	1050	444	792	297	489	468	315	405	522	846	168	720	243	567	648	411	282	1218	231	213	309	237	726	366
Michelia velutina	255	1284	612	441	234	510	0	759	690	1482	1050	444	783	297	489	468	327	405	525	846	240	720	324	567	654	477	300	1941	231	213	309	237	726	324
Michelia masticata	255	1092	612	441	234	471	0	717	441	1482	918	441	795	297	489	468	327	405	525	846	240	711	213	567	654	423	261	1467	231	213	309	237	726	327
Michelia sphaerantha	255	1284	612	441	234	339	0	717	450	1482	735	441	795	297	489	468	327	405	525	846	240	711	219	567	654	423	165	1212	231	213	309	237	726	369
Michelia doltsopa	255	1284	612	441	234	465	444	702	549	1482	1005	444	783	297	489	468	327	405	663	846	240	720	243	567	657	423	237	1482	231	213	309	237	726	432
Michelia lacei	255	1284	669	441	234	465	444	702	459	1482	873	444	783	351	489	468	327	405	525	846	240	720	243	567	657	510	234	1701	231	213	309	237	726	432
Michelia salicifolia	255	1284	612	441	234	342	447	759	672	1482	870	444	771	276	489	468	327	405	525	846	240	711	174	567	654	423	276	1443	231	213	309	231	726	324

Michelia martini	255	1284	612	441	234	459	0	759	459	1482	672	441	786	231	348	468	327	405	528	846	240	720	324	567	654	480	189	1224	231	213	309	237	726	393
Michelia coriacea	255	1242	669	441	234	447	447	642	453	1482	843	441	798	294	489	468	318	405	627	846	240	720	324	567	654	423	297	1479	231	213	306	237	726	393
Michelia ingrata	255	1284	669	441	234	477	0	759	453	1482	990	441	786	297	489	468	309	405	525	846	240	720	243	567	654	423	252	1464	231	213	309	237	726	324
Michelia wilsonii	255	1284	612	441	231	465	0	759	588	1482	990	444	792	297	489	468	327	405	579	846	240	720	243	567	654	423	279	1467	231	213	309	237	726	432
Michelia floribunda	255	1284	669	441	231	423	0	717	459	1482	849	411	780	273	489	465	327	405	525	846	240	720	243	567	654	423	165	1338	231	213	309	237	726	390
Michelia chapensis	255	1284	669	441	234	630	0	759	690	1482	795	411	786	288	489	468	318	405	522	846	240	711	219	567	654	423	261	1467	231	213	309	237	726	327
Michelia chapensis	255	1284	612	441	234	360	0	756	690	1482	1008	411	450	258	489	468	318	405	561	846	240	711	243	567	654	423	165	1218	231	213	309	237	726	327
Michelia hypolampra	252	1281	612	441	234	399	0	717	552	1482	1005	444	780	258	327	468	318	405	522	846	240	711	243	564	654	423	165	1218	231	213	309	237	726	321
Michelia viridipetala	255	1284	612	441	234	483	0	756	690	1482	849	444	702	276	327	204	315	405	525	636	240	720	279	567	654	375	189	1308	231	213	309	237	726	327
Michelia balansae	255	1284	612	438	234	450	0	759	690	1482	582	444	768	147	489	204	318	405	525	846	240	720	123	567	654	408	219	1479	231	213	309	237	726	369
Michelia guangxiensis	255	1284	669	441	234	486	0	759	690	1482	996	444	774	297	489	417	327	405	525	738	240	720	234	567	654	423	189	1200	231	213	309	237	726	327
Michelia figo	255	1167	612	441	234	465	0	756	543	1482	1008	444	771	381	180	468	327	405	528	846	240	717	255	567	654	423	273	1473	231	213	309	237	723	327
Michelia shiluensis	255	1284	612	441	234	381	0	759	561	1482	849	444	774	294	489	204	327	405	525	843	240	717	318	570	654	423	219	1449	231	213	309	237	726	369
Michelia odora	138	1284	612	441	234	333	0	759	690	1482	849	444	780	297	489	204	321	405	525	846	240	720	225	555	642	423	273	957	231	213	309	237	723	324
Michelia montana	246	1284	612	438	234	465	0	759	453	1482	834	444	774	297	489	468	324	405	525	846	240	720	243	567	654	423	273	1203	231	213	309	237	726	366
Elmerrillia ovalis	255	1197	612	441	234	297	0	759	690	1482	624	444	771	297	489	468	324	405	525	843	240	720	120	567	654	390	219	1332	231	213	306	237	726	324
Michelia compressa	255	1284	612	438	234	273	0	759	690	1482	675	444	699	276	327	204	318	405	525	846	168	669	225	567	654	423	252	1470	231	213	309	237	726	324
Michelia macclurei	255	1284	612	438	234	486	0	702	459	1482	942	444	756	297	489	204	327	405	525	840	240	717	234	567	654	423	237	1467	231	213	309	237	726	327
Michelia guangdongensis	255	1284	612	438	234	420	0	702	561	1320	804	444	777	276	327	468	303	405	525	846	240	717	285	567	654	423	165	1215	231	213	309	237	726	144
Michelia maudiae	255	1284	612	441	234	324	0	759	459	1482	786	444	474	342	489	204	303	405	564	846	240	717	138	567	654	423	213	1464	231	213	309	237	726	393
Michelia foveolata	255	1284	612	441	234	465	0	759	459	1482	441	444	783	297	489	204	318	405	525	846	240	717	225	567	654	423	258	1230	231	213	309	237	726	393
Michelia cavaleriei	255	1347	669	441	234	696	0	759	690	1482	861	444	768	297	489	468	327	405	525	846	240	717	267	567	654	423	258	1230	231	213	309	237	705	369
Magnolia elegans	255	1197	669	441	228	345	447	759	456	1482	426	444	786	297	489	462	327	405	525	846	237	723	243	561	657	390	195	1281	231	207	309	234	726	111
Magnolia borneensis	0	738	0	138	0	303	234	219	0	522	156	180	516	141	132	258	192	336	0	357	0	216	0	0	165	216	0	126	0	0	210	0	420	255
Magnolia carsonii	255	1284	570	441	228	318	447	759	456	1482	765	444	774	192	489	465	327	405	525	843	225	723	243	564	651	423	165	1113	231	213	309	234	723	0
Magnolia cathcartii	255	1284	669	441	234	408	447	759	462	1443	846	444	798	279	315	465	327	405	645	843	237	723	243	567	657	417	228	1251	231	213	309	237	726	327
Magnolia zenii	255	1197	612	441	234	441	447	759	462	1482	846	444	768	297	489	468	327	405	525	846	240	723	243	567	657	420	174	1461	231	213	309	237	726	261
Magnolia biondii	255	1080	336	441	234	468	447	759	462	1479	690	444	522	297	327	204	327	333	525	486	240	723	0	567	657	420	0	1470	231	213	309	237	726	324
Magnolia amoena	255	1236	669	441	234	438	447	885	462	1482	825	444	765	297	489	468	327	405	525	828	240	723	243	567	657	420	273	1461	231	213	309	237	726	324
Magnolia sinostellata	255	1086	612	441	234	369	447	759	462	1482	1125	444	771	297	348	468	327	405	525	846	240	723	243	567	657	408	303	1314	231	213	309	237	726	324
Magnolia stellata	246	1185	612	441	234	489	447	759	462	1482	954	444	786	183	489	540	327	405	543	846	243	723	243	444	657	423	303	1467	231	213	309	237	726	369
Magnolia kobus	255	1284	669	441	234	441	447	759	462	1482	804	444	771	297	489	540	327	405	525	846	243	723	237	567	657	423	165	1434	231	213	309	237	726	327
Magnolia salicifolia	255	1197	612	441	234	345	447	759	453	1482	804	444	711	276	489	468	327	405	525	846	240	720	240	567	642	420	210	1521	231	213	309	237	726	366
Magnolia denudata	255	1197	669	441	234	138	447	759	462	1479	642	444	774	276	489	468	327	405	525	846	240	720	177	567	657	423	165	1152	231	213	309	237	726	261
Magnolia cylindrica	255	1128	612	441	234	366	447	759	462	1479	609	444	453	297	315	468	327	405	525	846	240	720	243	567	654	423	165	1230	231	213	309	237	726	261
Magnolia liliiflora	255	1284	612	438	234	345	447	759	462	1482	441	444	771	276	327	462	318	405	558	921	240	723	225	567	657	423	243	1170	231	210	309	237	726	258
Magnolia sprengeri	255	1197	612	441	234	318	447	759	462	1479	675	444	789	276	312	468	318	405	525	846	240	720	243	567	657	414	174	2121	231	213	309	237	726	210
Magnolia sargentiana	255	1197	612	441	234	327	447	555	462	1482	945	444	768	297	327	468	321	405	525	636	240	720	243	567	657	417	189	1455	231	213	309	237	726	324
Magnolia campbellii	255	1281	612	429	234	174	447	648	441	1485	690	411	774	276	489	468	315	405	525	846	240	720	243	567	657	423	165	1203	231	213	309	237	726	324
Magnolia dawsoniana	255	1284	612	441	234	342	447	759	462	1479	441	444	768	297	486	468	327	402	525	846	240	720	273	567	657	423	270	1464	231	213	309	237	726	327
Magnolia acuminata var. *subcordata*	255	1284	612	441	234	339	447	759	462	1482	852	444	537	297	489	468	318	411	525	843	231	720	192	567	657	366	195	1281	231	213	306	237	726	324
Magnolia acuminata	255	1284	612	441	234	288	447	759	462	1482	936	444	771	297	153	468	327	411	525	846	240	720	228	567	657	423	192	1458	231	213	306	237	726	240
Kmeria duperreana	255	1284	669	441	234	0	447	648	462	1482	813	411	768	297	489	468	306	405	522	846	168	714	243	567	660	417	195	1509	231	213	306	237	726	324
Kmeria septentrionalis	255	1284	612	441	234	0	447	645	462	1482	615	411	765	279	489	468	306	402	522	846	174	714	219	567	660	420	165	1422	231	213	306	237	726	324
Magnolia nitida var. *lotungensis*	255	1197	612	441	234	0	444	759	198	1482	633	405	405	297	489	465	327	405	525	846	240	720	243	567	657	420	93	1338	231	213	309	237	726	240
Pachylarnax praecalva	0	138	0	0	0	0	0	270	0	90	0	87	0	0	0	150	0	0	393	144	0	219	0	0	0	0	0	237	0	213	0	0	237	144
Magnolia kachirachirai	255	1197	669	441	234	0	444	759	159	1482	693	405	735	297	489	468	327	405	525	846	240	720	243	555	657	453	291	1464	231	213	309	237	726	324
Magnolia sinica	255	1197	612	441	231	0	447	759	198	1482	849	405	522	297	489	468	315	405	468	843	237	720	276	567	657	420	165	1455	231	213	309	237	726	366
Magnolia nitida	255	1080	669	441	234	0	447	759	0	1479	642	411	753	297	489	465	327	405	573	822	240	720	243	567	657	465	165	1476	231	213	309	237	726	240
Magnolia poasana	255	1284	669	441	234	138	447	147	462	1482	1062	444	762	360	489	708	327	405	522	843	168	720	243	567	657	420	165	1476	231	213	309	237	726	327
Magnolia panamensis	255	1284	669	441	234	138	447	147	462	1473	951	444	771	297	489	678	327	405	522	843	168	720	243	567	657	420	165	1485	231	213	309	237	726	261
Magnolia sharpii	255	1284	669	441	234	303	447	147	462	1476	768	444	762	297	489	663	327	405	522	843	168	720	243	567	657	420	165	1521	231	213	309	237	726	327
Magnolia guatemalensis	255	1284	669	441	234	138	447	147	462	1479	1008	444	741	279	489	633	327	405	522	843	168	720	243	567	657	414	189	1464	231	213	309	237	726	327
Magnolia iltisiana	255	1284	669	441	234	303	447	147	462	1479	1038	444	783	297	489	468	327	405	522	843	168	720	198	567	657	420	189	1470	231	201	297	237	720	207
Magnolia grandiflora	255	1284	669	441	234	138	447	648	462	1482	1092	447	786	279	489	468	327	405	522	846	168	720	243	567	657	414	165	1461	231	213	309	237	726	306
Magnolia striatifolia	255	1284	669	441	225	129	447	759	462	1482	852	444	774	297	489	468	327	405	561	843	168	720	237	567	657	420	189	1374	231	213	309	237	726	261
Magnolia schiedeana	255	1284	612	441	234	138	447	648	462	1482	672	444	786	297	489	468	327	405	522	846	168	720	138	567	657	420	165	1473	231	213	309	237	726	327
Magnolia tamaulipana	255	1284	612	441	234	138	447	756	429	1392	801	321	717	279	180	468	303	405	522	843	168	720	189	567	657	387	165	1323	231	213	309	237	726	327
Magnolia virginiana	255	1284	609	441	234	138	447	759	459	1479	840	447	768	291	489	468	327	405	525	846	240	720	243	564	657	387	165	1458	231	213	309	237	726	261
Magnolia macrophylla	249	1284	669	441	234	0	447	258	462	1482	792	444	690	297	489	468	318	405	525	843	240	720	243	567	654	423	165	1464	231	210	309	237	726	324
Magnolia macrophylla var. *ashei*	249	1167	669	441	234	0	447	258	462	1482	864	444	687	297	348	468	318	405	525	735	240	720	243	567	654	423	165	1467	231	210	309	237	726	138
Magnolia dealbata	255	1227	612	441	234	0	447	258	462	1482	660	444	687	297	489	468	318	405	525	840	168	720	186	567	654	423	165	1476	231	210	309	237	726	324
Magnolia championii	255	1197	612	441	219	0	444	435	339	1506	852	411	759	297	489	468	324	405	525	951	168	714	243	567	657	384	165	1461	231	213	309	237	726	240
Magnolia coco	255	1197	612	441	219	0	444	435	453	1506	825	411	762	297	327	432	315	405	525	825	168	714	243	528	657	384	165	1485	231	213	309	237	726	240
Magnolia phanerophlebia	255	1197	612	441	234	0	444	756	339	1677	972	411	768	285	489	468	303	405	525	843	237	717	243	567	657	420	165	1326	231	213	297	237	726	261
Magnolia pterocarpa	255	1158	450	441	234	0	288	0	330	1455	933	411	744	297	423	465	288	402	525	846	240	717	0	444	657	420	165	1236	231	213	309	237	726	240

Magnolia hodgsonii	255	1284	612	441	234	129	444	612	453	1344	996	411	768	270	489	468	318	405	525	846	240	720	207	567	657	420	165	1707	231	213	309	237	726	144
Magnolia henryi	255	1281	612	441	234	0	444	147	384	1452	1053	411	762	270	489	432	327	405	525	846	234	723	243	567	657	417	165	1473	231	213	309	237	726	369
Magnolia albosericea	255	1284	612	441	234	129	444	654	0	1506	693	411	540	279	327	468	297	405	612	738	240	717	219	567	657	420	165	1161	231	207	309	237	726	303
Magnolia liliifera	255	1284	612	441	219	0	345	756	339	1479	1176	411	771	294	327	465	327	402	507	837	240	720	264	567	657	387	165	1275	231	0	303	183	726	324
Magnolia delavayi	255	1284	669	441	234	129	444	102	462	1293	1173	411	774	285	489	468	327	402	525	843	240	720	243	567	603	384	189	1494	231	213	309	237	726	189
Magnolia pastazaensis	249	1284	609	441	234	0	447	540	297	1482	609	411	786	297	489	468	327	405	546	849	237	720	237	567	657	405	165	867	231	213	291	237	723	324
Magnolia equatorialis	237	1284	609	441	195	0	447	429	297	1482	624	285	780	162	153	468	327	405	546	849	237	720	114	567	657	420	165	1410	231	213	309	237	720	321
Magnolia ovata	255	1284	609	441	234	0	447	609	363	1482	750	285	774	297	489	468	327	405	546	849	237	720	240	567	657	420	189	1479	231	213	309	207	723	324
Magnolia dodecapetala	255	1284	609	441	234	0	447	540	339	1482	663	411	774	297	489	468	327	411	546	849	237	720	240	567	657	387	165	1215	231	213	309	237	723	366
Magnolia kichuana	255	1284	609	441	234	0	441	609	297	1482	657	411	768	297	489	468	327	405	516	849	237	720	222	567	657	414	189	1485	231	213	309	237	774	366
Magnolia zamorana	255	1284	609	441	234	0	447	609	297	1488	441	411	792	297	489	468	327	405	546	849	237	720	135	567	657	411	165	1476	78	213	309	237	723	324
Magnolia mercedesiarum	249	1284	609	441	234	0	447	609	339	1455	441	411	708	297	489	468	327	405	546	849	237	720	240	567	657	420	189	1743	231	213	309	237	723	366
Magnolia mindoensis	246	1248	609	441	234	0	447	606	339	1482	729	411	774	297	489	465	324	408	546	849	237	720	240	567	657	396	189	1473	231	213	309	237	720	366
Magnolia mexicana	255	1284	609	441	231	0	447	402	363	1482	759	444	771	297	489	468	327	405	546	738	237	717	243	567	657	420	189	1215	231	213	309	237	726	324
Manglietia conifera	255	1197	612	441	231	171	447	273	462	1479	1071	318	657	276	489	468	327	405	525	843	240	717	192	444	657	420	165	1212	231	213	309	237	966	324
Manglietia insignis	255	1197	669	441	231	300	447	273	462	1479	1002	444	657	297	489	468	327	405	549	843	240	717	243	567	657	420	165	1224	231	213	309	237	726	366
Manglietia duclouxii	255	1284	612	441	231	0	447	273	345	1479	1005	444	213	297	327	468	327	405	525	843	240	717	243	567	657	423	189	1461	231	213	309	237	726	240
Manglietia hookeri	255	1197	669	441	231	162	447	273	459	1482	855	444	747	276	489	468	327	405	468	846	240	717	243	567	657	423	165	1029	231	213	309	237	711	324
Manglietia aromatica	255	1197	612	441	231	171	447	273	462	1482	912	444	450	297	180	468	312	405	525	843	168	717	243	567	657	423	165	1071	231	213	309	237	870	324
Manglietia lucida	255	1197	612	441	231	315	447	267	462	1482	789	444	753	276	489	468	327	405	525	846	240	717	243	567	657	423	165	1473	231	213	309	237	720	324
Manglietia grandis	255	1197	612	441	231	0	447	273	465	1482	441	444	759	252	348	468	327	402	546	846	240	717	243	567	657	375	165	1284	231	201	309	237	711	366
Manglietia megaphylla	255	1197	612	441	225	288	447	273	462	1482	849	444	645	297	348	468	327	405	525	843	240	717	0	567	654	420	165	1281	231	213	309	237	726	366
Manglietia rufibarbata	255	1197	612	441	231	171	447	273	462	1482	1119	444	639	297	489	468	327	405	525	843	240	717	243	567	654	420	165	1458	231	213	309	237	711	324
Manglietia ventii	255	1197	612	441	231	174	447	252	462	1479	891	444	429	276	489	468	327	405	525	846	240	717	237	567	654	423	165	1305	231	213	309	237	711	324
Manglietia ovoidea	255	975	669	441	231	0	447	273	462	1482	1005	444	639	276	348	468	327	405	525	843	240	717	204	567	654	390	165	1308	231	213	309	237	726	324
Manglietia kwangtungensis	255	1197	612	441	231	141	456	273	462	1482	1005	444	750	297	489	468	312	405	525	846	240	717	243	567	654	375	165	1287	231	210	309	237	726	324
Manglietia szechuanica	255	1269	612	441	231	171	447	147	465	1482	1239	444	651	297	489	468	327	405	525	843	240	717	243	567	654	423	165	1215	231	216	309	237	726	324
Manglietia pachyphylla	255	1197	612	441	231	0	456	273	462	1482	993	444	642	153	489	468	306	405	525	843	240	717	243	567	654	420	165	1467	231	213	309	237	726	324
Manglietia fordiana	255	1197	612	441	231	0	456	273	462	1482	843	444	642	255	489	468	300	405	525	846	240	717	243	567	657	375	165	1071	231	213	309	237	726	324
Manglietia glauca	255	1197	612	441	234	174	447	273	462	1482	1086	444	645	276	489	468	327	405	525	846	240	717	243	525	657	375	165	1245	231	213	309	237	726	324
Manglietia utilis	255	978	612	441	231	318	447	273	0	1479	774	444	651	276	489	468	312	405	525	846	168	717	243	567	657	423	189	1212	231	213	309	237	726	324
Manglietia caveana	255	1110	612	441	231	306	447	273	462	1479	990	444	546	276	489	468	327	405	522	846	168	717	204	567	657	375	165	1272	231	213	309	237	726	321
Manglietia garrettii	255	1197	612	441	231	306	447	273	393	1479	1038	444	651	96	489	468	327	405	525	843	168	717	210	567	657	423	165	1074	231	213	309	237	726	324
Manglietia decidua	255	1197	612	441	219	315	447	273	462	1482	705	444	672	252	489	468	327	405	522	843	240	720	243	567	654	474	171	1443	231	0	309	237	726	321
Magnolia obovata	255	1272	612	441	225	171	447	273	462	1482	1005	444	681	276	489	468	327	402	525	846	0	720	222	567	654	420	189	1473	231	132	309	237	726	324
Magnolia officinalis	255	1275	612	441	234	132	447	273	462	1482	633	444	702	258	327	204	327	402	522	846	0	720	204	567	651	387	189	1410	231	132	309	237	726	207
Magnolia tripetala	255	1275	669	441	234	306	447	273	462	1482	891	444	681	297	489	468	327	402	651	846	0	720	324	567	654	420	189	1200	231	180	309	237	726	366
Magnolia wilsonii	255	876	612	441	234	162	447	759	450	1476	1002	318	504	276	489	468	327	399	612	633	240	720	0	567	642	387	165	1077	231	213	309	237	726	324
Magnolia globosa	255	1230	612	441	219	270	447	759	450	1476	1005	444	663	297	489	465	327	399	525	849	240	720	219	573	621	396	189	1386	231	213	309	237	726	324
Magnolia sieboldii	255	1137	669	441	234	135	447	759	456	1479	1008	444	741	294	486	468	327	405	564	840	240	720	183	567	639	387	165	1089	231	213	309	237	726	324
Magnolia sieboldii subsp. *sinensis*	255	1137	669	441	234	330	447	759	342	1479	849	444	741	297	486	468	324	405	525	840	240	720	240	567	639	387	165	1230	231	213	309	237	726	324
Magnolia fraseri	255	1284	669	441	258	0	447	744	459	1482	678	444	684	297	315	468	327	405	525	846	240	720	243	567	654	420	186	657	231	213	309	237	726	396
Magnolia fraseri var. *pyrimidata*	255	1284	612	441	258	0	444	744	456	1482	816	444	687	297	489	468	327	405	525	846	240	720	243	567	654	474	165	1134	231	213	309	237	726	396
Magnolia splendens	255	1197	612	441	234	0	444	756	174	1470	939	444	531	297	327	468	327	405	525	843	240	717	243	567	657	417	165	1491	231	213	306	237	726	321
Magnolia portoricensis	255	1197	612	441	234	0	444	756	0	1470	567	444	531	297	489	468	327	405	522	843	240	717	267	567	657	390	165	699	231	213	306	237	726	321
Magnolia cubensis	255	1197	612	441	234	0	444	756	165	1470	672	444	720	297	489	468	294	405	525	840	240	717	204	567	657	387	165	1872	231	213	306	234	726	321
Magnolia bankardiorum	255	1197	612	441	234	0	447	612	336	1464	993	444	627	297	489	264	327	405	516	843	240	702	255	567	657	423	165	1812	231	213	306	237	726	321
Liriodendron chinense	0	1284	612	369	225	0	444	0	0	1479	318	444	660	288	153	0	327	423	522	570	0	699	177	567	606	357	165	477	231	0	297	237	0	144
Liriodendron tulipifera X *Liriodendron chinense*	249	1197	612	333	225	0	444	0	0	1479	462	444	450	288	315	228	327	423	393	678	0	699	177	567	606	411	192	1047	231	0	297	237	726	144
Liriodendron tulipifera	258	1197	612	450	213	0	444	0	0	1479	462	351	660	288	489	0	327	423	390	678	0	699	177	567	606	411	198	858	231	0	297	222	726	144
Ave.	247	1219	613	433	229	222	343	556	422	1459	812	426	702	281	434	438	319	401	526	820	213	710	221	554	644	411	188	1333	226	201	305	232	716	309

Appendix 29. (Continued)

Taxon name	MKT257	MKT261	MKT265	MKT267	MKT271	MKT272	MKT274	MKT276	MKT277	MKT277	MKT277	MKT279	MKT282	MKT282	MKT283	MKT283	MKT283	MKT284	MKT285	MKT288	MKT290	MKT292	MKT293	MKT293	MKT295	MKT296	MKT297	MKT297	MKT298	MKT302	MKT303	MKT303	MKT304	MKT305

	746_1_4	594_1_4	995_1_4	759_1_4	364_1_4	827_1_4	838_1_4	084_1_4	188_1_4	229_1_4	532_1_4	537_1_4	190_1_4	250_1_4	198_1_4	483_1_4	955_1_4	160_1_4	757_1_4	424_1_4	683_1_4	559_1_4	201_1_4	539_1_4	011_1_4	836_1_4	546_1_4	825_1_4	063_1_4	745_1_4	404_1_4	711_1_4	375_1_4	891_1_4
Length of the reference for each loci	282	555	222	759	351	2319	423	267	495	744	2040	702	1116	453	297	438	567	759	291	432	207	255	810	225	417	360	471	378	1296	1086	843	264	591	459
Magnolia griffithii	261	564	0	759	345	2235	423	267	486	570	2040	690	984	396	297	264	558	759	291	432	207	219	810	222	384	363	0	168	1314	630	846	261	585	435
Michelia baillonii	261	564	216	759	306	2235	423	267	486	744	1992	690	975	432	297	279	558	759	291	432	207	219	810	222	414	363	0	168	1296	501	846	261	585	432
Michelia sirindhorniae	261	564	216	759	348	2316	423	267	486	741	2040	690	984	450	297	396	558	759	291	432	207	219	810	222	417	351	0	165	1314	0	846	249	585	435
Michelia velutina	261	564	216	759	330	2247	423	267	486	741	2040	690	984	420	297	393	558	759	282	432	207	219	810	222	411	351	0	234	1314	0	843	246	594	435
Michelia masticata	261	564	216	759	351	2241	423	267	486	741	2040	666	966	432	294	396	558	717	291	432	0	126	792	222	237	402	0	234	1266	0	843	261	591	432
Michelia sphaerantha	261	564	216	759	339	2247	423	267	486	741	2040	666	984	300	294	396	558	759	291	432	0	234	810	222	468	402	0	156	1284	375	843	261	588	393
Michelia doltsopa	261	564	213	759	351	2178	423	267	483	741	2031	690	1116	522	297	396	558	759	291	432	207	0	810	222	417	402	0	234	1311	0	846	261	591	435
Michelia lacei	261	564	213	759	351	2247	423	267	486	741	2040	690	999	492	117	396	558	759	291	432	207	243	810	222	393	345	0	168	1281	0	846	261	588	381
Michelia salicifolia	258	564	204	759	246	2106	423	267	486	741	2037	636	984	450	297	396	558	762	291	432	207	243	792	222	399	372	0	156	936	450	852	234	591	276
Michelia martini	261	564	216	759	354	2247	423	267	486	741	1992	846	981	441	297	396	558	759	291	432	207	234	810	222	417	381	0	240	1311	375	843	258	591	402
Michelia coriacea	261	564	216	759	351	2244	423	267	486	741	2040	690	984	450	297	396	558	759	291	432	207	135	810	219	417	402	0	156	1527	453	846	261	591	402
Michelia ingrata	261	555	216	759	354	2319	423	267	486	744	2037	690	984	525	297	396	558	759	291	432	207	243	810	222	414	402	0	156	1314	453	846	231	591	402
Michelia wilsonii	261	564	216	759	348	2247	423	267	489	741	2040	690	912	450	297	396	558	774	291	432	207	246	810	222	417	402	0	234	1311	621	843	258	591	399
Michelia floribunda	261	564	213	759	351	2247	423	267	486	741	1992	696	984	468	297	396	558	759	291	432	207	243	810	222	417	402	0	168	1314	450	846	249	591	402
Michelia chapensis	261	564	213	759	351	2319	423	267	486	741	2040	690	984	558	297	396	558	759	291	432	207	216	810	222	414	366	0	168	1311	450	846	147	591	354
Michelia chapensis	261	564	213	759	351	2157	423	267	486	741	2040	690	954	567	297	396	558	759	291	432	207	216	792	222	414	402	0	168	1311	183	846	159	591	354
Michelia hypolampra	261	564	216	759	351	2229	423	267	486	741	1992	696	903	534	297	396	558	759	291	432	207	216	804	222	357	402	0	156	1185	0	843	228	591	402
Michelia viridipetala	258	564	216	759	351	2247	423	267	330	744	2040	666	984	252	294	396	558	612	291	432	207	135	810	222	234	369	0	156	1140	453	168	249	591	435
Michelia balansae	261	564	216	759	351	2313	423	267	486	744	2040	666	984	444	297	396	558	759	291	432	207	135	810	222	414	369	0	165	1299	453	843	249	591	381
Michelia guangxiensis	261	564	216	759	351	2247	423	267	483	744	1992	666	987	354	294	396	558	615	291	432	207	219	810	222	414	402	0	156	1308	453	840	249	591	435
Michelia figo	258	564	216	759	348	2247	423	267	483	741	1917	666	987	450	297	396	558	759	291	432	207	243	810	222	414	402	0	156	1290	0	720	246	588	378
Michelia shiluensis	261	564	216	759	306	2247	423	267	330	744	1992	666	984	648	297	396	558	759	291	432	204	219	810	222	414	360	0	234	1308	450	843	207	591	402
Michelia odora	261	747	138	759	351	2016	423	267	486	744	1992	666	984	432	297	396	558	759	288	432	207	243	810	222	414	402	0	162	1143	450	849	249	591	408
Michelia montana	261	564	216	759	351	2247	423	267	486	744	2040	666	984	450	297	396	558	759	291	381	207	135	810	222	414	357	0	231	1293	0	843	258	591	429
Elmerrillia ovalis	261	564	213	759	339	2244	423	267	486	738	1992	666	969	432	297	396	558	759	291	363	186	219	792	222	414	363	0	366	1308	453	852	258	588	336
Michelia compressa	258	564	216	759	351	2259	423	267	486	744	2040	663	984	192	297	396	558	759	291	381	204	243	792	222	420	402	0	234	1308	0	840	249	588	435
Michelia macclurei	261	492	216	759	351	2247	423	267	486	744	1992	690	984	444	297	396	558	759	291	432	207	243	810	219	414	402	0	156	1308	0	843	228	585	435
Michelia guangdongensis	261	564	216	759	351	2157	423	267	330	744	1992	690	984	429	297	396	558	759	291	432	207	243	792	219	414	402	0	156	1140	267	462	258	585	0
Michelia maudiae	261	564	195	759	351	2247	423	267	486	744	2040	690	984	426	297	396	558	759	291	432	207	189	810	222	414	402	0	156	1131	177	765	258	585	165
Michelia foveolata	261	555	216	759	351	2319	423	267	330	744	1992	690	984	426	270	396	558	615	288	432	207	135	792	222	405	402	0	156	1311	453	840	258	585	435
Michelia cavaleriei	261	564	216	759	351	2316	423	267	486	744	2007	636	984	423	297	396	558	759	288	432	207	132	810	222	417	402	0	156	1308	450	843	258	588	393
Magnolia elegans	105	558	213	759	342	2175	423	267	486	648	1992	660	999	450	297	396	558	756	291	432	207	171	798	225	417	342	0	375	1314	450	816	261	576	435
Magnolia borneensis	0	165	0	618	0	795	138	0	117	291	924	0	375	198	186	279	378	87	147	108	192	0	420	147	0	123	0	372	243	0	108	162	303	87
Magnolia carsonii	0	564	216	759	261	2178	423	267	486	570	1845	690	984	450	297	0	558	756	291	432	207	231	792	225	417	360	0	369	1314	360	843	261	585	435
Magnolia cathcartii	0	564	216	759	351	2247	423	267	486	648	2043	690	903	450	297	396	558	759	288	432	207	231	792	225	420	354	87	375	1311	450	843	246	585	354
Magnolia zenii	282	555	213	759	360	2157	423	267	486	744	1992	639	984	450	294	396	555	768	291	432	207	255	810	225	417	363	0	378	162	612	846	264	579	354
Magnolia biondii	282	252	216	759	357	2121	108	267	486	741	1896	417	822	336	0	396	165	552	288	321	207	255	810	225	237	363	0	378	1296	612	507	249	579	435
Magnolia amoena	282	555	210	759	351	2247	423	267	486	744	2040	693	984	447	297	396	558	759	291	435	207	306	801	225	402	357	0	378	1296	609	789	264	588	435
Magnolia sinostellata	282	555	0	759	354	2319	423	267	330	744	2040	696	984	471	297	396	558	759	291	432	207	204	810	225	417	363	0	378	1296	612	846	252	588	393
Magnolia stellata	282	555	216	759	351	2247	423	267	486	744	2040	693	984	453	297	396	558	759	291	432	207	255	810	225	417	327	0	378	1296	612	846	264	591	435
Magnolia kobus	282	555	216	759	351	2247	423	267	486	744	1992	702	984	375	297	396	558	759	291	432	207	255	810	225	417	357	0	378	1296	201	846	264	588	435
Magnolia salicifolia	261	555	216	759	351	2250	423	267	486	744	2040	693	984	429	297	396	558	759	291	432	207	255	810	225	417	258	0	378	1296	612	846	264	591	435
Magnolia denudata	282	555	186	759	354	2247	423	267	330	744	1992	696	984	255	297	396	558	759	291	432	207	255	792	225	402	375	87	378	1137	612	849	264	591	429
Magnolia cylindrica	282	555	216	759	351	2157	423	267	330	744	1992	636	1068	255	297	396	558	696	291	432	207	255	792	225	234	318	0	378	930	609	846	264	591	435
Magnolia liliiflora	282	555	216	759	354	2145	423	267	330	744	1965	696	984	255	297	396	558	615	291	432	207	255	810	225	417	327	0	378	933	612	846	252	591	435
Magnolia sprengeri	282	381	216	759	354	2043	423	267	330	744	2040	639	984	273	297	396	558	696	291	432	207	255	810	225	417	366	0	378	930	612	843	261	588	438
Magnolia sargentiana	261	555	216	759	348	2247	423	267	486	744	2040	690	981	432	297	396	558	696	291	432	207	252	810	225	417	360	0	372	177	0	846	264	591	252
Magnolia campbellii	261	555	216	759	348	2319	423	267	486	744	1992	690	981	426	297	396	555	756	291	432	207	252	792	225	189	375	96	378	1317	0	846	249	591	435
Magnolia dawsoniana	282	555	207	759	348	2247	423	267	486	744	2040	687	984	423	297	396	558	759	291	432	207	252	792	225	369	375	0	378	444	453	627	252	591	393
Magnolia acuminata var. *subcordata*	0	564	216	759	342	2247	423	267	486	744	2037	639	984	432	297	396	558	759	291	432	0	255	792	153	417	384	0	378	1242	0	840	261	588	252
Magnolia acuminata	0	564	0	759	351	2157	423	267	486	744	1992	696	984	252	297	396	558	759	291	432	207	255	810	225	417	384	0	378	1137	453	615	261	579	432
Kmeria duperreana	105	564	210	759	351	2175	423	264	489	744	2040	642	984	471	294	396	561	756	291	432	0	243	777	225	234	375	0	378	1119	390	684	249	585	435
Kmeria septentrionalis	0	564	216	759	348	2172	423	264	489	744	1992	636	984	450	294	396	561	756	291	432	0	249	810	225	216	303	0	378	1140	393	840	249	585	438
Magnolia nitida var. *lotungensis*	264	549	216	759	258	2238	423	267	426	744	1989	636	849	444	297	357	561	732	291	432	0	108	810	225	372	363	162	375	696	0	846	234	498	450
Pachylarnax praecalva	0	0	0	0	0	0	0	0	252	0	0	0	264	0	0	0	0	0	0	0	0	0	321	0	0	0	0	0	84	0	0	0	0	0
Magnolia kachirachirai	240	546	216	759	351	2328	423	267	492	744	2040	690	993	444	297	396	561	741	291	432	0	255	810	225	417	363	0	375	699	450	846	186	498	435
Magnolia sinica	261	549	0	759	351	2247	423	267	330	744	2040	687	981	417	297	396	561	729	345	435	0	111	810	225	417	363	78	378	696	0	168	234	498	435
Magnolia nitida	243	549	216	759	348	2145	423	267	492	744	2040	690	993	417	297	396	561	732	291	432	0	111	807	225	417	369	0	378	1143	609	843	261	498	435
Magnolia poasana	0	558	216	759	348	2247	423	267	492	648	2040	690	984	411	297	396	561	732	291	432	0	252	810	225	231	366	0	342	1305	375	840	255	579	258
Magnolia panamensis	0	558	216	759	348	2319	423	267	492	648	2040	636	984	438	297	396	561	732	291	432	0	252	810	225	231	366	0	342	1305	603	840	255	588	435
Magnolia sharpii	0	558	216	759	348	2247	423	267	492	648	2040	636	984	450	297	396	576	756	291	432	0	135	807	225	231	366	201	342	1128	423	840	255	588	456
Magnolia guatemalensis	153	558	216	759	348	2319	423	267	492	648	1992	672	984	444	297	396	561	732	291	432	0	132	810	225	234	369	0	342	1134	0	840	261	588	429

Magnolia iltisiana	0	558	216	759	348	2319	333	267	489	648	2040	636	984	450	297	396	561	732	291	432	0	249	810	225	231	351	0	342	1134	0	840	255	579	435
Magnolia grandiflora	147	558	216	759	348	2319	423	267	492	648	2016	690	984	450	297	396	561	756	291	432	0	246	795	225	417	366	0	342	1143	450	843	243	588	435
Magnolia striatifolia	264	558	216	759	348	2319	423	267	492	648	2016	606	984	450	297	372	561	756	291	432	0	246	792	225	417	366	0	342	1056	432	840	243	588	435
Magnolia schiedeana	0	558	216	759	300	2247	417	267	492	648	1992	654	984	450	297	396	561	732	291	432	0	249	810	225	387	366	90	342	1308	219	843	243	588	384
Magnolia tamaulipana	0	558	216	759	318	2178	423	267	492	648	1992	606	984	450	288	396	561	756	291	432	0	249	810	225	0	369	84	342	603	0	393	243	588	435
Magnolia virginiana	150	558	216	759	351	2250	423	267	492	648	2040	636	984	450	297	396	555	732	291	432	0	0	810	225	417	366	0	0	1305	0	843	183	588	459
Magnolia macrophylla	255	558	216	759	351	2247	423	267	492	648	1989	690	981	444	297	396	561	732	243	432	0	252	810	225	414	363	0	375	1302	0	840	258	588	300
Magnolia macrophylla var. *ashei*	156	546	216	759	351	2247	423	267	492	648	1989	690	981	444	297	396	561	732	243	432	0	252	810	225	414	351	0	375	1248	0	840	261	558	435
Magnolia dealbata	156	558	216	759	351	2265	423	267	330	648	1989	690	984	402	297	396	561	732	243	432	0	252	810	225	216	363	204	375	1248	0	840	246	588	435
Magnolia championii	0	564	216	759	336	2247	300	264	492	744	2040	630	966	414	297	396	561	756	288	432	0	0	807	225	504	402	111	375	1128	375	843	234	591	432
Magnolia coco	0	564	216	759	258	2103	291	261	492	744	1992	606	870	453	297	396	561	756	288	432	0	0	789	225	408	402	0	375	921	0	522	234	591	432
Magnolia phanerophlebia	0	564	207	759	336	2247	423	264	330	744	1992	603	981	450	297	0	561	615	288	411	0	0	807	225	231	360	0	375	1137	450	843	261	588	432
Magnolia pterocarpa	0	561	147	759	258	1926	333	267	330	744	1992	630	981	402	243	396	558	624	288	432	0	0	792	0	0	402	0	375	843	453	516	234	567	432
Magnolia hodgsonii	0	564	219	759	258	2319	186	267	492	744	1992	630	867	450	294	396	558	759	288	432	0	0	792	225	417	384	0	378	1317	426	516	255	567	441
Magnolia henryi	0	564	219	759	156	2157	186	267	492	744	2040	630	981	426	297	393	561	753	279	432	0	0	801	225	417	396	0	378	1176	426	516	234	585	432
Magnolia albosericea	0	561	216	759	303	2157	423	267	492	744	1986	576	873	450	297	390	561	720	288	432	0	0	792	225	414	231	0	378	933	267	717	249	591	432
Magnolia liliifera	0	564	216	759	351	2247	291	267	336	744	2022	630	966	450	297	396	561	720	282	363	0	0	810	225	417	402	0	378	1290	255	510	261	582	432
Magnolia delavayi	0	555	216	759	258	2319	291	258	492	744	1992	630	981	444	297	396	561	729	291	432	0	0	810	225	417	363	0	378	1317	375	843	249	591	432
Magnolia pastazaensis	0	564	213	759	348	2217	423	264	330	744	1989	690	981	432	291	396	543	732	288	432	0	0	792	225	417	297	165	375	1245	450	846	258	582	444
Magnolia equatorialis	0	564	213	759	348	2280	423	264	330	618	2034	636	981	429	294	396	402	420	288	432	0	0	810	0	0	291	165	375	1071	609	294	258	492	435
Magnolia ovata	0	564	213	759	300	2319	423	264	492	744	1995	690	981	378	294	396	549	615	288	432	0	0	774	225	417	300	162	375	1137	450	846	258	582	444
Magnolia dodecapetala	0	564	213	759	351	2247	423	267	492	744	2034	690	981	450	294	396	549	732	288	432	0	0	810	225	417	297	165	375	1245	609	843	219	582	435
Magnolia kichuana	0	561	213	759	348	2247	423	267	492	744	1989	690	972	450	294	396	549	732	288	432	0	0	810	150	417	297	210	375	1137	591	843	240	582	435
Magnolia zamorana	0	564	213	759	348	2253	423	267	492	744	1989	690	981	426	294	396	549	732	288	432	0	0	792	150	417	297	189	375	1137	450	843	246	582	432
Magnolia mercedesiarum	0	564	213	759	348	2280	423	267	492	744	2034	690	981	450	294	396	558	732	288	432	0	0	792	225	417	297	195	375	1245	606	843	258	576	432
Magnolia mindoensis	0	564	213	759	348	2247	423	267	492	732	1959	690	981	408	294	396	549	732	288	429	0	0	810	225	417	297	168	375	1245	609	843	258	582	351
Magnolia mexicana	0	564	213	759	330	2250	423	267	492	744	1989	636	891	273	291	396	549	732	288	429	0	0	810	225	213	306	111	342	1305	609	501	258	582	435
Manglietia conifera	0	561	192	759	351	2166	423	267	330	744	2040	636	981	543	297	396	561	756	111	432	207	216	810	225	417	372	0	375	1062	450	627	261	588	399
Manglietia insignis	0	561	216	759	351	2229	423	267	492	744	1992	636	981	444	297	396	561	756	291	432	207	216	810	225	378	372	111	375	1248	450	846	261	588	435
Manglietia duclouxii	0	561	216	759	318	2247	333	267	330	744	1992	690	981	444	297	396	537	756	111	432	207	219	810	225	417	372	90	375	1119	450	795	261	588	435
Manglietia hookeri	156	561	216	759	351	2319	423	267	492	744	2040	636	900	444	297	378	537	756	291	432	207	219	810	225	417	402	0	375	1251	450	843	261	588	435
Manglietia aromatica	0	561	216	759	258	2184	240	270	492	744	2016	606	984	432	297	360	561	756	291	432	207	213	792	225	183	372	0	375	1140	0	846	261	588	435
Manglietia lucida	0	561	174	759	258	2244	423	267	492	744	1992	630	984	117	297	396	561	756	243	432	207	219	810	225	387	372	0	372	1248	450	846	261	588	435
Manglietia grandis	0	558	216	759	258	2247	423	267	492	744	2040	690	981	444	297	378	561	756	291	429	207	219	810	225	417	369	0	375	1140	450	843	261	585	435
Manglietia megaphylla	0	561	216	759	345	2247	423	267	330	744	1998	636	981	441	297	396	561	756	111	432	207	219	792	225	417	372	0	375	1254	270	846	261	555	420
Manglietia rufibarbata	0	561	216	759	306	2229	333	267	492	744	1992	636	981	327	297	396	561	756	111	432	207	219	810	225	417	372	0	330	1146	450	843	261	588	345
Manglietia ventii	0	561	0	759	258	2088	423	267	492	744	1863	690	981	444	297	378	561	756	111	432	207	246	810	225	417	402	0	375	1248	609	843	261	588	435
Manglietia ovoidea	0	561	216	759	351	2157	423	267	492	744	2010	636	981	636	297	396	561	756	243	432	207	219	792	225	387	369	195	375	1131	450	846	261	588	435
Manglietia kwangtungensis	0	561	216	747	351	2247	423	267	330	744	2040	636	978	639	297	378	561	756	0	432	207	216	810	225	417	372	0	375	1131	606	846	216	588	396
Manglietia szechuanica	0	561	216	759	351	2190	423	267	492	744	2040	636	900	444	297	396	456	756	291	432	207	216	792	225	417	372	0	372	1131	609	804	261	588	441
Manglietia pachyphylla	0	561	216	759	318	2319	423	267	492	744	1863	690	978	414	297	396	561	756	111	432	207	219	810	225	417	375	0	375	1143	450	843	216	588	435
Manglietia fordiana	0	561	216	759	351	2247	423	267	492	744	1863	690	900	639	297	396	561	756	273	432	207	219	810	225	237	360	0	375	504	450	843	261	588	339
Manglietia glauca	0	561	0	759	351	2193	423	267	492	744	2064	690	981	444	297	396	561	756	291	432	207	222	792	225	195	375	0	375	1302	627	849	261	585	405
Manglietia utilis	0	561	216	759	258	2157	423	267	330	729	1992	633	996	444	297	396	570	756	291	432	207	210	810	225	0	372	0	375	1140	0	843	249	588	435
Manglietia caveana	0	561	0	759	318	2040	423	267	492	744	1998	690	999	531	297	396	537	756	291	432	207	219	792	225	417	402	0	375	1296	450	780	261	588	240
Manglietia garrettii	0	561	216	759	351	2229	423	267	492	744	2040	690	981	456	297	396	468	759	291	411	207	222	810	225	417	363	0	375	1248	450	843	261	588	435
Manglietia decidua	0	561	216	759	351	2229	423	267	330	744	2037	693	978	429	297	360	561	756	291	432	207	198	792	225	417	402	0	375	1143	450	843	228	588	372
Magnolia obovata	0	561	216	759	348	2244	423	267	492	744	1995	639	984	258	297	396	561	756	291	432	0	249	810	225	411	363	159	375	1119	552	843	261	585	435
Magnolia officinalis	0	561	216	759	303	2175	423	267	330	744	1992	693	984	426	297	396	489	756	291	432	0	249	792	225	0	405	111	375	1128	450	246	234	585	432
Magnolia tripetala	0	561	216	759	348	2244	423	267	330	744	2040	639	984	426	297	396	561	756	291	429	207	249	810	225	417	366	0	372	1140	177	840	261	588	435
Magnolia wilsonii	0	186	216	759	255	2037	423	267	330	744	1992	687	987	273	297	396	561	393	216	258	207	237	810	225	204	402	120	0	837	0	288	261	585	435
Magnolia globosa	0	564	216	759	351	2244	423	267	492	744	2040	690	984	444	276	396	561	756	291	432	207	237	792	225	417	402	168	375	1128	375	843	231	585	435
Magnolia sieboldii	0	564	216	759	300	2244	423	267	492	744	1992	690	978	423	297	396	561	756	291	432	207	237	804	216	417	357	0	375	1122	177	843	231	585	435
Magnolia sieboldii subsp. *sinensis*	0	564	216	759	300	2244	423	267	492	744	2013	690	975	423	297	396	561	609	291	432	207	237	810	216	417	348	96	375	1233	198	843	231	579	435
Magnolia fraseri	0	564	105	759	348	2247	423	267	492	744	2040	633	984	429	294	396	561	759	228	432	0	135	810	225	417	357	0	378	1122	318	843	234	588	435
Magnolia fraseri var. *pyrimidata*	0	564	105	759	348	2244	423	267	492	744	1989	633	972	432	294	396	561	759	228	432	0	135	801	225	417	357	0	378	1311	0	843	234	498	435
Magnolia splendens	0	564	213	759	300	2118	423	267	492	744	2028	663	975	444	309	396	561	756	291	429	0	243	771	225	384	357	0	375	1296	606	846	243	588	435
Magnolia portoricensis	0	564	213	759	348	2103	423	267	492	744	2022	663	846	444	294	396	561	756	291	429	0	243	789	225	417	357	0	366	1161	606	834	243	588	435
Magnolia cubensis	153	564	213	759	258	2166	423	267	492	744	1989	663	975	396	297	396	561	609	291	429	0	243	789	225	414	366	0	375	1299	606	822	228	588	390
Magnolia bankardiorum	0	564	210	759	312	2265	423	267	492	741	1989	663	846	450	297	396	561	756	291	429	0	243	789	225	417	372	87	366	1101	606	831	243	585	426
Liriodendron chinense	0	555	0	759	243	2028	330	267	483	738	1968	510	771	450	288	372	507	501	0	429	0	0	801	0	0	339	0	0	0	0	648	0	0	426
Liriodendron tulipifera X *Liriodendron chinense*	0	555	0	747	243	2037	147	267	330	735	1755	558	768	450	288	372	408	567	0	429	0	0	801	0	0	327	0	0	0	0	138	0	258	255
Liriodendron tulipifera	0	558	0	759	243	2085	147	276	330	738	1992	507	966	450	297	372	507	567	0	363	0	0	810	0	0	237	0	0	0	0	141	0	0	426

Ave.	118	547	191	752	324	2192	397	263	449	718	1981	651	958	424	288	381	544	717	266	421	121	176	796	211	351	359	31	307	1116	345	757	239	563	401

Appendix 29. (Continued)

Taxon name	MKT306820_14	MKT308263_14	MKT308611_14	MKT308778_14	MKT312515_14	MKT314389_14	MKT314507_14	MKT314708_14	MKT314787_14	MKT315126_14	MKT315917_14	MKT316089_14	MKT317772_14	MKT318012_14	MKT322600_14	MKT325055_14	MKT325925_14	MKT326621_14	MKT328127_14	MKT328764_14	MKT332397_14	MKT333354_14	MKT334782_14	MKT337557_14	MKT339163_14	MKT343704_14	MKT344417_14	MKT345063_14	MKT346101_14	MKT347521_14	MKT348468_14	MKT349073_14	MKT350500_14	MKT351432_14	
Length of the reference for each loci	711	324	549	1335	459	852	474	255	2811	375	483	939	882	411	735	486	267	696	240	453	393	678	1029	579	1152	216	471	774	906	1452	573	597	1080	495
Magnolia griffithii	714	324	549	1335	459	804	471	120	2811	345	477	939	882	96	738	420	261	693	240	453	393	678	1032	504	405	216	456	771	906	1449	477	534	768	324
Michelia baillonii	714	324	549	1311	321	852	471	108	2811	345	480	939	882	567	735	420	261	693	234	453	393	561	1161	576	414	216	456	771	906	1446	567	597	774	324
Michelia sirindhorniae	711	318	549	1332	459	852	471	147	2811	339	465	939	882	387	735	420	261	642	237	453	393	678	1251	531	405	216	456	768	906	1440	570	597	768	363
Michelia velutina	684	324	549	1335	459	852	471	255	2814	270	480	939	882	372	735	420	261	693	237	453	369	678	1260	573	405	216	456	774	906	1449	570	597	843	363
Michelia masticata	714	315	549	1332	459	804	471	255	2808	345	483	939	768	0	729	420	261	675	237	453	393	678	1260	573	405	195	366	741	906	1449	570	597	537	378
Michelia sphaerantha	714	315	549	1332	459	804	471	123	2808	369	477	939	882	0	735	420	261	675	237	453	393	678	1260	570	336	195	456	774	906	1449	570	597	483	327
Michelia doltsopa	714	318	549	1332	456	852	471	255	2811	357	471	939	876	0	735	420	261	690	237	453	387	678	1260	414	405	216	456	774	906	1254	570	597	822	447
Michelia lacei	711	324	549	1332	456	804	444	255	2820	357	471	939	876	588	855	420	261	690	237	453	387	678	1260	576	405	216	456	774	906	1452	570	597	822	327
Michelia salicifolia	714	324	549	1332	459	852	471	255	2814	345	483	939	876	0	738	420	261	675	237	453	387	678	1035	408	327	216	366	702	906	1449	570	597	789	297
Michelia martini	711	324	549	1338	459	852	408	255	2811	345	477	939	882	0	735	420	261	693	237	453	387	678	1035	453	405	216	366	768	906	1512	657	534	822	375
Michelia coriacea	711	324	549	1332	459	852	471	111	2811	345	483	939	882	0	726	420	261	693	234	405	387	678	1260	450	405	216	456	774	906	1446	570	597	921	327
Michelia ingrata	711	318	549	1335	456	852	471	255	2811	345	483	939	882	0	735	420	261	693	237	453	387	678	1260	576	405	216	456	774	906	1446	513	597	825	378
Michelia wilsonii	714	324	549	1335	459	852	471	255	2811	345	471	939	882	672	735	420	261	693	234	453	387	678	1260	453	405	216	456	774	906	1446	513	597	978	465
Michelia floribunda	669	318	552	1998	138	852	444	255	2811	345	483	939	882	0	735	420	261	693	237	453	387	678	1260	447	405	204	456	774	906	1449	570	597	822	327
Michelia chapensis	711	318	549	1335	321	852	471	258	2811	345	483	939	879	387	735	420	207	693	237	453	387	675	1260	573	405	216	456	774	906	1446	570	573	822	324
Michelia chapensis	711	318	549	1335	456	804	471	108	2811	336	483	939	882	0	855	420	255	693	237	453	387	678	1260	453	405	216	456	774	906	1449	570	597	822	375
Michelia hypolampra	711	324	549	1131	132	804	471	117	2811	345	483	939	882	303	642	420	261	693	237	453	387	678	1260	435	378	216	366	777	906	1524	651	597	822	375
Michelia viridipetala	594	324	549	1167	459	846	471	147	2811	345	483	939	765	0	735	417	255	693	237	453	390	678	1257	414	405	216	366	771	906	1446	567	534	771	327
Michelia balansae	711	324	549	1332	138	804	471	222	2808	309	483	939	882	384	852	417	255	693	237	453	390	678	1254	576	414	216	456	774	906	1452	564	597	822	327
Michelia guangxiensis	711	324	549	1338	459	852	471	123	2799	345	483	939	882	0	735	225	255	696	237	453	393	678	1155	576	357	216	456	774	906	1344	564	597	825	324
Michelia figo	708	324	549	1338	459	837	471	198	2799	345	483	939	882	567	708	414	261	696	237	453	393	678	930	576	291	216	366	774	906	1446	570	597	759	324
Michelia shiluensis	711	324	549	1338	459	804	471	123	2811	345	483	939	882	0	735	420	261	696	237	453	393	678	1260	576	405	216	456	774	906	1059	570	534	822	375
Michelia odora	711	324	549	1335	138	801	471	255	2814	345	480	939	882	0	735	420	264	696	237	453	393	678	1260	444	312	216	456	774	906	1446	570	597	819	327
Michelia montana	708	324	549	1335	459	852	471	255	2808	309	483	939	876	567	642	420	261	696	237	453	393	678	1260	414	726	216	456	768	906	1449	570	597	768	375
Elmerrillia ovalis	711	324	549	1338	459	804	471	153	2814	348	483	939	882	0	855	417	207	693	234	453	393	678	1005	387	405	213	456	702	906	1449	570	594	771	327
Michelia compressa	684	324	549	1338	459	849	471	198	2811	345	483	939	768	0	852	420	258	696	237	453	390	678	1254	414	405	216	456	702	906	1446	570	597	894	405
Michelia macclurei	711	324	549	1335	459	804	471	255	2814	345	483	939	882	0	735	225	267	696	129	453	393	678	1026	453	405	216	456	774	906	1305	570	597	810	324
Michelia guangdongensis	627	324	549	1335	459	804	471	108	2805	345	483	939	768	153	735	420	267	696	237	444	393	678	1155	453	405	216	456	774	906	1044	570	525	819	324
Michelia maudiae	711	324	549	1335	459	804	471	123	2811	336	483	939	768	0	792	414	216	696	237	453	468	561	930	375	192	216	456	774	906	1449	570	597	477	375
Michelia foveolata	711	318	549	1335	462	804	471	108	2805	345	483	939	762	0	738	414	264	693	237	453	381	561	930	453	381	216	456	774	906	1446	570	597	819	375
Michelia cavaleriei	711	324	549	1335	459	852	471	258	2811	345	480	939	882	645	735	414	267	693	237	453	390	678	1029	453	414	216	456	774	906	1449	570	597	822	453
Magnolia elegans	642	324	549	1311	459	852	468	255	2811	309	483	939	768	0	735	489	261	684	237	453	393	678	1254	531	327	216	450	702	906	1452	465	597	813	324
Magnolia borneensis	123	0	216	108	243	345	117	147	1596	0	306	270	0	0	381	186	222	222	153	342	132	105	219	171	279	0	111	0	573	531	246	411	141	198
Magnolia carsonii	648	324	549	1092	459	855	387	117	2811	351	483	939	882	0	873	489	249	684	234	453	393	678	1149	549	405	216	456	981	906	1452	537	597	849	324
Magnolia cathcartii	603	324	549	1281	138	804	471	255	2811	351	330	939	882	378	735	489	207	684	237	453	393	675	1254	576	357	216	456	771	906	1443	531	597	771	324
Magnolia zenii	681	324	294	1332	459	852	471	255	2817	375	483	939	762	390	735	486	255	696	240	453	393	678	1044	552	405	216	456	735	906	1446	420	597	837	321
Magnolia biondii	597	324	354	1008	135	309	465	255	2814	360	483	939	621	390	642	420	258	522	240	453	372	570	903	549	363	216	366	372	906	1083	573	534	447	324
Magnolia amoena	681	324	549	1332	138	852	471	255	2814	360	474	939	882	0	735	486	258	696	240	453	393	678	1260	579	405	216	456	774	906	1452	573	597	930	366
Magnolia sinostellata	525	324	549	1137	459	852	471	255	2811	360	483	939	882	0	735	486	258	696	240	453	393	678	1260	579	405	216	456	774	906	1452	516	597	831	498
Magnolia stellata	591	324	549	1335	459	852	474	255	2811	360	480	939	879	390	735	486	267	696	240	453	393	678	1260	573	447	216	456	774	906	1452	573	597	831	408
Magnolia kobus	588	324	549	1335	459	852	471	255	2811	375	483	939	879	354	735	486	267	696	240	453	393	678	1266	579	363	216	456	774	906	1452	573	597	831	318
Magnolia salicifolia	618	324	294	1335	459	852	471	255	2811	360	483	939	768	0	735	486	267	696	240	453	393	678	1260	579	282	216	456	735	906	1323	570	597	831	456
Magnolia denudata	663	324	294	1329	450	852	471	255	2814	360	483	939	882	0	735	486	261	696	240	453	393	678	1044	549	405	216	456	774	906	1449	570	597	564	324
Magnolia cylindrica	678	300	549	1332	453	804	387	156	2814	357	483	939	768	0	735	486	261	696	240	453	393	570	1044	579	258	216	456	585	906	1305	573	597	675	324
Magnolia liliiflora	672	324	480	1167	459	780	471	255	2814	360	483	939	768	0	735	420	261	696	240	453	393	678	1158	564	405	216	366	774	906	1305	573	597	786	324
Magnolia sprengeri	597	324	549	1329	456	804	471	255	2814	360	474	939	768	0	735	294	261	696	240	453	393	678	1260	507	405	216	360	702	906	1455	570	534	831	324
Magnolia sargentiana	618	318	549	1332	456	852	471	255	3030	360	483	939	768	0	735	489	228	696	237	453	393	678	1092	414	363	216	456	774	906	1449	567	534	831	324
Magnolia campbellii	663	318	549	1332	459	852	471	255	2862	360	483	939	882	0	642	423	261	522	240	453	393	678	1260	579	399	216	456	978	906	1452	459	597	831	189
Magnolia dawsoniana	528	324	549	1332	459	852	471	108	2814	360	474	939	882	0	735	486	231	522	240	453	348	678	1362	579	213	216	456	774	906	1302	567	534	831	324

Magnolia acuminata var. subcordata	684	324	276	1335	459	852	459	258	2811	360	483	939	882	0	735	489	264	696	240	459	387	678	1152	567	267	216	456	702	906	1281	570	591	828	324
Magnolia acuminata	684	324	531	1335	426	852	447	255	2811	360	483	939	882	0	642	489	264	684	240	453	387	678	654	576	405	216	366	774	906	1299	570	591	828	324
Kmeria duperreana	684	318	549	1323	459	843	468	255	2823	303	483	936	870	0	774	420	243	690	240	459	393	678	1263	576	405	216	456	813	906	1452	567	597	825	264
Kmeria septentrionalis	684	318	549	1323	459	852	468	108	2820	303	417	855	768	0	735	420	243	690	240	459	393	678	1263	573	405	216	456	624	906	1446	567	597	711	312
Magnolia nitida var. *lotungensis*	840	324	549	1332	321	852	471	255	2808	357	483	939	768	0	735	489	261	690	240	453	390	678	1263	414	405	216	456	972	906	1155	477	597	822	324
Pachylarnax praecalva	0	0	0	0	0	0	0	0	669	0	0	0	0	0	72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105	0	0	327	0
Magnolia kachirachirai	840	318	549	1332	459	852	471	108	2805	369	483	939	882	0	735	489	252	693	240	453	387	561	1260	447	405	216	456	774	906	324	402	597	825	321
Magnolia sinica	795	324	549	1332	138	852	471	108	2814	360	483	939	882	0	474	489	252	693	240	453	390	675	1263	411	405	216	366	759	906	1293	513	597	921	432
Magnolia nitida	606	324	549	1170	459	852	471	255	2811	360	483	936	765	0	471	489	261	693	240	453	345	678	936	414	405	216	456	990	906	1479	477	534	825	312
Magnolia poasana	714	324	549	1212	459	852	471	255	2820	372	480	939	879	0	735	417	252	693	240	453	393	678	1254	552	306	216	456	546	909	1137	513	594	927	324
Magnolia panamensis	687	324	549	1212	459	852	471	255	2820	372	480	939	879	0	735	417	252	693	240	453	393	678	1254	552	405	216	456	546	909	1140	513	594	897	435
Magnolia sharpii	786	324	549	1209	459	852	471	255	2817	372	480	939	879	0	735	417	252	693	240	453	393	678	1257	573	405	219	456	615	906	1137	513	594	987	366
Magnolia guatemalensis	714	324	294	1212	138	852	468	255	2820	369	480	939	879	0	741	417	252	693	240	453	393	663	1257	573	414	219	456	825	909	1392	495	594	1008	363
Magnolia iltisiana	714	324	549	1209	459	852	471	147	2814	372	480	855	879	0	726	417	252	693	240	453	393	678	1257	576	414	219	456	618	909	1200	513	594	798	324
Magnolia grandiflora	594	324	549	1212	459	852	471	255	2817	372	480	939	882	384	735	483	252	690	240	453	390	678	1257	576	435	216	456	573	906	1134	513	594	897	324
Magnolia striatifolia	714	324	534	1212	138	852	471	258	2814	372	480	939	882	0	735	417	252	693	240	441	390	678	1257	549	192	216	456	825	906	1446	513	597	708	324
Magnolia schiedeana	714	324	549	1047	459	852	471	255	2814	372	480	939	882	0	735	417	252	693	240	453	393	678	1044	576	336	216	456	609	906	1368	510	594	897	324
Magnolia tamaulipana	669	324	549	1134	321	852	471	123	2817	366	480	930	768	0	834	417	252	693	240	453	393	561	1257	93	351	216	366	534	906	1161	513	597	684	324
Magnolia virginiana	702	324	549	1332	456	801	471	108	2817	372	483	939	855	387	732	489	252	693	240	453	390	678	1161	549	396	216	366	777	906	1296	513	534	798	324
Magnolia macrophylla	684	324	546	1263	459	852	471	255	2814	303	483	939	879	0	702	489	258	693	240	459	393	678	1260	582	405	216	366	708	906	1446	513	534	774	372
Magnolia macrophylla var. *ashei*	594	324	546	1263	459	852	489	147	2814	303	483	939	765	387	735	489	258	693	240	459	393	678	1260	576	405	216	456	774	906	1446	513	597	798	399
Magnolia dealbata	684	324	291	1263	459	852	345	147	2814	309	483	939	879	0	735	489	258	693	240	459	393	678	1260	579	405	216	456	981	906	1446	468	597	687	324
Magnolia championii	693	324	549	1335	459	852	471	255	2778	255	483	939	882	0	738	489	261	696	237	459	393	675	1314	414	405	216	456	774	906	1290	516	597	636	324
Magnolia coco	693	324	549	1335	459	852	447	255	2778	255	483	939	768	0	735	489	261	696	237	459	393	675	1254	108	192	216	456	702	906	1404	288	597	795	324
Magnolia phanerophlebia	684	324	549	1335	459	852	471	255	2775	258	468	939	882	0	735	489	261	693	237	459	393	678	1254	576	336	216	456	771	906	1272	390	531	816	417
Magnolia pterocarpa	684	324	480	1335	459	849	471	123	2808	258	468	939	768	0	735	423	225	693	237	234	396	678	936	555	405	216	456	774	906	1266	444	534	915	0
Magnolia hodgsonii	684	324	276	1335	459	852	471	255	2811	258	468	939	882	0	732	423	258	693	237	459	396	678	1149	516	408	216	456	774	906	1443	351	597	750	324
Magnolia henryi	684	318	549	1332	459	852	471	141	2808	258	468	939	768	0	735	423	261	696	237	459	393	675	1260	576	411	216	456	702	906	1398	408	597	654	324
Magnolia albosericea	639	324	276	1335	321	852	336	147	2808	258	468	939	588	0	735	489	261	693	240	459	378	672	1041	576	405	216	366	702	906	1257	330	597	726	324
Magnolia liliifera	693	324	549	1320	456	849	471	111	2811	258	468	888	768	0	657	423	261	696	240	459	396	678	1251	546	405	216	456	774	906	1290	291	534	897	171
Magnolia delavayi	684	324	549	1335	459	852	471	228	2814	258	483	936	867	405	534	489	261	696	240	459	393	672	1260	576	432	216	456	774	906	1308	477	597	828	381
Magnolia pastazaensis	669	324	294	1335	321	849	312	93	2811	357	483	939	768	0	735	483	258	693	240	459	393	681	1155	522	405	216	456	696	906	1446	513	534	819	324
Magnolia equatorialis	510	324	549	1335	459	498	312	0	2811	357	483	939	882	0	732	483	258	693	240	459	393	681	1155	111	363	216	456	696	906	1152	570	597	930	324
Magnolia ovata	714	324	294	1335	459	852	321	108	2811	357	483	939	882	0	735	483	258	693	240	459	393	681	1122	207	249	216	456	696	906	1452	570	597	924	318
Magnolia dodecapetala	714	324	549	1332	135	852	606	255	2811	357	483	939	882	249	732	483	258	693	240	459	393	681	1143	522	405	216	456	771	906	1446	570	597	930	381
Magnolia kichuana	714	324	549	1314	459	852	498	240	2811	357	483	939	882	0	735	483	258	663	240	459	393	681	1122	561	363	216	456	696	906	1449	570	597	930	318
Magnolia zamorana	714	318	549	1335	459	852	498	147	2811	357	483	939	768	276	735	483	258	693	240	459	393	681	1122	519	354	216	456	765	906	1305	513	534	927	363
Magnolia mercedesiarum	714	324	294	1335	456	852	387	255	2811	357	483	939	882	0	735	483	258	693	240	459	393	681	1227	594	207	216	456	768	906	1449	570	594	831	360
Magnolia mindoensis	714	324	549	1335	459	852	321	240	2811	357	483	939	882	387	735	483	231	693	240	459	393	681	1122	576	318	216	456	771	906	1449	510	597	930	366
Magnolia mexicana	684	324	549	1341	459	852	498	255	2814	294	483	939	882	0	279	489	261	633	240	459	393	681	1143	522	405	216	366	771	906	1446	570	597	831	417
Manglietia conifera	636	318	294	1332	459	843	447	255	2808	360	477	939	765	0	735	402	225	669	237	459	381	636	1257	564	405	216	456	777	906	1452	510	504	798	324
Manglietia insignis	636	318	549	1332	459	843	447	255	2808	360	477	939	765	450	735	402	225	669	237	459	381	636	1257	573	405	216	456	777	906	1452	570	441	939	324
Manglietia duclouxii	636	318	549	1329	459	843	519	147	2817	351	483	939	765	0	735	402	225	696	237	459	384	525	1257	552	414	216	456	807	906	1158	417	504	801	324
Manglietia hookeri	681	318	549	1356	138	750	471	255	2826	360	483	939	882	369	735	402	225	669	237	459	384	636	1044	573	405	216	456	807	906	1161	510	591	798	324
Manglietia aromatica	567	318	549	1329	459	498	459	132	2832	357	483	939	735	0	735	402	252	669	237	459	381	525	1026	576	405	216	456	774	906	1452	510	441	933	324
Manglietia lucida	681	318	549	1332	459	852	471	255	2826	360	480	939	882	0	735	468	252	669	237	459	384	678	1260	576	597	216	456	780	906	1446	510	441	798	420
Manglietia grandis	681	318	549	1332	459	852	471	210	2817	360	483	939	765	0	735	402	252	669	237	459	381	678	1257	573	405	216	456	777	906	1158	570	591	939	324
Manglietia megaphylla	528	318	549	1332	321	852	471	255	2811	360	477	939	882	0	735	468	252	669	237	459	381	636	1155	573	405	216	456	699	906	1449	510	504	645	315
Manglietia rufibarbata	681	318	549	1332	459	852	471	177	2811	360	483	939	765	0	735	468	252	666	237	459	381	678	1257	570	405	216	456	777	906	1449	570	441	792	324
Manglietia ventii	681	318	549	1215	459	852	471	252	2826	360	429	939	882	0	741	468	141	669	234	459	381	636	1257	414	411	216	456	705	906	1008	510	504	792	324
Manglietia ovoidea	681	318	294	1167	459	852	438	255	2817	357	477	939	765	0	735	402	252	669	237	459	381	636	1257	576	405	216	456	759	906	1452	510	504	636	324
Manglietia kwangtungensis	681	318	549	1329	321	852	471	255	2817	360	483	939	882	357	735	468	252	669	237	459	384	678	1254	564	405	216	456	771	906	1452	510	504	933	324
Manglietia szechuanica	588	318	549	1329	459	852	471	255	2826	360	483	939	879	0	735	402	225	669	237	459	381	636	1254	576	597	216	456	777	906	1305	507	534	939	378
Manglietia pachyphylla	681	318	549	1311	459	852	471	147	2826	360	483	939	882	0	735	468	249	696	237	459	384	678	1257	576	405	216	456	807	906	1452	417	591	792	324
Manglietia fordiana	666	318	549	1311	456	852	465	255	2832	360	483	939	765	0	735	402	252	696	237	459	384	678	1257	576	405	216	456	774	906	1452	417	591	792	324
Manglietia glauca	681	318	546	1329	459	852	657	255	2826	360	483	939	882	0	735	402	252	543	237	435	384	675	1023	573	405	216	456	951	906	1452	417	588	678	324
Manglietia utilis	792	318	549	1329	459	804	471	117	2823	360	495	939	765	0	717	465	252	696	237	459	384	672	1176	561	405	216	456	708	906	1452	468	591	687	324
Manglietia caveana	720	270	294	1332	459	852	519	255	2817	360	483	939	765	0	735	366	225	696	237	459	381	678	1047	561	390	216	456	978	906	1452	417	504	687	324
Manglietia garrettii	636	318	549	1329	459	750	471	255	2817	360	483	939	765	288	735	402	252	669	237	459	381	678	1251	579	405	216	456	777	906	1452	468	591	798	213
Manglietia decidua	681	318	549	1323	321	852	471	255	2820	360	477	939	882	387	735	558	252	696	237	459	384	678	1257	576	405	213	456	774	906	1359	513	528	798	423
Magnolia obovata	684	318	543	1332	459	852	471	108	2814	360	483	939	714	0	732	489	216	693	237	459	384	669	1155	411	405	216	456	765	900	1446	417	597	582	402
Magnolia officinalis	684	318	549	1332	138	852	459	99	2814	360	0	939	891	0	735	489	216	633	237	459	384	669	1029	411	324	216	366	720	900	1392	513	597	528	309
Magnolia tripetala	786	318	549	1329	321	852	471	66	2814	360	483	939	843	345	735	489	231	693	237	459	384	669	1155	564	405	216	456	777	900	1455	570	597	639	360
Magnolia wilsonii	480	318	549	1332	459	498	312	108	2817	405	489	939	765	0	735	258	231	696	0	459	384	678	1221	444	396	216	366	681	906	1014	417	534	684	240
Magnolia globosa	789	318	549	1332	138	852	471	255	2820	405	483	939	765	0	735	423	231	696	240	459	384	678	1149	567	192	216	456	762	906	1452	570	597	798	324

Magnolia sieboldii	696	318	549	1323	459	801	471	117	2814	345	483	939	768	0	735	489	231	696	240	459	384	678	1254	573	405	216	366	807	906	1305	513	597	798	315
Magnolia sieboldii subsp. *sinensis*	648	318	549	1323	459	849	471	192	2814	345	483	939	882	0	735	489	231	696	240	459	384	678	1254	564	411	216	456	777	906	1449	513	597	798	324
Magnolia fraseri	684	318	549	1332	456	852	471	255	2814	372	483	939	885	0	735	489	261	696	234	459	573	657	1257	453	405	216	456	780	906	1452	510	597	828	318
Magnolia fraseri var. *pyrimidata*	684	318	549	1332	453	852	471	255	2811	360	483	939	768	0	735	489	261	696	234	459	390	657	1257	441	405	216	456	777	906	1452	552	597	1035	318
Magnolia splendens	684	318	549	1332	138	852	447	108	2811	357	450	939	882	0	735	423	216	690	240	459	393	672	1257	576	411	216	366	708	906	1446	519	534	798	318
Magnolia portoricensis	684	318	549	1332	459	852	447	240	2811	357	450	939	768	0	735	423	216	690	240	459	393	672	1257	576	405	216	456	699	906	1446	561	534	798	360
Magnolia cubensis	684	318	549	1332	90	852	447	243	3051	360	450	939	879	240	735	423	216	693	234	459	390	672	1254	411	606	216	456	984	906	1449	423	597	861	333
Magnolia bankardiorum	684	318	549	1332	459	852	471	255	2811	360	450	939	768	387	735	423	216	693	240	459	393	672	1263	504	405	216	456	669	906	1446	519	597	894	318
Liriodendron chinense	492	303	435	273	345	762	411	0	2373	405	396	855	762	0	657	420	0	693	231	459	390	363	1362	408	0	153	366	546	906	0	420	588	930	0
Liriodendron tulipifera X *Liriodendron chinense*	492	276	354	276	345	726	447	0	2376	414	381	939	762	0	621	225	0	402	231	459	390	360	843	408	0	153	453	663	906	108	420	588	834	0
Liriodendron tulipifera	492	303	435	258	459	726	411	0	2370	408	417	939	762	0	699	423	0	579	231	459	390	516	1161	408	0	153	453	720	906	108	420	588	651	0
Ave.	665	315	507	1265	398	815	454	196	2779	341	467	924	820	103	718	434	241	671	233	449	385	649	1168	505	375	211	434	742	896	1320	512	568	793	326

Appendix 29. (Continued)

Taxon name	MKT351705_1_4MKT351865_1_4MKT354514_1_4MKT355030_1_4MKT355367_1_4MKT355607_1_4MKT358915_1_4MKT359853_1_4MKT362323_1_4MKT362454_1_4MKT363600_1_4MKT370789_1_4											
Length of the reference for each loci	1206	1110	648	1062	474	1401	1626	669	660	423	531	402
Magnolia griffithii	723	1098	630	1008	393	1398	1326	669	660	420	441	402
Michelia baillonii	714	1110	630	1011	393	1395	1596	669	660	420	441	402
Michelia sirindhorniae	900	1110	537	1059	477	1398	1104	669	660	423	438	402
Michelia velutina	822	1110	630	1062	393	1398	1512	669	639	423	441	396
Michelia masticata	960	1110	630	1008	477	1401	1626	669	825	423	441	402
Michelia sphaerantha	1155	1110	630	1005	477	1401	1599	669	663	423	441	402
Michelia doltsopa	972	1110	624	1008	426	1416	1623	669	768	423	441	402
Michelia lacei	972	1110	624	1008	393	1401	1626	669	768	423	441	402
Michelia salicifolia	1008	1110	624	1011	393	1404	1494	669	768	423	441	402
Michelia martini	825	1110	627	1008	393	1401	1626	669	657	423	441	399
Michelia coriacea	1155	1110	564	1011	477	1401	1623	669	657	423	438	435
Michelia ingrata	957	1110	624	1011	465	1389	1629	669	594	423	441	402
Michelia wilsonii	825	1110	564	1011	465	1389	1626	669	660	423	441	402
Michelia floribunda	1152	1110	627	1011	477	1398	1488	669	660	423	441	402
Michelia chapensis	825	1110	630	969	477	1509	1626	669	999	423	441	402
Michelia chapensis	1011	1110	630	969	303	1401	1110	669	660	423	441	402
Michelia hypolampra	1011	1080	564	1011	291	1401	1629	669	1014	423	441	399
Michelia viridipetala	1152	1110	630	1011	393	1395	1629	669	1005	423	441	402
Michelia balansae	1152	1107	564	1011	477	1398	1626	669	660	423	444	402
Michelia guangxiensis	909	1110	630	1011	393	1395	1626	669	660	423	441	402
Michelia figo	612	1110	564	1011	393	1398	1599	669	660	423	441	402
Michelia shiluensis	1212	1110	564	1011	393	1395	1578	669	1005	417	441	402
Michelia odora	957	1110	564	1011	390	1392	1623	669	816	423	441	402
Michelia montana	906	1110	627	1011	390	1392	1626	669	816	423	441	402
Elmerrillia ovalis	1011	1026	624	1008	300	1386	1455	669	669	423	441	399
Michelia compressa	771	1110	627	1011	393	1398	1626	654	660	423	441	402
Michelia macclurei	774	1110	627	1011	393	1401	1629	669	657	423	441	402
Michelia guangdongensis	1011	1110	627	1011	393	1356	1479	669	660	426	441	390
Michelia maudiae	1203	1098	570	1011	393	1380	1626	669	1008	423	441	402
Michelia foveolata	1011	1110	630	1011	393	1401	1626	669	660	423	441	399
Michelia cavaleriei	1155	1110	600	1011	435	1401	1317	669	660	423	441	402
Magnolia elegans	1203	1110	630	1005	306	1371	1509	666	921	423	441	411
Magnolia borneensis	489	1041	312	297	123	243	738	186	810	0	207	252
Magnolia carsonii	1203	1110	630	1014	396	1401	1164	669	447	423	438	399
Magnolia cathcartii	1203	1110	630	1014	288	1401	1422	669	657	423	441	405
Magnolia zenii	1206	1110	630	1011	471	1398	1509	669	660	423	444	402
Magnolia biondii	1206	1110	612	1011	387	849	1128	669	660	423	444	399
Magnolia amoena	933	1110	612	1011	477	1398	1626	669	660	423	444	402

Magnolia sinostellata	1206	1110	630	1011	471	1401	1626	669	660	423	444	399
Magnolia stellata	975	1110	630	1011	474	1401	1599	669	660	423	522	402
Magnolia kobus	1206	1110	630	1011	387	1401	1626	669	660	423	441	402
Magnolia salicifolia	1206	1110	591	1011	393	1401	1626	669	657	423	444	402
Magnolia denudata	1338	1110	630	1011	423	1401	1488	669	657	423	318	402
Magnolia cylindrica	1203	1110	630	1011	471	1401	1509	669	657	423	228	399
Magnolia liliiflora	1320	1110	636	1011	474	1401	1626	669	660	423	519	399
Magnolia sprengeri	843	1110	630	1011	471	1398	1623	669	657	423	381	402
Magnolia sargentiana	774	1110	630	1005	378	1395	1626	669	657	264	444	339
Magnolia campbellii	1014	1110	627	1011	687	1395	1629	669	660	264	444	336
Magnolia dawsoniana	552	1110	627	1011	471	1398	1407	669	657	264	444	339
Magnolia acuminata var. *subcordata*	774	1110	627	1011	465	1401	1317	669	738	264	444	399
Magnolia acuminata	594	1110	630	1011	465	1404	1602	669	756	423	444	399
Kmeria duperreana	1008	1110	567	1011	393	1398	1629	669	657	420	216	381
Kmeria septentrionalis	1008	1110	582	1011	393	1398	1629	669	657	420	444	381
Magnolia nitida var. *lotungensis*	1200	1110	642	1011	390	1398	1515	669	666	420	444	405
Pachylarnax praecalva	123	0	0	171	0	120	225	0	0	0	0	0
Magnolia kachirachirai	1203	1104	624	1002	477	1398	1620	669	663	420	444	405
Magnolia sinica	1200	1110	624	1011	474	1401	1611	669	666	420	444	405
Magnolia nitida	1011	1110	603	1011	474	1401	1512	669	675	420	204	405
Magnolia poasana	1047	1074	549	1011	282	1398	1626	669	744	423	444	402
Magnolia panamensis	699	1110	549	1011	282	1401	1317	669	663	423	444	402
Magnolia sharpii	999	1110	624	1011	282	1401	1629	669	663	423	444	402
Magnolia guatemalensis	771	1110	624	1008	282	1401	1422	669	666	423	444	402
Magnolia iltisiana	681	1110	621	1011	555	1404	1419	669	663	420	444	402
Magnolia grandiflora	702	1113	627	1011	414	1401	1626	669	666	411	444	402
Magnolia striatifolia	702	1113	624	1011	465	1398	1626	603	657	411	444	402
Magnolia schiedeana	699	1110	624	1011	465	1401	1620	669	660	423	444	402
Magnolia tamaulipana	741	1113	627	1011	465	1401	1620	669	663	423	444	396
Magnolia virginiana	462	1110	549	1011	471	1398	1422	669	666	423	444	399
Magnolia macrophylla	918	1110	630	1008	303	1398	1659	669	750	423	519	402
Magnolia macrophylla var. *ashei*	918	1110	630	1008	303	1398	1623	669	726	423	444	402
Magnolia dealbata	774	1110	630	1008	303	1398	1620	669	726	423	444	402
Magnolia championii	1212	1113	642	1011	315	1395	1590	666	669	414	498	402
Magnolia coco	891	1110	627	1011	189	1395	1593	666	660	414	441	402
Magnolia phanerophlebia	1203	1113	630	1011	303	1398	1620	666	567	414	444	405
Magnolia pterocarpa	792	1110	624	1011	393	1398	1599	669	822	420	441	405
Magnolia hodgsonii	774	1110	630	735	393	1398	1617	666	675	420	441	405
Magnolia henryi	774	1110	630	987	393	1398	1620	666	660	420	441	402
Magnolia albosericea	870	1113	630	987	270	1398	1584	666	669	414	444	402
Magnolia liliifera	1203	1110	630	1008	300	1401	1425	120	666	420	441	405
Magnolia delavayi	774	1113	624	1011	303	1395	1632	666	669	420	444	405
Magnolia pastazaensis	996	1104	627	1008	390	1398	1590	669	675	420	444	402
Magnolia equatorialis	1098	1107	627	1008	330	1398	1314	333	744	420	444	402
Magnolia ovata	1014	1107	627	1008	390	1395	1626	669	669	420	444	402
Magnolia dodecapetala	939	1107	639	1008	390	1398	1305	669	843	417	444	402
Magnolia kichuana	1215	1107	627	1008	390	1401	1608	669	675	420	444	402
Magnolia zamorana	1197	1107	627	1008	582	1398	1629	669	843	420	444	405
Magnolia mercedesiarum	1215	1104	561	1008	390	1398	1317	669	849	420	444	402
Magnolia mindoensis	942	1104	627	1008	390	1398	1446	669	651	420	444	402
Magnolia mexicana	774	1047	561	1008	390	1398	1560	669	864	417	444	399
Manglietia conifera	1011	1098	582	1011	471	1404	1626	669	657	420	444	396
Manglietia insignis	888	1098	582	1011	471	1404	1599	669	657	420	444	396
Manglietia duclouxii	1203	1098	582	1011	471	1404	1689	669	660	420	444	402
Manglietia hookeri	240	1107	582	1011	477	1407	1626	669	660	420	444	405
Manglietia aromatica	771	1098	576	1008	336	1404	1428	666	657	420	444	396
Manglietia lucida	927	1110	576	1011	480	1404	1626	669	669	420	444	402
Manglietia grandis	1011	1107	579	1011	474	1407	1626	669	660	420	444	396
Manglietia megaphylla	1008	1098	579	1011	480	1404	1623	669	660	420	444	405
Manglietia ruflbarbata	789	1098	579	1011	480	1404	1317	669	660	420	444	405
Manglietia ventii	1011	1110	582	1011	486	1404	1509	669	657	420	444	402
Manglietia ovoidea	768	1110	579	990	471	1458	1686	669	660	420	456	402
Manglietia kwangtungensis	1143	1110	579	1011	474	1404	1599	669	660	420	456	405
Manglietia szechuanica	906	1110	582	1011	477	1404	1626	666	660	420	444	399
Manglietia pachyphylla	1011	1110	561	1005	468	1395	1626	669	1005	420	444	402
Manglietia fordiana	915	1110	582	1011	468	1407	1491	669	660	420	453	402
Manglietia glauca	789	1098	582	1011	468	1407	1599	669	660	420	435	393
Manglietia utilis	1203	1110	582	1011	477	1404	1626	669	657	420	444	405
Manglietia caveana	771	1098	582	1011	477	1404	1512	669	1005	420	444	405

Manglietia garrettii	1206	1098	582	1011	468	1404	1629	669	660	417	444	405
Manglietia decidua	903	1110	582	1011	468	1398	1629	669	657	426	444	402
Magnolia obovata	1014	1089	642	1005	393	1278	1518	669	657	420	438	375
Magnolia officinalis	1014	1110	642	1017	477	1395	1584	723	660	420	438	405
Magnolia tripetala	930	1110	498	1011	360	1395	1629	669	657	474	438	399
Magnolia wilsonii	759	1110	915	1011	471	1200	1602	669	657	420	444	408
Magnolia globosa	984	1110	582	1011	471	1401	1629	669	1014	420	444	405
Magnolia sieboldii	1002	1110	585	1011	471	1398	1629	669	1014	420	441	381
Magnolia sieboldii subsp. *sinensis*	1002	1110	585	1011	471	1398	1629	669	666	420	441	381
Magnolia fraseri	1206	1110	627	1011	480	1404	1596	669	675	420	444	402
Magnolia fraseri var. *pyrimidata*	927	1110	627	1011	480	1404	1623	666	699	420	444	402
Magnolia splendens	990	1113	630	1011	387	1401	1626	669	663	423	444	402
Magnolia portoricensis	552	1113	642	1011	471	1401	1626	669	660	423	444	402
Magnolia cubensis	636	1113	630	1011	474	1350	1314	666	663	498	444	402
Magnolia bankardiorum	1188	1110	627	1011	477	1401	1620	669	654	423	423	402
Liriodendron chinense	240	1065	600	957	369	912	1308	525	0	417	417	120
Liriodendron tulipifera X *Liriodendron chinense*	237	1017	471	1017	369	816	1143	525	0	417	318	0
Liriodendron tulipifera	240	1038	597	1011	369	789	1596	525	0	420	318	252
Ave.	931	1096	602	995	412	1360	1531	649	684	410	430	389

Appendix 30. Information and statistics of the 400 nuclear supercontigs (including exon and intron) used in the phylogenetic analyses out of 504 targeted genes in this study. The list was arranged in decreasing order of the number of quartets shared with the concatenated ML tree estimated from each gene tree.

Alignment_name	No_of_quartets resolved identically	Percentage_of_quartets resolved identically	start (in concatenated supermatrix)	end	Arabidopsis_ID	Description	No of taxa	Alignment length	Total matrix cells	Undetermined characters	Missing percent	No variable sites	Proportion variable sites	Parsimony informatin sites	Proportion parsimony informative	AT content	GC content	A	C	G	T	-	?
supermatirx	9691375	1.00	1	765376	N/A	N/A	125	765376	95672000	9743128	10.184	321537	0.42	186094	0.243	0.583	0.417	23151394	16851233	18955784	26970461	9743128	0
MKT001844_1_4_APOV	6834394	0.71	1	3247	AT2G48120.2	pale cress protein (PAC)	124	3247	402628	17881	4.441	1563	0.481	904	0.278	0.569	0.431	98219	80174	85434	120920	17881	0
MKT002001_1_4_APOV	6509323	0.67	3248	5685	AT4G09010.2	ascorbate peroxidase 4	124	2438	302312	19914	6.587	1108	0.454	604	0.248	0.587	0.413	81780	54907	61626	84085	19914	0
MKT004737_1_4	1799048	0.19	5686	6968	AT3G05850.1	MuDR family transposase	123	1283	157809	18410	11.666	849	0.662	583	0.454	0.565	0.435	38257	26504	34161	40477	18410	0
MKT004964_1_4	2374827	0.25	6969	7545	AT3G19615.1	beta-1, 4-xylosidase	125	577	72125	3942	5.466	259	0.449	142	0.246	0.599	0.401	22629	12534	14757	18263	3942	0
MKT005032_1_4	5892909	0.61	7546	8520	AT2G20635.1	protein kinase and Mad3-BUB1-I domain-containing protein	124	975	120900	9069	7.501	411	0.422	219	0.225	0.603	0.397	33980	23204	21213	33434	9069	0
MKT005035_1_4_APOV	5944449	0.61	8521	10575	AT2G20635.1	protein kinase and Mad3-BUB1-I domain-containing protein	124	2055	254820	15215	5.971	912	0.444	493	0.24	0.559	0.441	58566	56057	49548	75434	15215	0
MKT006060_1_4_APOV	5682849	0.59	10576	13623	AT1G49380.1	cytochrome c biogenesis protein family	124	3048	377952	26256	6.947	1276	0.419	767	0.252	0.58	0.42	90792	72447	75243	113214	26256	0
MKT008026_1_4_APOV	7311508	0.75	13624	16783	AT3G56040.1	UDP-glucose pyrophosphorylase 3	124	3160	391840	16649	4.249	1149	0.364	705	0.223	0.611	0.389	100224	63193	82639	129135	16649	0
MKT012393_1_4_APOV	4222532	0.44	16784	20588	AT3G13940.1	DNA binding / DNA-directed RNA polymerase	125	3805	475625	33586	7.061	1600	0.42	909	0.239	0.593	0.407	124075	81311	98636	138017	33586	0
MKT012543_1_4	1415408	0.15	20589	21029	AT4G29570.1	Cytidine/deoxycytidylate deaminase family protein	95	441	41895	4806	11.472	334	0.757	210	0.476	0.574	0.426	10220	7864	7897	11108	4806	0
MKT012837_1_4_APOV	3901793	0.40	21030	22766	AT5G10920.1	L-Aspartase-like family protein	123	1737	213651	9416	4.407	696	0.401	412	0.237	0.587	0.413	53876	41463	42806	66090	9416	0

MKT014126_1_4	4080623	0.42	22767	23931	AT3G26680.3	DNA repair metallo-beta-lactamase family protein	122	1165	142130	17902	12.596	541	0.464	316	0.271	0.572	0.428	33561	26911	26222	37534	17902	0
MKT014169_1_4_APOV	6103625	0.63	23932	25827	AT5G45170.1	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein	124	1896	235104	24953	10.614	872	0.46	481	0.254	0.603	0.397	62367	40048	43431	64305	24953	0
MKT014423_1_4_APOV	6776534	0.70	25828	28527	AT5G17290.1	autophagy protein Apg5 family	123	2700	332100	24193	7.285	1065	0.394	579	0.214	0.613	0.387	83593	58111	61232	104971	24193	0
MKT014504_1_4_APOV	7182837	0.74	28528	30618	AT3G26710.1	cofactor assembly of complex C	125	2091	261375	17624	6.743	1009	0.483	576	0.275	0.598	0.402	68761	48841	49154	76995	17624	0
MKT014815_1_4	4266498	0.44	30619	31601	AT5G61030.2	glycine-rich RNA-binding protein 3	125	983	122875	16155	13.148	439	0.447	233	0.237	0.583	0.417	30031	19439	25223	32027	16155	0
MKT015133_1_4	6457048	0.67	31602	32752	AT4G32010.2	HSI2-like 1	122	1151	140422	4495	3.201	527	0.458	312	0.271	0.597	0.403	41276	27448	27384	39819	4495	0
MKT017247_1_4	4005135	0.41	32753	35477	AT2G44660.1	ALG6, ALG8 glycosyltransferase family	125	2725	340625	20031	5.881	1085	0.398	602	0.221	0.604	0.396	82903	60900	65954	110837	20031	0
MKT017888_1_4	7270562	0.75	35478	36899	AT5G23060.1	calcium sensing receptor	124	1422	176328	9417	5.341	547	0.385	323	0.227	0.589	0.411	43880	32776	35635	54620	9417	0
MKT018003_1_4	1846311	0.19	36900	37249	AT5G58760.2	damaged DNA binding 2	109	350	38150	9254	24.257	190	0.543	120	0.343	0.632	0.368	9181	4478	5925	9312	9254	0
MKT018104_1_4	6134472	0.63	37250	38830	AT5G58330.3	lactate/malate dehydrogenase family protein	123	1581	194463	3692	1.899	499	0.316	302	0.191	0.624	0.376	54880	33244	38463	64184	3692	0
MKT018636_1_4_APOV	6967236	0.72	38831	42939	AT4G35560.2	Transducin/WD40 repeat-like superfamily protein	123	4109	505407	41092	8.13	1550	0.377	866	0.211	0.632	0.368	143739	85123	86049	149404	41092	0
MKT021441_1_4	3899179	0.40	42940	44114	AT3G30200.1	Plant transposase (Ptta/En/Spm family)	103	1175	121025	9825	8.118	466	0.397	294	0.25	0.584	0.416	34350	17524	28744	30582	9825	0
MKT021766_1_4_APOV	6628617	0.68	44115	45975	AT3G52905.1	Polynucleotidyl transferase, ribonuclease H-like superfamily protein	122	1861	227042	25185	11.093	879	0.472	519	0.279	0.573	0.427	53232	38121	48208	62296	25185	0
MKT021934_1_4_APOV	6388760	0.66	45976	48130	AT2G24830.1	zinc finger (CCCH-type) family protein / D111/G-patch domain-containing protein	124	2155	267220	22068	8.258	1023	0.475	617	0.286	0.524	0.476	63320	53630	63011	65191	22068	0
MKT023081_1_4_APOV	7514867	0.78	48131	49833	AT1G53710.1	Calcineurin-like metallo-phosphoesterase superfamily protein	123	1703	209469	5684	2.714	594	0.349	329	0.193	0.573	0.427	55385	37665	49251	61484	5684	0
MKT023139_1_4	5405359	0.56	49834	51979	AT5G11700.1	ephrin type-B receptor	123	2146	263958	15458	5.856	882	0.411	504	0.235	0.622	0.378	68111	40557	53293	86539	15458	0
MKT024581_1_4	6720222	0.69	51980	52925	AT5G11100.1	Calcium-dependent lipid-binding (CaLB domain) family protein	123	946	116358	3549	3.05	313	0.331	202	0.214	0.632	0.368	29648	18901	22603	41657	3549	0
MKT024877_1_4	5263295	0.54	52926	55204	AT2G13440.1	glucose-inhibited division family A protein	123	2279	280317	23109	8.244	979	0.43	589	0.258	0.574	0.426	70540	52787	56896	76985	23109	0
MKT025491_1_4_APOV	6850530	0.71	55205	58139	AT5G64250.2	Aldolase-type TIM barrel family protein	124	2935	363940	29567	8.124	1204	0.41	718	0.245	0.606	0.394	89959	57409	74203	112802	29567	0
MKT025734_1_4	6712615	0.69	58140	60024	AT1G21610.1	wound-responsive family protein	124	1885	233740	7731	3.308	594	0.315	362	0.192	0.609	0.391	68399	41364	46922	69324	7731	0
MKT025845_1_4	5392169	0.56	60025	63747	AT5G04070.1	NAD(P)-binding Rossmann-fold superfamily protein	123	3723	457929	38435	8.393	1655	0.445	953	0.256	0.595	0.405	105665	91888	78094	143847	38435	0
MKT027074_1_4	6957012	0.72	63748	64861	AT3G26900.3	shikimate kinase like 1	123	1114	137022	5129	3.743	431	0.387	233	0.209	0.569	0.431	34313	30145	26722	40713	5129	0
MKT027421_1_4_APOV	4943260	0.51	64862	66193	AT1G10830.1	15-cis-zeta-carotene isomerase	123	1332	163836	16917	10.326	641	0.481	356	0.267	0.536	0.464	37401	27757	40369	41392	16917	0
MKT028511_1_4_APOV	8042130	0.83	66194	69835	AT1G07910.1	RNAligase	124	3642	451608	37278	8.255	1444	0.396	850	0.233	0.579	0.421	111290	71000	103652	128388	37278	0
MKT033363_1_4	5259530	0.54	69836	71213	AT1G27595.1	symplekin	123	1378	169494	3949	2.33	458	0.332	299	0.217	0.573	0.427	50315	25430	45220	44580	3949	0
MKT033924_1_4_APOV	7064886	0.73	71214	72600	AT3G16760.1	Tetratricopeptide repeat (TPR)-like superfamily protein	123	1387	170601	4236	2.483	507	0.366	297	0.214	0.526	0.474	44271	41006	37865	43223	4236	0
MKT035534_1_4	6499007	0.67	72601	73896	AT4G18370.2	DEGP protease 5	122	1296	158112	11237	7.107	669	0.516	428	0.33	0.584	0.416	45468	26636	34422	40349	11237	0
MKT037336_1_4_APOV	5850077	0.60	73897	77110	AT4G04880.1	adenosine/AMP deaminase family protein	124	3214	398536	25266	6.34	1276	0.397	762	0.237	0.613	0.387	104984	69143	75327	123816	25266	0
MKT040158_1_4_APOV	6340409	0.65	77111	79154	AT5G54855.1	Pollen Ole e 1 allergen and extensin family protein	123	2044	251412	30286	12.046	987	0.483	578	0.283	0.555	0.445	60133	42154	56078	62761	30286	0
MKT041541_1_4_APOV	6816859	0.70	79155	83810	AT2G43400.2	electron-transfer flavoprotein:ubiquinone oxidoreductase	123	4656	572688	41641	7.271	2094	0.45	1180	0.253	0.6	0.4	149292	105796	106336	169623	41641	0
MKT041966_1_4	3311048	0.34	83811	84258	AT3G09720.2	P-loop containing nucleoside triphosphate hydrolases superfamily protein	121	448	54208	4112	7.586	256	0.571	157	0.35	0.58	0.42	12346	8437	12562	16751	4112	0
MKT042175_1_4	4125158	0.43	84259	85886	AT1G23400.1	RNA-binding CRS1 / YhbY (CRM) domain-containing protein	123	1628	200244	19068	9.522	657	0.404	362	0.222	0.6	0.4	49722	33422	38836	59196	19068	0
MKT042873_1_4	7800869	0.80	85887	89814	AT1G33360.1	ATP-dependent Clp protease	124	3928	487072	61708	12.669	1789	0.455	972	0.247	0.614	0.386	122578	75396	89290	138100	61708	0
MKT043000_1_4	818337	0.08	89815	90358	AT4G24670.2	tryptophan aminotransferase related 2	97	544	52768	3717	7.044	367	0.675	245	0.45	0.501	0.499	12372	12930	11486	12263	3717	0
MKT043957_1_4_APOV	7656722	0.79	90359	92252	AT5G49530.1	SIN-like family protein	124	1894	234856	15420	6.566	735	0.388	401	0.212	0.592	0.408	58186	41922	47439	71889	15420	0
MKT044207_1_4_APOV	1534487	0.16	92253	95118	AT5G25770.1	alpha/beta-Hydrolases superfamily protein	124	2866	355384	31223	8.786	1457	0.508	830	0.29	0.603	0.397	91216	62353	66437	104155	31223	0
MKT044398_1_4	4398439	0.45	95119	95651	AT4G11560.1	bromo-adjacent homology (BAH) domain-containing protein	122	533	65026	3545	5.452	160	0.3	101	0.189	0.553	0.447	17009	13338	14117	17017	3545	0
MKT044450_1_4	6398556	0.66	95652	99045	AT5G47800.4	Phototropic-responsive NPH3 family protein	123	3394	417462	30024	7.192	1623	0.478	1003	0.296	0.531	0.469	105559	88205	93370	100304	30024	0
MKT044548_1_4	691900	0.07	99046	99355	AT1G51440.1	alpha/beta-Hydrolases superfamily protein	103	310	31930	2163	6.774	263	0.848	231	0.745	0.505	0.495	6368	7078	7646	8675	2163	0
MKT046452_1_4	2001402	0.21	99356	101084	AT3G52850.1	vacuolar sorting receptor homolog 1	123	1729	212667	33468	15.737	824	0.477	472	0.273	0.596	0.404	48115	35498	36834	58752	33468	0
MKT048020_1_4_APOV	8023889	0.83	101085	104579	AT4G17760.2	PCNA domain-containing protein	123	3495	429885	27427	6.38	1522	0.435	923	0.264	0.596	0.404	105955	72124	90469	133910	27427	0
MKT049010_1_4_APOV	6307964	0.65	104580	107186	AT5G41480.1	Folylpolyglutamate synthetase family protein	123	2607	320661	16240	5.065	1138	0.437	670	0.257	0.6	0.4	83585	57784	64040	99012	16240	0
MKT049457_1_4	6609925	0.68	107187	111041	AT2G14820.2	Phototropic-responsive NPH3 family protein	124	3855	478020	23128	4.838	1374	0.356	774	0.201	0.554	0.446	129587	85291	117310	122704	23128	0

MKT049651_1_4_APOV	6016303	0.62	111042	113677	AT5G02250.1	Ribonuclease II/R family protein	123	2636	324228	15506	4.782	967	0.367	557	0.211	0.587	0.413	85527	59857	67530	95808	15506	0
MKT049743_1_4	6735633	0.70	113678	115467	AT1G23000.1	Heavy metal transport/detoxification superfamily protein	124	1790	221960	7374	3.322	699	0.391	414	0.231	0.55	0.45	62216	42034	54386	55950	7374	0
MKT049745_1_4	802160	0.08	115468	116613	AT1G78550.2	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	123	1146	140958	20233	14.354	531	0.463	295	0.257	0.556	0.444	35898	27258	26257	31312	20233	0
MKT049974_1_4_APOV	7878227	0.81	116614	119088	AT5G10320.6	ATP synthase subunit B	124	2475	306900	19198	6.255	1232	0.498	707	0.286	0.569	0.431	78751	61043	62994	84914	19198	0
MKT050498_1_4_APOV	5318644	0.55	119089	120826	AT1G74640.1	alpha/beta-Hydrolases superfamily protein	124	1738	215512	19218	8.917	721	0.415	424	0.244	0.554	0.446	52376	39498	47979	56441	19218	0
MKT052244_1_4_APOV	7400748	0.76	120827	124039	AT2G35610.1	xyloglucanase 113	124	3213	398412	21867	5.489	1149	0.358	670	0.209	0.618	0.382	101056	75187	68762	131540	21867	0
MKT052493_1_4	7364902	0.76	124040	128993	AT4G26100.1	casein kinase 1	124	4954	614296	43778	7.127	1885	0.381	1118	0.226	0.588	0.412	145633	98044	136815	190026	43778	0
MKT054033_1_4_APOV	6632503	0.68	128994	132006	AT4G10030.1	alpha/beta-Hydrolases superfamily protein	123	3013	370599	21382	5.77	1262	0.419	727	0.241	0.596	0.404	91183	67052	73850	117132	21382	0
MKT054141_1_4_APOV	2588738	0.27	132007	134844	AT2G30410.3	tubulin folding cofactor A (KIESEL)	124	2838	351912	38933	11.063	1524	0.537	853	0.301	0.578	0.422	81275	60749	71353	99602	38933	0
MKT055672_1_4_APOV	3551893	0.37	134845	136192	AT5G50230.1	Transducin/WD40 repeat-like superfamily protein	123	1348	165804	3608	2.176	308	0.228	171	0.127	0.578	0.422	43507	31736	36676	50277	3608	0
MKT056344_1_4	4779630	0.49	136193	137466	AT4G18760.1	receptor like protein 51	123	1274	156702	10203	6.511	590	0.463	307	0.241	0.576	0.424	41760	31975	30015	42749	10203	0
MKT058473_1_4_APOV	5952853	0.61	137467	139371	AT5G63200.1	tetratricopeptide repeat (TPR)-containing protein	123	1905	234315	13236	5.649	771	0.405	453	0.238	0.569	0.431	58783	42824	52418	67054	13236	0
MKT058531_1_4	5450317	0.56	139372	140686	AT1G47290.1	3beta-hydroxysteroid-dehydrogenase/decarboxylase isoform 1	122	1315	160430	6264	3.905	598	0.455	357	0.271	0.596	0.404	43953	27165	35128	47920	6264	0
MKT059069_1_4_APOV	4951049	0.51	140687	142325	AT5G19940.2	Plastid-lipid associated protein PAP / fibrillin family protein	124	1639	203236	17428	8.575	744	0.454	423	0.258	0.581	0.419	49534	33532	44187	58555	17428	0
MKT059496_1_4_APOV	6975694	0.72	142326	144633	AT5G23395.1	Cox19-like CHCH family protein	123	2308	283884	17251	6.077	1107	0.48	557	0.241	0.578	0.422	64776	44863	67762	89232	17251	0
MKT062212_1_4	3626791	0.37	144634	146198	AT1G02410.3	cytochrome c oxidase assembly protein CtaG / Cox11 family	122	1565	190930	25331	13.267	762	0.487	473	0.302	0.547	0.453	44477	39100	35825	46197	25331	0
MKT062415_1_4_APOV	5923779	0.61	146199	148682	AT5G10070.2	RNase L inhibitor protein-like protein	123	2484	305532	21549	7.053	1124	0.452	633	0.255	0.593	0.407	77460	60578	55007	90938	21549	0
MKT063487_1_4	6939603	0.72	148683	149659	AT2G21550.2	Bifunctional dihydrofolate reductase/thymidylate synthase	122	977	119194	3931	3.298	427	0.437	258	0.264	0.583	0.417	28635	17968	30129	38531	3931	0
MKT063650_1_4_APOV	5301046	0.55	149660	151797	AT3G07060.1	NHL domain-containing protein	122	2138	260836	21615	8.287	873	0.408	476	0.223	0.619	0.381	64208	41078	49908	84027	21615	0
MKT064181_1_4_APOV	4529337	0.47	151798	153469	AT3G32930.2	6, 7-dimethyl-8-ribityllumazine synthase	122	1672	203984	17118	8.392	697	0.417	415	0.248	0.54	0.46	46956	44613	41348	53949	17118	0
MKT065092_1_4_APOV	4879250	0.50	153470	155131	AT5G18660.1	NAD(P)-binding Rossmann-fold superfamily protein	122	1662	202764	4669	2.303	670	0.403	408	0.245	0.496	0.504	47596	47594	52288	50617	4669	0
MKT065135_1_4_APOV	7236018	0.75	155132	157958	AT2G42080.1	Chaperone DnaJ-domain superfamily protein	121	2827	342067	14438	4.221	1100	0.389	632	0.224	0.584	0.416	88611	63338	73110	102570	14438	0
MKT065481_1_4_APOV	5943351	0.61	157959	160072	AT1G72440.1	CCAAT-binding factor	122	2114	257908	19057	7.389	937	0.443	536	0.254	0.59	0.41	68824	41645	56262	72120	19057	0
MKT072919_1_4_APOV	4869021	0.50	160073	162184	AT3G59650.2	mitochondrial ribosomal protein L51/S25/CI-B8 family protein	122	2112	257664	22671	8.799	977	0.463	537	0.254	0.595	0.405	62850	40887	54295	76961	22671	0
MKT074080_1_4_APOV	5665175	0.58	162185	163577	AT1G75200.1	flavodoxin family protein / radical SAM domain-containing protein	122	1393	169946	10603	6.239	531	0.381	326	0.234	0.508	0.492	36207	40660	37599	44877	10603	0
MKT074616_1_4	1636297	0.17	163578	165286	AT5G04040.2	Patatin-like phospholipase family protein	123	1709	210207	6037	2.872	454	0.266	292	0.171	0.498	0.502	45566	46046	56327	56231	6037	0
MKT074911_1_4	4410817	0.46	165287	165739	AT4G01550.1	NAC domain containing protein 69	116	453	52548	3996	7.604	243	0.536	138	0.305	0.574	0.426	11514	7058	13600	16380	3996	0
MKT075332_1_4	3566258	0.37	165740	166070	AT3G51360.8	Eukaryotic aspartyl protease family protein	109	331	36079	2173	6.023	176	0.532	92	0.278	0.558	0.442	9153	9003	5993	9757	2173	0
MKT075417_1_4_APOV	6477236	0.67	166071	168228	AT2G42770.1	Peroxisomal membrane 22 kDa (Mpv17/PMP22) family protein	122	2158	263276	21397	8.127	954	0.442	540	0.25	0.601	0.399	62127	47289	49077	83386	21397	0
MKT076221_1_4	5780837	0.60	168229	168797	AT5G54930.1	AT hook motif-containing protein	121	569	68849	3278	4.761	277	0.487	176	0.309	0.41	0.59	13281	18682	19949	13659	3278	0
MKT076335_1_4_APOV	5993340	0.62	168798	170610	AT2G43370.2	RNA-binding (RRM/RBD/RNP motifs) family protein	122	1813	221186	27978	12.649	955	0.527	648	0.357	0.592	0.408	51463	38824	39757	63164	27978	0
MKT077005_1_4_APOV	6567486	0.68	170611	173407	AT3G24320.2	MUTL protein homolog 1	122	2797	341234	19648	5.758	997	0.356	548	0.196	0.62	0.38	81102	53588	68548	118348	19648	0
MKT077685_1_4	4479883	0.46	173408	174376	AT5G51340.1	Tetratricopeptide repeat (TPR)-like superfamily protein	121	969	117249	4380	3.736	399	0.412	231	0.238	0.658	0.342	34372	16651	21993	39853	4380	0
MKT079447_1_4_APOV	2121508	0.22	174377	177235	AT4G02790.1	GTP-binding family protein	123	2859	351657	49464	14.066	1117	0.391	637	0.223	0.586	0.414	83822	57688	67485	93198	49464	0
MKT080632_1_4	6234343	0.64	177236	179951	AT3G04500.3	RNA-binding (RRM/RBD/RNP motifs) family protein	122	2716	331352	24091	7.271	1261	0.464	750	0.276	0.564	0.436	77346	48997	84891	96027	24091	0
MKT081437_1_4_APOV	6343306	0.65	179952	183449	AT5G27560.4	DUF1995 domain protein, putative (DUF1995)	123	3498	430254	37243	8.656	1507	0.431	783	0.224	0.605	0.395	108292	70613	84679	129427	37243	0
MKT082329_1_4	6166067	0.64	183450	184199	AT4G24620.2	phosphoglucose isomerase 1	122	750	91500	4045	4.421	271	0.361	138	0.184	0.609	0.391	22645	15865	18279	30666	4045	0
MKT083137_1_4	3879736	0.40	184200	184756	AT5G42400.8	SET domain protein 25	121	557	67397	3438	5.101	256	0.46	150	0.269	0.604	0.396	19513	10773	14502	19171	3438	0
MKT083367_1_4_APOV	5475560	0.56	184757	188093	AT3G25470.1	bacterial hemolysin-like protein	122	3337	407114	36925	9.07	1436	0.43	810	0.243	0.6	0.4	95563	65979	82124	126523	36925	0
MKT083464_1_4_APOV	6544627	0.68	188094	190103	AT3G24200.2	FAD/NAD(P)-binding oxidoreductase family protein	123	2010	247230	10466	4.233	790	0.393	454	0.226	0.585	0.415	68299	45151	53070	70244	10466	0
MKT084780_1_4_APOV	7111116	0.73	190104	192885	AT3G01920.1	DHBP synthase RibB-like alpha/beta domain-containing protein	123	2782	342186	15618	4.564	1064	0.382	663	0.238	0.588	0.412	92305	65277	69172	99814	15618	0
MKT085635_1_4	5927414	0.61	192886	194541	AT5G20570.1	RING-box 1	122	1656	202032	14899	7.375	794	0.479	485	0.293	0.579	0.421	41153	35615	43225	67140	14899	0
MKT086766_1_4_APOV	4279869	0.44	194542	197376	AT1G59990.2	DEA(D/H)-box RNA helicase family	122	2835	345870	23855	6.897	1314	0.463	768	0.271	0.585	0.415	82658	68481	65175	105701	23855	0

						protein																
MKT087337_1_4	7475425	0.77	197377	200538	AT1G07510.1	FTSH protease 10	122	3162	385764	31302	8.114	1581	0.5	921	0.291	0.571	0.429	94737	61978	90305	107442	31302	0
MKT087636_1_4_APOV	6889555	0.71	200539	202489	AT5G63040.1	transmembrane protein	121	1951	236071	8594	3.64	807	0.414	472	0.242	0.589	0.411	62616	44214	49275	71372	8594	0
MKT088403_1_4	6252221	0.65	202490	203998	AT3G57940.2	GNAT acetyltransferase (DUF699)	121	1509	182589	8992	4.925	542	0.359	271	0.18	0.613	0.387	46052	29354	37806	60385	8992	0
MKT089525_1_4_APOV	7117239	0.73	203999	206371	AT3G14910.1	Rab3 GTPase-activating protein non-catalytic subunit	122	2373	289506	19042	6.577	962	0.405	561	0.236	0.557	0.443	69503	59735	60017	81209	19042	0
MKT094099_1_4	5140677	0.53	206372	207201	AT4G05530.1	indole-3-butyric acid response 1	118	830	97940	5779	5.901	369	0.445	221	0.266	0.57	0.43	22184	25413	14196	30368	5779	0
MKT095133_1_4_APOV	4733026	0.49	207202	209047	AT2G22370.1	mediator of RNA polymerase II transcription subunit	121	1846	223366	8039	3.599	738	0.4	398	0.216	0.563	0.437	53166	46797	47316	68048	8039	0
MKT095310_1_4	752832	0.08	209048	209331	ATMG00860.1	DNA/RNA polymerases superfamily protein	102	284	28968	1667	5.755	135	0.475	96	0.338	0.463	0.537	6845	7511	7129	5816	1667	0
MKT095730_1_4_APOV	6107387	0.63	209332	212294	AT1G77090.1	thylakoid lumenal protein (Mog1/PsbP/DUF1795-like photosystem II reaction center PsbP family protein)	121	2963	358523	29988	8.364	1328	0.448	766	0.259	0.579	0.421	87903	64587	73794	102251	29988	0
MKT097806_1_4	3765436	0.39	212295	213067	No_hit	No_hit	119	773	91987	4074	4.429	353	0.457	184	0.238	0.613	0.387	28540	13984	20033	25356	4074	0
MKT097815_1_4_APOV	5593567	0.58	213068	214983	AT4G03200.1	catalytics	121	1916	231836	9816	4.234	848	0.443	495	0.258	0.596	0.404	56260	41430	48249	76081	9816	0
MKT099172_1_4_APOV	3380850	0.35	214984	216950	AT3G16270.3	ENTH/VHS family protein	120	1967	236040	19095	8.09	948	0.482	565	0.287	0.572	0.428	59119	38415	54367	65044	19095	0
MKT099267_1_4	4131289	0.43	216951	218100	AT4G09680.3	conserved telomere maintenance component 1	121	1150	139150	6086	4.374	469	0.408	232	0.202	0.582	0.418	35138	25958	29710	42258	6086	0
MKT099416_1_4_APOV	4978938	0.51	218101	220113	AT4G33030.1	sulfoquinovosyldiacylglycerol 1	122	2013	245586	10754	4.379	637	0.316	371	0.184	0.536	0.464	64848	60606	48380	60998	10754	0
MKT100456_1_4	5029597	0.52	220114	221116	AT1G04210.1	Leucine-rich repeat protein kinase family protein	121	1003	121363	7384	6.084	379	0.378	214	0.213	0.59	0.41	30051	21351	25308	37269	7384	0
MKT102093_1_4_APOV	5292916	0.55	221117	223541	AT5G48470.1	hypothetical protein	121	2425	293425	20914	7.128	1177	0.485	702	0.289	0.564	0.436	70917	57706	61092	82796	20914	0
MKT102398_1_4	5576755	0.58	223542	225493	AT1G72790.1	hydroxyproline-rich glycoprotein family protein	121	1952	236192	4847	2.052	784	0.402	492	0.252	0.524	0.476	65648	60961	49090	55646	4847	0
MKT102617_1_4_APOV	1159413	0.12	225494	227525	ATMG00520.1	Intron maturase, type II family protein	122	2032	247904	5280	2.13	52	0.026	21	0.01	0.474	0.526	63341	64982	62664	51637	5280	0
MKT102671_1_4	4312982	0.45	227526	228415	AT5G51980.2	Transducin/WD40 repeat-like superfamily protein	116	890	103240	12648	12.251	411	0.462	246	0.276	0.58	0.42	26982	20820	17151	25639	12648	0
MKT103416_1_4	6657763	0.69	228416	230097	AT2G24270.2	aldehyde dehydrogenase 11A3	121	1682	203522	15362	7.548	760	0.452	448	0.266	0.583	0.417	52252	34530	44013	57365	15362	0
MKT103490_1_4	6178139	0.64	230098	232680	AT4G35830.2	aconitase 1	121	2583	312543	33005	10.56	925	0.358	495	0.192	0.601	0.399	68528	51474	59988	99548	33005	0
MKT103531_1_4_APOV	2664964	0.27	232681	233731	AT1G55880.1	Pyridoxal-5'-phosphate-dependent enzyme family protein	119	1051	125069	25121	20.086	455	0.433	274	0.261	0.546	0.454	26876	20534	24791	27747	25121	0
MKT104268_1_4	5818593	0.60	233732	234267	AT5G61450.1	P-loop containing nucleoside triphosphate hydrolases superfamily protein	115	536	61640	4019	6.52	247	0.461	146	0.272	0.55	0.45	16433	11017	14948	15223	4019	0
MKT104669_1_4	2160240	0.22	234268	234817	AT3G48110.1	glycine-tRNA ligase	119	550	65450	2886	4.409	199	0.362	99	0.18	0.62	0.38	15482	11316	12442	23324	2886	0
MKT106488_1_4	2173860	0.22	234818	235609	AT2G20000.2	CDC27 family protein	120	792	95040	1732	1.822	296	0.374	175	0.221	0.627	0.373	24602	17326	17456	33924	1732	0
MKT108799_1_4_APOV	3917177	0.40	235610	236926	AT2G19270.1	mitotic checkpoint protein PRCC-carboxy-term protein	122	1317	160674	7304	4.546	654	0.497	376	0.285	0.571	0.429	37554	25397	40378	50041	7304	0
MKT109897_1_4	5570634	0.57	236927	237741	AT1G43760.1	DNAse I-like superfamily protein	113	815	92095	3047	3.309	306	0.375	192	0.236	0.576	0.424	27641	19326	18378	23703	3047	0
MKT110241_1_4_APOV	4148923	0.43	237742	239554	AT3G07670.1	Rubisco methyltransferase family protein	122	1813	221186	9918	4.484	774	0.427	431	0.238	0.56	0.44	55113	49823	42956	63376	9918	0
MKT110690_1_4	4574295	0.47	239555	240400	AT1G78780.2	pathogenesis-related family protein	114	846	96444	6774	7.024	416	0.492	241	0.285	0.538	0.462	24732	21503	19916	23519	6774	0
MKT111153_1_4_APOV	1449058	0.15	240401	242304	AT5G51220.2	ubiquinol-cytochrome C chaperone family protein	119	1904	226576	50253	22.179	906	0.476	531	0.279	0.575	0.425	43987	32482	44213	55641	50253	0
MKT111535_1_4_APOV	6063557	0.63	242305	243869	AT5G16850.2	telomerase reverse transcriptase	121	1565	189365	11075	5.848	541	0.346	335	0.214	0.613	0.387	51498	34742	34148	57902	11075	0
MKT111570_1_4_APOV	5333822	0.55	243870	245790	AT2G21710.2	Mitochondrial transcription termination factor family protein	121	1921	232441	6293	2.707	677	0.352	369	0.192	0.569	0.431	62832	52721	44849	65746	6293	0
MKT111920_1_4	4393078	0.45	245791	247289	AT5G66060.2	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	115	1499	172385	20140	11.683	784	0.523	460	0.307	0.531	0.469	27711	34932	36424	53178	20140	0
MKT113256_1_4_APOV	6454436	0.67	247290	249531	AT3G52180.3	dual specificity protein phosphatase (DsPTP1) family protein	121	2242	271282	10239	3.774	907	0.405	522	0.233	0.616	0.384	69546	50148	50171	91178	10239	0
MKT114467_1_4	5238713	0.54	249532	250180	AT1G43760.1	DNAse I-like superfamily protein	116	649	75284	5918	7.861	346	0.533	236	0.364	0.586	0.414	20783	11421	17318	19844	5918	0
MKT115451_1_4_APOV	5126653	0.53	250181	251973	AT5G63060.1	Sec14p-like phosphatidylinositol transfer family protein	120	1793	215160	26282	12.215	731	0.408	405	0.226	0.61	0.39	52237	36447	37323	62871	26282	0
MKT115677_1_4_APOV	5216263	0.54	251974	254787	AT5G22820.3	ARM repeat superfamily protein	122	2814	343308	29463	8.582	1416	0.503	828	0.294	0.585	0.415	87137	63976	66466	96266	29463	0
MKT116135_1_4	6412838	0.66	254788	256819	AT4G33700.3	CBS domain protein (DUF21)	120	2032	243840	18473	7.576	889	0.438	522	0.257	0.591	0.409	67056	44073	48024	66214	18473	0
MKT116442_1_4_APOV	6816230	0.70	256820	259718	AT1G31780.1	oligomeric golgi complex subunit	121	2899	350779	17130	4.883	947	0.327	524	0.181	0.604	0.396	92314	62836	69263	109236	17130	0
MKT117656_1_4_APOV	5145483	0.53	259719	263104	AT3G27110.2	Peptidase family M48 family protein	122	3386	413092	32865	7.956	1258	0.372	724	0.214	0.614	0.386	104522	66669	80101	128935	32865	0
MKT117762_1_4	866563	0.09	263105	264036	AT1G14390.1	Leucine-rich repeat protein kinase family protein	116	932	108112	20650	19.101	649	0.696	513	0.55	0.541	0.459	26503	16435	23987	20537	20650	0
MKT118146_1_4	2648078	0.27	264037	264482	AT1G66030.1	cytochrome P450, family 96, subfamily A, polypeptide 14 pseudogene	106	446	47276	5856	12.387	269	0.603	190	0.426	0.528	0.472	11237	8939	10627	10617	5856	0
MKT120073_1_4_APOV	7566737	0.78	264483	266358	AT1G05410.2	CDPK adapter, putative (DUF1423)	121	1876	226996	20686	9.113	656	0.35	371	0.198	0.609	0.391	56083	35273	45298	69656	20686	0
MKT120644_1_4	3545738	0.37	266359	266990	AT2G03670.1	cell division cycle 48B	121	632	76472	3402	4.449	252	0.399	147	0.233	0.612	0.388	20260	14104	14258	24448	3402	0

MKT120725_1_4	5812741	0.60	266991	268525	AT5G39890.1	2-aminoethanethiol dioxygenase, putative (DUF1637)	121	1535	185735	18838	10.142	659	0.429	411	0.268	0.582	0.418	41597	32653	37031	55616	18838	0
MKT122427_1_4_APOV	3566221	0.37	268526	270534	AT2G20210.1	RNI-like superfamily protein	121	2009	243089	18850	7.754	975	0.485	589	0.293	0.582	0.418	58688	48164	45550	71837	18850	0
MKT124409_1_4_APOV	7382302	0.76	270535	273356	AT5G42765.1	plasma membrane fusion protein	122	2822	344284	27247	7.914	1079	0.382	633	0.224	0.595	0.405	84296	72084	56006	104651	27247	0
MKT124578_1_4_APOV	5573992	0.58	273357	276513	AT3G20480.5	tetraacyldisaccharide 4'-kinase family protein	121	3157	381997	26954	7.056	1372	0.435	824	0.261	0.608	0.392	95574	72273	66869	120327	26954	0
MKT125774_1_4_APOV	7130823	0.74	276514	280078	AT3G18480.1	CCAAT-displacement protein alternatively spliced product	121	3565	431365	30622	7.099	1247	0.35	736	0.206	0.601	0.399	107325	63887	96020	133511	30622	0
MKT125823_1_4	5345157	0.55	280079	280936	AT5G58090.1	O-Glycosyl hydrolases family 17 protein	121	858	103818	2999	2.889	314	0.366	194	0.226	0.56	0.44	25288	18378	25924	31229	2999	0
MKT126260_1_4_APOV	5996728	0.62	280937	284015	AT5G64630.1	Transducin/WD40 repeat-like superfamily protein	121	3079	372559	30208	8.108	1164	0.378	638	0.207	0.606	0.394	89208	61743	73207	118193	30208	0
MKT126264_1_4	5161722	0.53	284016	284697	AT2G25600.1	Shaker pollen inward K+ channel	120	682	81840	3013	3.682	359	0.526	218	0.32	0.539	0.461	19201	16529	19772	23325	3013	0
MKT126492_1_4	5327885	0.55	284698	286302	ATMG00860.1	DNA/RNA polymerases superfamily protein	121	1605	194205	18250	9.397	933	0.581	620	0.386	0.576	0.424	53517	34897	39397	48144	18250	0
MKT126679_1_4	4772635	0.49	286303	287739	AT5G05170.1	Cellulose synthase family protein	122	1437	175314	16499	9.411	576	0.401	292	0.203	0.592	0.408	44221	30875	33887	49832	16499	0
MKT127097_1_4_APOV	6010375	0.62	287740	290151	AT2G28450.2	zinc finger (CCCH-type) family protein	121	2412	291852	19310	6.616	911	0.378	500	0.207	0.584	0.416	77497	53443	59968	81634	19310	0
MKT127492_1_4_APOV	6508336	0.67	290152	291423	AT2G40316.3	autophagy-like protein	120	1272	152640	21414	14.029	508	0.399	283	0.222	0.635	0.365	38008	20718	27471	45029	21414	0
MKT129330_1_4_APOV	642730	0.07	291424	293069	AT1G26840.1	origin recognition complex protein 6	122	1646	200812	32057	15.964	945	0.574	560	0.34	0.622	0.378	42874	30663	33101	62117	32057	0
MKT129653_1_4_APOV	3666126	0.38	293070	294320	AT5G52180.1	transmembrane protein 161AB protein	121	1251	151371	3593	2.374	383	0.306	216	0.173	0.54	0.46	27435	31025	36968	52350	3593	0
MKT130843_1_4_APOV	3775559	0.39	294321	297457	AT2G26340.1	hypothetical protein	122	3137	382714	30531	7.977	1450	0.462	802	0.256	0.602	0.398	96307	65010	74910	115956	30531	0
MKT130987_1_4_APOV	6093666	0.63	297458	299909	AT4G13670.1	plastid transcriptionally active 5	121	2452	296692	31266	10.538	1218	0.497	676	0.276	0.605	0.395	75906	45430	59400	84690	31266	0
MKT131170_1_4	587896	0.06	299910	300168	AT3G42170.2	BED zinc finger and hAT dimerization domain-containing protein	87	259	22533	988	4.385	186	0.718	137	0.529	0.512	0.488	6754	7221	3292	4278	988	0
MKT131604_1_4_APOV	3783840	0.39	300169	302013	AT5G16690.2	DAYSLEEPER origin recognition complex subunit 3	121	1845	223245	19670	8.811	743	0.403	404	0.219	0.609	0.391	54341	37494	42165	69575	19670	0
MKT132265_1_4	1338477	0.14	302014	302292	AT3G49160.1	pyruvate kinase family protein	93	279	25947	2126	8.194	163	0.584	87	0.312	0.564	0.436	7478	5348	5035	5960	2126	0
MKT136353_1_4	7349891	0.76	302293	303912	AT3G51800.3	metallopeptidase M24 family protein	121	1620	196020	18783	9.582	594	0.367	325	0.201	0.574	0.426	45853	35774	39640	55970	18783	0
MKT137339_1_4	294903	0.03	303913	304336	AT2G40730.1	kinase family with ARM repeat domain-containing protein	120	424	50880	8265	16.244	196	0.462	114	0.269	0.596	0.404	10637	7788	9465	14725	8265	0
MKT138013_1_4	6343230	0.65	304337	306323	AT4G17610.1	tRNA/rRNA methyltransferase (SpoU) family protein	121	1987	240427	8277	3.443	725	0.365	371	0.187	0.61	0.39	67458	39114	51316	74262	8277	0
MKT138505_1_4	5466991	0.56	306324	306827	AT3G24255.5	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	120	504	60480	3559	5.885	251	0.498	153	0.304	0.588	0.412	13317	11398	12035	20171	3559	0
MKT138586_1_4	6055257	0.62	306828	308806	AT3G50420.2	Pentatricopeptide repeat (PPR) superfamily protein	117	1979	231543	16276	7.029	880	0.445	500	0.253	0.571	0.429	48180	31156	61401	74530	16276	0
MKT138928_1_4	1694953	0.17	308807	310021	AT1G52590.1	Putative thiol-disulfide oxidoreductase DCC	122	1215	148230	24344	16.423	551	0.453	289	0.238	0.62	0.38	37304	19247	27644	39691	24344	0
MKT139741_1_4_APOV	6163832	0.64	310022	312055	AT4G37510.1	Ribonuclease III family protein	121	2034	246114	13581	5.518	828	0.407	444	0.218	0.551	0.449	52672	49448	54896	75517	13581	0
MKT143784_1_4	5123700	0.53	312056	312786	AT2G02070.2	indeterminate(ID)-domain 5	119	731	86989	3336	3.835	257	0.352	148	0.202	0.471	0.529	16023	20970	23273	23387	3336	0
MKT146240_1_4_APOV	5779418	0.60	312787	313739	AT3G17712.3	hypothetical protein	121	953	115313	3452	2.994	293	0.307	148	0.155	0.595	0.405	31837	18833	26438	34753	3452	0
MKT148312_1_4	6407936	0.66	313740	316128	AT2G31260.1	autophagy 9 (APG9)	121	2389	289069	26620	9.209	1018	0.426	600	0.251	0.603	0.397	72358	51727	52343	86021	26620	0
MKT149396_1_4_APOV	5788573	0.60	316129	319092	AT3G17040.2	high chlorophyll fluorescent 107	121	2964	358644	13339	3.719	1227	0.414	692	0.233	0.598	0.402	97276	64624	74069	109336	13339	0
MKT149614_1_4_APOV	1933514	0.20	319093	321664	AT1G56090.1	Tetratricopeptide repeat (TPR)-like superfamily protein	122	2572	313784	22621	7.209	1282	0.498	750	0.292	0.56	0.44	79710	61061	66792	83600	22621	0
MKT152047_1_4_APOV	6468341	0.67	321665	324216	AT1G72640.1	NAD(P)-binding Rossmann-fold superfamily protein	122	2552	311344	25625	8.23	1174	0.46	715	0.28	0.578	0.422	78194	60265	60376	86884	25625	0
MKT153301_1_4	5336449	0.55	324217	325397	AT2G02650.1	Ribonuclease H-like superfamily protein	121	1181	142901	5828	4.078	597	0.506	373	0.316	0.529	0.471	30733	31907	32642	41791	5828	0
MKT153988_1_4	6299980	0.65	325398	328025	AT1G55250.4	histone mono-ubiquitination 2	121	2628	317988	33725	10.606	1197	0.455	700	0.266	0.599	0.401	77770	51440	62465	92588	33725	0
MKT154349_1_4_APOV	6580912	0.68	328026	329450	AT1G63680.3	ALBINO OR PALE-GREEN 13	121	1425	172425	4051	2.349	434	0.305	277	0.194	0.488	0.512	39628	35252	51035	42459	4051	0
MKT154711_1_4_APOV	6571439	0.68	329451	331990	AT2G44420.3	protein N-terminal asparagine amidohydrolase family protein	122	2540	309880	16751	5.406	1064	0.419	601	0.237	0.58	0.42	77522	57536	65593	92478	16751	0
MKT155109_1_4	5971795	0.62	331991	333084	AT3G47420.3	putative glycerol-3-phosphate transporter 1	121	1094	132374	3845	2.905	349	0.319	222	0.203	0.549	0.451	30261	27312	30662	40294	3845	0
MKT155265_1_4	4915041	0.51	333085	335215	AT5G13240.1	transcription regulator	122	2131	259982	15812	6.082	688	0.323	363	0.17	0.593	0.407	59785	47243	52219	84923	15812	0
MKT155305_1_4	7124267	0.74	335216	336318	AT5G01881.1	transmembrane protein	120	1103	132360	7440	5.621	498	0.451	286	0.259	0.578	0.422	38404	27847	24788	33881	7440	0
MKT157257_1_4_APOV	5840731	0.60	336319	338901	AT5G25070.1	neurofilament light protein	121	2583	312543	15930	5.097	917	0.355	451	0.175	0.596	0.404	92037	51837	67882	84857	15930	0
MKT157285_1_4_APOV	6849934	0.71	338902	342663	AT1G77320.2	transcription coactivator	121	3762	455202	16434	3.61	1447	0.385	797	0.212	0.591	0.409	121626	81875	97648	137619	16434	0
MKT157286_1_4_APOV	6345469	0.65	342664	344506	AT1G77290.3	Glutathione S-transferase family protein	121	1843	223003	5027	2.254	596	0.323	353	0.192	0.57	0.43	63720	38953	54706	60597	5027	0
MKT159057_1_4	6337292	0.65	344507	345907	AT5G35360.3	acetyl Co-enzyme a carboxylase biotin carboxylase subunit	117	1401	163917	10552	6.437	676	0.483	394	0.281	0.57	0.43	41102	23168	42845	46250	10552	0
MKT160185_1_4_APOV	5829771	0.60	345908	347771	AT4G26980.1	RNI-like superfamily protein	120	1864	223680	9231	4.127	786	0.422	474	0.254	0.547	0.453	56031	55617	41438	61363	9231	0
MKT160703_1_4_APOV	6104807	0.63	347772	349783	AT1G34770.3	melanoma-associated antigen G1-like protein	121	2012	243452	12667	5.203	827	0.411	436	0.217	0.607	0.393	70813	42379	48235	69358	12667	0
MKT160851_1_4_APOV	5621780	0.58	349784	352088	AT5G55760.1	sirtuin 1	120	2305	276600	29915	10.815	841	0.365	475	0.206	0.594	0.406	67412	49386	50875	79012	29915	0
MKT161286_1_4	5740167	0.59	352089	352893	AT3G61182.1	low-molecular-weight cysteine-rich 54	120	805	96600	3915	4.053	332	0.412	201	0.25	0.574	0.426	27905	17925	21599	25256	3915	0

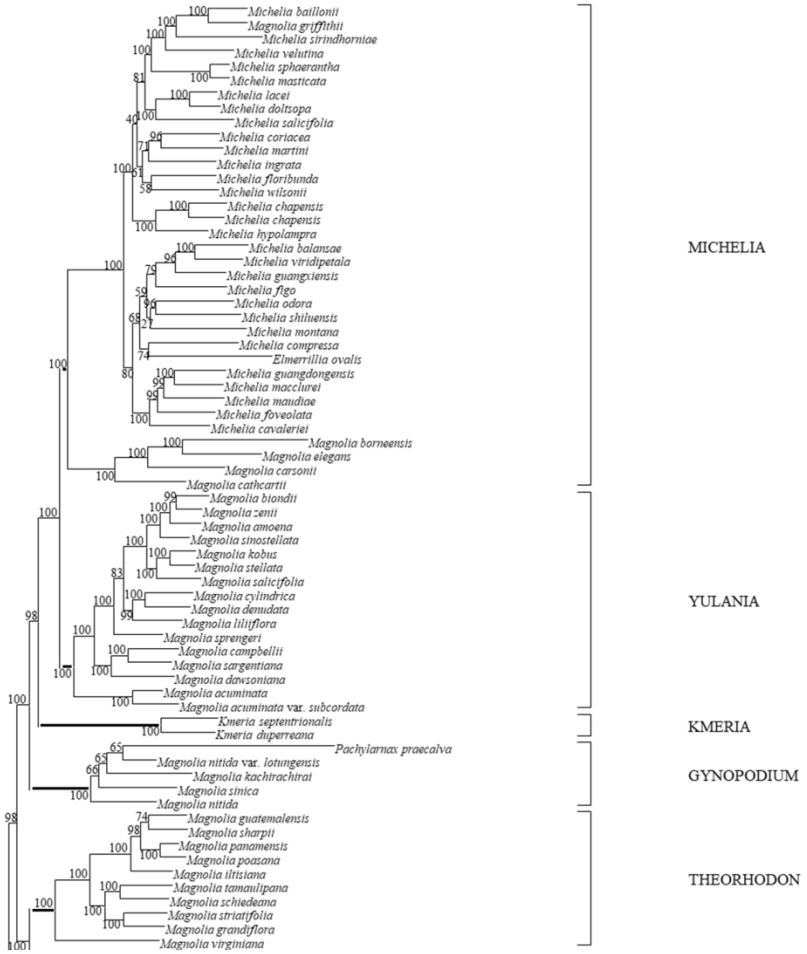
MKT162606_1_4_APOV	6282415	0.65	352894	354991	AT4G30580.1	Phospholipid/glycerol acyltransferase family protein	121	2098	253858	10204	4.02	759	0.362	460	0.219	0.598	0.402	59538	45985	52040	86091	10204	0
MKT164012_1_4_APOV	4840152	0.50	354992	356653	AT5G06430.1	Thioredoxin superfamily protein	121	1662	201102	9645	4.796	801	0.482	479	0.288	0.557	0.443	52140	45865	39090	54362	9645	0
MKT164029_1_4	3420719	0.35	356654	357067	AT5G49430.2	WD40/YVTN repeat and Bromo-WDR9-I-like domain-containing protein	120	414	49680	2241	4.511	154	0.372	103	0.249	0.58	0.42	15572	10998	8911	11958	2241	0
MKT164244_1_4	4213728	0.43	357068	358678	AT4G37200.1	Thioredoxin superfamily protein	121	1611	194931	9658	4.955	700	0.435	412	0.256	0.594	0.406	48803	34745	40459	61266	9658	0
MKT165315_1_4	5284441	0.55	358679	360141	AT4G13620.1	Integrase-type DNA-binding superfamily protein	122	1463	178486	5689	3.187	713	0.487	456	0.312	0.526	0.474	44933	41643	40224	45997	5689	0
MKT167910_1_4_APOV	6410732	0.66	360142	361819	AT5G49570.1	peptide-N-glycanase 1	120	1678	201360	2767	1.374	520	0.31	263	0.157	0.634	0.366	55270	33535	39057	70731	2767	0
MKT168213_1_4	6492693	0.67	361820	365408	AT2G28470.5	beta-galactosidase 8	122	3589	437858	26663	6.089	1398	0.39	852	0.237	0.611	0.389	119723	74199	85328	131945	26663	0
MKT169758_1_4_APOV	6521445	0.67	365409	368249	AT5G24850.1	cryptochrome 3	122	2841	346602	20309	5.859	1225	0.431	700	0.246	0.587	0.413	88502	66504	68474	102813	20309	0
MKT169891_1_4	4792672	0.49	368250	369195	AT4G24380.2	dihydrofolate reductase	121	946	114466	9130	7.976	440	0.465	267	0.282	0.536	0.464	24762	24047	24830	31697	9130	0
MKT175152_1_4_APOV	6362197	0.66	369196	371468	AT2G20495.2	Serine/Threonine-kinase	121	2273	275033	14955	5.438	1001	0.44	544	0.239	0.573	0.427	73007	48903	62230	75938	14955	0
MKT176042_1_4	5149915	0.53	371469	373004	AT1G64760.2	O-Glycosyl hydrolases family 17 protein	121	1536	185856	15775	8.488	683	0.445	384	0.25	0.571	0.429	46791	38123	34532	50635	15775	0
MKT176331_1_4	6279202	0.65	373005	374852	AT3G16110.1	PDI-like 1-6	120	1848	221760	13971	6.3	894	0.484	530	0.287	0.564	0.436	63728	48435	42169	53457	13971	0
MKT177392_1_4_APOV	6704108	0.69	374853	377096	AT2G42780.2	transcription elongation factor B polypeptide	122	2244	273768	19058	6.961	893	0.398	505	0.225	0.616	0.384	64956	43998	54129	91627	19058	0
MKT182888_1_4_APOV	5168346	0.53	377097	378557	AT1G09010.1	glycoside hydrolase family 2 protein	122	1461	178242	4593	2.577	418	0.286	269	0.184	0.558	0.442	46935	38282	38523	49909	4593	0
MKT184400_1_4_APOV	5761251	0.59	378558	380212	AT2G20790.2	clathrin adaptor complexes medium subunit family protein	121	1655	200255	4191	2.093	363	0.219	202	0.122	0.583	0.417	52492	39356	42411	61805	4191	0
MKT185663_1_4_APOV	3557401	0.37	380213	382654	AT5G17670.1	alpha/beta-Hydrolases superfamily protein	121	2442	295482	29919	10.125	1009	0.413	560	0.229	0.613	0.387	72149	51167	51389	90858	29919	0
MKT185666_1_4_APOV	7065670	0.73	382655	386238	AT5G45360.1	F-box family protein	121	3584	433664	24063	5.549	1466	0.409	888	0.248	0.574	0.426	100989	79566	94942	134104	24063	0
MKT186190_1_4_APOV	6848223	0.71	386239	388847	AT4G26410.1	chromosome-associated kinesin	122	2609	318298	21564	6.775	1142	0.438	611	0.234	0.599	0.401	80812	61392	57662	96868	21564	0
MKT187982_1_4	6345130	0.65	388848	390123	AT3G45690.1	Major facilitator superfamily protein	119	1276	151844	12488	8.224	561	0.44	301	0.236	0.585	0.415	42739	25451	32396	38770	12488	0
MKT188496_1_4_APOV	5379316	0.56	390124	391549	AT5G01310.1	APRATAXIN-like protein	121	1426	172546	3856	2.235	535	0.375	289	0.203	0.598	0.402	48441	31879	35864	52506	3856	0
MKT190086_1_4_APOV	6648316	0.69	391550	393609	AT1G53860.1	Remorin family protein	121	2060	249260	6045	2.425	848	0.412	486	0.236	0.584	0.416	68458	50173	50904	73680	6045	0
MKT193152_1_4	5177067	0.53	393610	396747	AT5G01260.3	Carbohydrate-binding-like fold	122	3138	382836	25269	6.6	1160	0.37	714	0.228	0.581	0.419	104679	72194	77718	102976	25269	0
MKT193254_1_4	5098520	0.53	396748	397660	AT4G02070.2	MUTS homolog 6	119	913	108647	6041	5.56	351	0.384	171	0.187	0.574	0.426	29944	13540	30158	28964	6041	0
MKT194050_1_4_APOV	5348244	0.55	397661	399563	AT5G05490.1	Rad21/Rec8-like family protein	120	1903	228360	20505	8.979	1029	0.541	621	0.326	0.549	0.451	51899	50646	43083	62227	20505	0
MKT194086_1_4_APOV	3420563	0.35	399564	402616	AT5G43600.1	ureidoglycolate amidohydrolase	122	3053	372466	31681	8.506	1380	0.452	794	0.26	0.618	0.382	98103	63546	66773	112363	31681	0
MKT196134_1_4_APOV	3395913	0.35	402617	404733	AT4G38090.2	ribosomal protein S5 domain protein	122	2117	258274	28548	11.053	966	0.456	565	0.267	0.57	0.43	57093	49730	48896	74007	28548	0
MKT196157_1_4_APOV	5817428	0.60	404734	406992	AT1G17760.1	Tetratricopeptide repeat (TPR)-like superfamily protein	121	2259	273339	9438	3.453	955	0.423	528	0.234	0.611	0.389	79217	44688	58061	81935	9438	0
MKT197215_1_4	5154930	0.53	406993	408734	AT3G10230.1	lycopene cyclase	121	1742	210782	4329	2.054	392	0.225	240	0.138	0.543	0.457	52922	43213	51246	59072	4329	0
MKT198187_1_4	6141486	0.63	408735	409605	AT3G54290.1	hemerythrin HHE cation-binding domain protein	119	871	103649	4220	4.071	381	0.437	237	0.272	0.511	0.489	25170	22004	26506	25749	4220	0
MKT198387_1_4_APOV	5828156	0.60	409606	410997	AT5G08320.1	E2F-associated phosphoprotein	118	1392	164256	32616	19.857	708	0.509	415	0.298	0.59	0.41	40651	26407	27607	36975	32616	0
MKT198537_1_4	6256824	0.65	410998	411857	AT5G40410.1	Tetratricopeptide repeat (TPR)-like superfamily protein	121	860	104060	5490	5.276	392	0.456	261	0.303	0.562	0.438	16337	19564	23515	39154	5490	0
MKT198585_1_4	4184400	0.43	411858	412817	AT4G04650.1	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	120	960	115200	7446	6.464	449	0.468	280	0.292	0.515	0.485	19930	26088	26036	35700	7446	0
MKT199612_1_4	6442183	0.66	412818	415303	AT5G64460.5	Phosphoglycerate mutase family protein	122	2486	303292	37287	12.294	1213	0.488	738	0.297	0.594	0.406	72719	51078	56954	85254	37287	0
MKT200802_1_4	5699554	0.59	415304	416318	AT1G08510.1	fatty acyl-ACP thioesterases B	120	1015	121800	6916	5.678	449	0.442	273	0.269	0.536	0.464	30145	25390	27907	31442	6916	0
MKT201180_1_4	3219976	0.33	416319	417181	AT2G05915.1	hypothetical protein	121	863	104423	6112	5.853	456	0.528	277	0.321	0.57	0.43	24088	22891	19448	31884	6112	0
MKT202602_1_4_APOV	6023336	0.62	417182	419286	AT4G11060.1	mitochondrially targeted single-stranded DNA binding protein	121	2105	254705	27844	10.932	1085	0.515	646	0.307	0.605	0.395	60865	42999	46440	76557	27844	0
MKT203107_1_4	6909341	0.71	419287	421262	AT2G17200.1	ubiquitin family protein	122	1976	241072	12454	5.166	727	0.368	412	0.209	0.566	0.434	60002	50729	48471	69416	12454	0
MKT203205_1_4_APOV	5268857	0.54	421263	424284	AT3G58530.1	RNI-like superfamily protein	122	3022	368684	36934	10.018	1369	0.453	774	0.256	0.595	0.405	90014	66849	67529	107358	36934	0
MKT204768_1_4	6144527	0.63	424285	425093	AT1G12430.2	armadillo repeat kinesin 3	120	809	97080	5264	5.422	292	0.361	152	0.188	0.644	0.356	30869	13717	18887	28343	5264	0
MKT204875_1_4	2453676	0.25	425094	425744	AT4G39290.1	Galactose oxidase/kelch repeat superfamily protein	120	651	78120	10801	13.826	528	0.811	399	0.613	0.56	0.44	18663	20882	8789	18985	10801	0
MKT205092_1_4_APOV	6468526	0.67	425745	427790	AT2G34640.1	plastid transcriptionally active 12	121	2046	247566	16620	6.713	737	0.36	434	0.212	0.569	0.431	66679	44115	55260	64892	16620	0
MKT205230_1_4	3640489	0.38	427791	428634	AT4G04640.1	ATPase, F1 complex, gamma subunit protein	120	844	101280	10252	10.122	393	0.466	208	0.246	0.525	0.475	20600	18904	24267	27257	10252	0
MKT206098_1_4_APOV	6248419	0.64	428635	430893	AT3G10970.3	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein	121	2259	273339	15469	5.659	1026	0.454	592	0.262	0.588	0.412	68034	47902	58352	83582	15469	0
MKT206466_1_4_APOV	5992588	0.62	430894	432895	AT2G43110.1	U3 containing 90S pre-ribosomal complex subunit	121	2002	242242	12978	5.357	1022	0.51	610	0.305	0.599	0.401	63659	47917	43981	73707	12978	0
MKT206470_1_4	5737321	0.59	432896	433637	AT1G67500.4	recovery protein 3	121	742	89782	4271	4.757	383	0.516	216	0.291	0.549	0.451	24112	18987	19603	22809	4271	0
MKT208284_1_4_APOV	4705404	0.49	433638	436674	AT3G43540.2	initiation factor 4F subunit (DUF1350)	122	3037	370514	29185	7.877	1461	0.481	843	0.278	0.606	0.394	97915	70285	64307	108822	29185	0
MKT208916_1_4	4508008	0.47	436675	437540	AT4G18930.1	RNA ligase/cyclic nucleotide phosphodiesterase family protein	120	866	103920	2575	2.478	434	0.501	238	0.275	0.506	0.494	24808	22641	27410	26486	2575	0
MKT208959_1_4	3745907	0.39	437541	437926	AT1G52680.1	late embryogenesis abundant protein-related / LEA protein-like protein	113	386	43618	3383	7.756	261	0.676	155	0.402	0.556	0.444	12477	8010	9871	9877	3383	0

MKT210113_1_4_APOV	6855646	0.71	437927	441232	AT3G59490.4	hypothetical protein	121	3306	400026	20081	5.02	1437	0.435	811	0.245	0.582	0.418	99987	75885	82927	121146	20081	0
MKT210707_1_4_APOV	5320186	0.55	441233	444446	AT4G01860.2	Transducin family protein / WD-40 repeat family protein	122	3214	392108	18094	4.615	1214	0.378	625	0.194	0.608	0.392	104819	67925	78581	122689	18094	0
MKT211758_1_4_APOV	6330382	0.65	444447	446564	AT4G15420.2	Ubiquitin fusion degradation UFD1 family protein	121	2118	256278	4354	1.699	711	0.336	405	0.191	0.552	0.448	68563	52198	60579	70584	4354	0
MKT212863_1_4_APOV	6211672	0.64	446565	449159	AT2G35500.1	shikimate kinase like 2	121	2595	313995	35754	11.387	1093	0.421	589	0.227	0.561	0.439	74843	56823	65260	81315	35754	0
MKT217609_1_4	3346336	0.35	449160	449744	AT2G39670.1	Radical SAM superfamily protein	115	585	67275	7137	10.609	227	0.388	120	0.205	0.577	0.423	15445	13954	11426	19313	7137	0
MKT223188_1_4_APOV	5264433	0.54	449745	452182	AT2G34860.2	DnaJ/Hsp40 cysteine-rich domain superfamily protein	122	2438	297436	18794	6.319	1111	0.456	597	0.245	0.589	0.411	69606	54887	59623	94526	18794	0
MKT223227_1_4	4392367	0.45	452183	453872	AT2G02410.12	yacP-like NYN domain protein	120	1690	202800	15333	7.561	735	0.435	415	0.246	0.608	0.392	50426	33379	40066	63596	15333	0
MKT223537_1_4	6730006	0.69	453873	455061	AT4G35300.5	tonoplast monosaccharide transporter2	121	1189	143869	11311	7.862	473	0.398	298	0.251	0.558	0.442	31756	28768	29761	42273	11311	0
MKT225133_1_4	1636276	0.17	455062	455579	AT2G03330.1	transmembrane protein	119	518	61642	3806	6.174	204	0.394	102	0.197	0.594	0.406	16609	11647	11811	17769	3806	0
MKT225962_1_4_APOV	1086130	0.11	455580	457410	AT3G21820.1	histone-lysine N-methyltransferase ATXR2	122	1831	223382	25316	11.333	931	0.508	553	0.302	0.62	0.38	51877	35020	40252	70917	25316	0
MKT227293_1_4_APOV	5860511	0.60	457411	459462	AT2G31840.2	Thioredoxin superfamily protein	121	2052	248292	10858	4.373	830	0.404	448	0.218	0.613	0.387	73496	40171	51692	72075	10858	0
MKT228111_1_4	3383995	0.35	459463	462348	AT2G19490.1	recA DNA recombination family protein	122	2886	352092	24710	7.018	1144	0.396	623	0.216	0.598	0.402	91625	58749	72885	104123	24710	0
MKT228199_1_4	6048637	0.62	462349	464024	AT3G14770.1	Nodulin MtN3 family protein	120	1676	201120	7970	3.963	574	0.342	329	0.196	0.61	0.39	45420	35915	39371	72444	7970	0
MKT229513_1_4	2625785	0.27	464025	465218	AT4G20380.9	LSD1 zinc finger family protein	95	1194	113430	4400	3.879	510	0.427	273	0.229	0.612	0.388	30463	19586	22752	36229	4400	0
MKT229926_1_4_APOV	2583062	0.27	465219	466569	AT3G62940.4	Cysteine proteinases superfamily protein	121	1351	163471	8562	5.238	708	0.524	432	0.32	0.532	0.468	45045	31941	40579	37344	8562	0
MKT231174_1_4	5816470	0.60	466570	467548	AT1G43760.1	DNAse I-like superfamily protein	117	979	114543	21774	19.009	442	0.451	275	0.281	0.568	0.432	25420	16747	23139	27463	21774	0
MKT232553_1_4	5370712	0.55	467549	470351	AT5G61380.1	CCT motif -containing response regulator protein	122	2803	341966	17562	5.136	996	0.355	602	0.215	0.584	0.416	91488	65344	69617	97955	17562	0
MKT232706_1_4_APOV	4684917	0.48	470352	471172	AT4G00560.1	NAD(P)-binding Rossmann-fold superfamily protein	122	821	100162	6253	6.243	484	0.59	326	0.397	0.55	0.45	23856	20939	21394	27720	6253	0
MKT233179_1_4	5373818	0.55	471173	472344	AT5G20420.1	chromatin remodeling 42	121	1172	141812	8550	6.029	577	0.492	360	0.307	0.592	0.408	34596	25400	29147	44119	8550	0
MKT233393_1_4	5036980	0.52	472345	473466	AT3G06530.3	ARM repeat superfamily protein	122	1122	136884	6153	4.495	453	0.404	261	0.233	0.617	0.383	31497	23273	26828	49133	6153	0
MKT233399_1_4_APOV	7027274	0.73	473467	476034	AT3G06530.2	ARM repeat superfamily protein	121	2568	310728	11123	3.58	976	0.38	588	0.229	0.573	0.427	74467	59626	68388	97124	11123	0
MKT234475_1_4_APOV	6235438	0.64	476035	478821	AT1G76450.1	Photosystem II reaction center PsbP family protein	121	2787	337227	47345	14.04	1278	0.459	686	0.246	0.602	0.398	78424	55009	60553	95896	47345	0
MKT235083_1_4	6354175	0.66	478822	480433	AT4G21470.1	riboflavin kinase/FMN hydrolase	121	1612	195052	18379	9.423	826	0.512	484	0.3	0.585	0.415	48030	35353	37906	55384	18379	0
MKT235890_1_4	4072923	0.42	480434	481578	AT1G50480.1	10-formyltetrahydrofolate synthetase	121	1145	138545	18815	13.58	474	0.414	251	0.219	0.601	0.399	33048	21607	26200	38875	18815	0
MKT236372_1_4_APOV	6282838	0.65	481579	486042	AT3G53900.1	uracil phosphoribosyltransferase	121	4464	540144	60836	11.263	1898	0.425	988	0.221	0.589	0.411	126982	94180	102983	155163	60836	0
MKT238438_1_4	6104033	0.63	486043	487019	AT3G61170.1	Tetratricopeptide repeat (TPR)-like superfamily protein	120	977	117240	11981	10.219	516	0.528	287	0.294	0.616	0.384	30329	18693	21670	34567	11981	0
MKT239819_1_4_APOV	1807553	0.19	487020	488471	AT3G45900.1	Ribonuclease P protein subunit P38-like protein	122	1452	177144	9611	5.426	651	0.448	386	0.266	0.522	0.478	44376	34474	45609	43074	9611	0
MKT240204_1_4	5137905	0.53	488472	489508	AT2G26990.1	proteasome family protein	121	1037	125477	3706	2.954	465	0.448	264	0.255	0.607	0.393	33973	23590	24277	39931	3706	0
MKT240662_1_4_APOV	6643406	0.69	489509	491840	AT5G24710.1	Transducin/WD40 repeat-like superfamily protein	122	2332	284504	11645	4.093	867	0.372	500	0.214	0.552	0.448	69639	60006	62110	81104	11645	0
MKT241357_1_4_APOV	6557284	0.68	491841	493766	AT5G66810.2	Ran-binding protein in the microtubule-organising centre protein	121	1926	233046	17617	7.559	943	0.49	513	0.266	0.615	0.385	52712	43119	39729	79869	17617	0
MKT241546_1_4	3853900	0.40	493767	494843	AT3G01880.1	vacuolar sorting-associated protein (DUF946)	121	1077	130317	6793	5.213	579	0.538	323	0.3	0.567	0.433	30529	17588	35796	39611	6793	0
MKT242726_1_4_APOV	4126877	0.43	494844	496737	AT1G48175.6	Cytidine/deoxycytidylate deaminase family protein	122	1894	231068	25288	10.944	816	0.431	484	0.256	0.563	0.437	48548	40875	49186	67171	25288	0
MKT242935_1_4	5614690	0.58	496738	499039	AT5G64370.1	beta-ureidopropionase	122	2302	280844	20731	7.382	1038	0.451	564	0.245	0.588	0.412	69535	49604	57567	83407	20731	0
MKT243378_1_4	4693313	0.48	499040	499946	AT3G44690.1	hypothetical protein	114	907	103398	13235	12.8	353	0.389	172	0.19	0.588	0.412	23700	18808	18330	29325	13235	0
MKT244181_1_4	6238225	0.64	499947	501359	AT1G49340.4	Phosphatidylinositol 3- and 4-kinase family protein	122	1413	172386	7511	4.357	487	0.345	314	0.222	0.496	0.504	39872	31175	51771	42057	7511	0
MKT244595_1_4	1640658	0.17	501360	501830	AT2G34970.1	Trimeric LpxA-like enzyme	116	471	54636	3349	6.13	148	0.314	89	0.189	0.603	0.397	12389	8258	12099	18541	3349	0
MKT245813_1_4_APOV	4523902	0.47	501831	503074	AT3G49070.2	transmembrane protein, putative (DUF677)	121	1244	150524	2280	1.515	445	0.358	281	0.226	0.572	0.428	45020	31091	32364	39769	2280	0
MKT246045_1_4	3436468	0.35	503075	504083	AT3G15110.1	transmembrane protein	120	1009	121080	6609	5.458	442	0.438	261	0.259	0.509	0.491	24596	33009	23112	33754	6609	0
MKT246079_1_4_APOV	6756061	0.70	504084	507305	AT2G17900.1	SET domain group 37	122	3222	393084	21802	5.546	1280	0.397	765	0.237	0.629	0.371	101142	69097	68933	132110	21802	0
MKT246461_1_4_APOV	6934339	0.72	507306	509902	AT3G24560.2	Adenine nucleotide alpha hydrolases-like superfamily protein	122	2597	316834	21637	6.829	1029	0.396	530	0.204	0.607	0.393	79630	49360	66323	99884	21637	0
MKT248146_1_4	6290196	0.65	509903	511364	AT2G31660.1	ARM repeat superfamily protein	121	1462	176902	5423	3.066	570	0.39	365	0.25	0.594	0.406	48051	36686	32962	53780	5423	0
MKT248631_1_4_APOV	2711403	0.28	511365	515552	AT1G73440.1	calmodulin-like protein	121	4188	506748	40488	7.99	2002	0.478	1144	0.273	0.594	0.406	129705	89313	100049	147193	40488	0
MKT249328_1_4_APOV	4745126	0.49	515553	518653	AT1G50000.1	methyltransferase	121	3101	375221	30013	7.999	1476	0.476	867	0.28	0.586	0.414	93101	62712	79953	109442	30013	0
MKT249944_1_4	3700753	0.38	518654	519279	AT2G23070.1	Protein kinase superfamily protein	119	626	74494	4237	5.688	311	0.497	227	0.363	0.636	0.364	17881	10855	14695	26826	4237	0
MKT250009_1_4_APOV	7131975	0.74	519280	522579	AT3G15090.1	GroES-like zinc-binding alcohol dehydrogenase family protein	122	3300	402600	33708	8.373	1357	0.411	788	0.239	0.579	0.421	103251	75286	80121	110234	33708	0
MKT251689_1_4_APOV	5686765	0.59	522580	526312	AT3G54170.1	FKBP12 interacting protein 37	122	3733	455426	38114	8.369	1681	0.45	966	0.259	0.593	0.407	120975	62895	107175	126267	38114	0
MKT255591_1_4	5610258	0.58	526313	527109	AT4G39660.2	alanine:glyoxylate aminotransferase 2	121	797	96437	4006	4.154	313	0.393	203	0.255	0.622	0.378	27569	16454	18435	29973	4006	0
MKT257161_1_4	7083157	0.73	527110	528687	AT4G02790.1	GTP-binding family protein	121	1578	190938	8383	4.39	639	0.405	351	0.222	0.568	0.432	52942	38289	40592	50732	8383	0
MKT257387_1_4	2618912	0.27	528688	529198	AT1G16800.1	P-loop containing nucleoside triphosphate hydrolases superfamily	121	511	61831	8189	13.244	232	0.454	125	0.245	0.544	0.456	13666	12544	11910	15522	8189	0

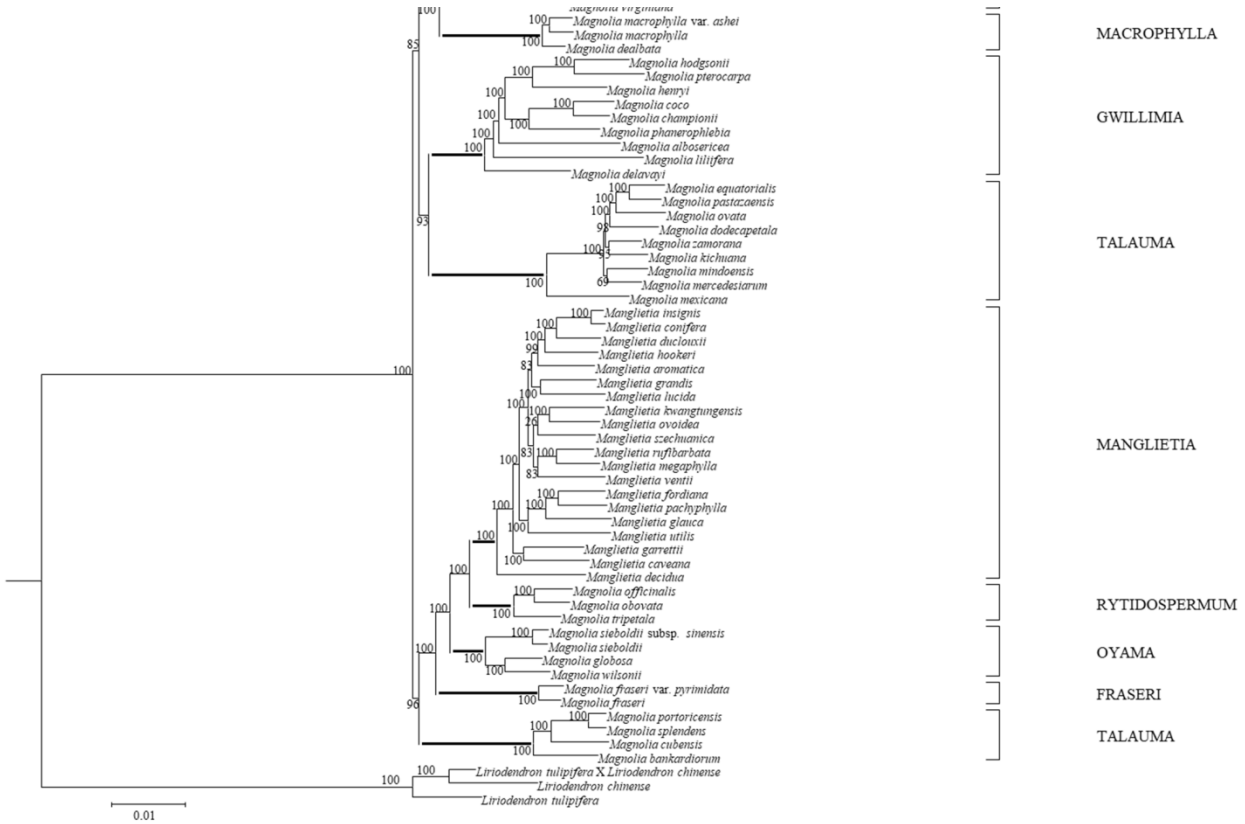
MKT259369_1_4_APOV	5925312	0.61	529199	531127	AT3G28030.4	protein 5'-3' exonuclease family protein	121	1929	233409	6899	2.956	708	0.367	371	0.192	0.603	0.397	62585	45326	44565	74034	6899	0
MKT261594_1_4	6225153	0.64	531128	532594	AT5G06440.1	polyketide cyclase/dehydrase/lipid transport superfamily protein	121	1467	177507	9878	5.565	632	0.431	351	0.239	0.621	0.379	46546	28615	34907	57561	9878	0
MKT264772_1_4_APOV	5249725	0.54	532595	535233	AT5G19130.1	GPI transamidase component family protein / Gaa1-like family protein	121	2639	319319	14823	4.642	979	0.371	546	0.207	0.59	0.41	82887	59902	65068	96639	14823	0
MKT265035_1_4_APOV	6599883	0.68	535234	537935	AT3G12080.1	GTP-binding family protein	121	2702	326942	22903	7.005	1005	0.372	567	0.21	0.614	0.386	84119	54423	62910	102587	22903	0
MKT265344_1_4_APOV	3456709	0.36	537936	540437	AT2G44760.1	dihydroorotate dehydrogenase (DUF3598)	121	2502	302742	17474	5.772	929	0.371	500	0.2	0.605	0.395	77955	51042	61653	94618	17474	0
MKT267759_1_4	4952493	0.51	540438	541396	AT2G18030.1	Peptide methionine sulfoxide reductase family protein	121	959	116039	3135	2.702	295	0.308	176	0.184	0.546	0.454	31938	24215	26996	29755	3135	0
MKT267794_1_4_APOV	5439310	0.56	541397	542964	AT5G39410.1	Saccharopine dehydrogenase	121	1568	189728	11880	6.262	581	0.371	371	0.237	0.541	0.459	48257	33553	48134	47904	11880	0
MKT268004_1_4_APOV	3398918	0.35	542965	546451	AT4G34140.10	D111/G-patch domain-containing protein	122	3487	425414	30785	7.236	1389	0.398	760	0.218	0.601	0.399	109768	72427	84742	127692	30785	0
MKT268009_1_4_APOV	6081580	0.63	546452	549086	AT3G27670.1	ARM repeat superfamily protein	121	2635	318835	13348	4.186	982	0.373	587	0.223	0.583	0.417	83602	61405	66031	94449	13348	0
MKT271231_1_4_APOV	6086893	0.63	549087	551548	AT5G48830.2	phosphoglycolate phosphatase	121	2462	297902	34360	11.534	1024	0.416	561	0.228	0.57	0.43	65274	50495	62920	84853	34360	0
MKT272162_1_4_APOV	6738232	0.70	551549	553902	AT2G20980.1	minichromosome maintenance 10	121	2354	284834	11594	4.07	877	0.373	497	0.211	0.604	0.396	68569	50744	57305	96622	11594	0
MKT272727_1_4_APOV	5520392	0.57	553903	556533	AT5G64860.1	disproportionating enzyme	122	2631	320982	19550	6.091	1009	0.384	537	0.204	0.611	0.389	82940	55239	61906	101347	19550	0
MKT272827_1_4	7556290	0.78	556534	560525	AT3G59060.4	phytochrome interacting factor 3-like 6	121	3992	483032	23951	4.958	1404	0.352	844	0.211	0.558	0.442	121854	97559	105576	134092	23951	0
MKT273349_1_4_APOV	6778655	0.70	560526	563217	AT1G08750.3	Peptidase C13 family	122	2692	328424	30411	9.26	1149	0.427	720	0.267	0.612	0.388	84857	51083	64460	97613	30411	0
MKT274838_1_4	6029146	0.62	563218	564530	AT5G53330.1	Ubiquitin-associated/translation elongation factor EF1B protein	121	1313	158873	15935	10.03	504	0.384	258	0.196	0.603	0.397	34754	27100	29611	51473	15935	0
MKT275800_1_4_APOV	6058671	0.63	564531	566105	AT3G17611.1	RHOMBOID-like protein 14	120	1575	189000	8332	4.408	693	0.44	397	0.252	0.537	0.463	42706	40260	43304	54398	8332	0
MKT276078_1_4_APOV	3953999	0.41	566106	567506	AT5G52810.1	NAD(P)-binding Rossmann-fold superfamily protein	122	1401	170922	4718	2.76	463	0.33	261	0.186	0.573	0.427	41160	31881	38967	54196	4718	0
MKT276084_1_4	5260019	0.54	567507	568144	AT1G77280.2	kinase with adenine nucleotide alpha hydrolases-like domain-containing protein	120	638	76560	3071	4.011	257	0.403	140	0.219	0.599	0.401	23212	12929	16515	20833	3071	0
MKT277188_1_4	5827801	0.60	568145	569070	AT4G08685.1	Pollen Ole e 1 allergen and extensin family protein	122	926	112972	11778	10.426	431	0.465	229	0.247	0.529	0.471	25555	22668	24946	28025	11778	0
MKT277229_1_4	6364178	0.66	569071	570867	AT1G33410.2	SUPPRESSOR OF AUXIN RESISTANCE1	121	1797	217437	13341	6.136	698	0.388	400	0.223	0.632	0.368	57949	35116	40046	70985	13341	0
MKT277271_1_4_APOV	6383863	0.66	570868	574955	AT1G50120.1	immunoglobulin	121	4088	494648	25617	5.179	1524	0.373	871	0.213	0.615	0.385	124644	86898	93476	164013	25617	0
MKT277532_1_4	6075083	0.63	574956	579564	AT5G66920.1	SKU5 similar 17	121	4609	557689	23423	4.2	1832	0.397	1066	0.231	0.601	0.399	147324	107439	105635	173868	23423	0
MKT277935_1_4_APOV	6801546	0.70	579565	581846	AT5G56960.1	basic helix-loop-helix (bHLH) DNA-binding family protein	120	2282	273840	5010	1.83	821	0.36	501	0.22	0.58	0.42	76415	62881	50092	79442	5010	0
MKT278004_1_4_APOV	6306073	0.65	581847	584629	AT1G55280.1	Lipase/lipooxygenase, PLAT/LH2 family protein	121	2783	336743	16816	4.994	1204	0.433	703	0.253	0.575	0.425	92244	63719	72163	91801	16816	0
MKT279186_1_4_APOV	6667342	0.69	584630	587677	AT3G09180.3	mediator of RNA polymerase II transcription subunit	120	3048	365760	23089	6.313	1288	0.423	731	0.24	0.584	0.416	91247	70366	72208	108850	23089	0
MKT279537_1_4	6638937	0.69	587678	589528	AT1G80410.1	tetratricopeptide repeat (TPR)-containing protein	120	1851	222120	15586	7.017	728	0.393	448	0.242	0.594	0.406	52063	32929	50968	70574	15586	0
MKT280150_1_4_APOV	6639921	0.69	589529	592174	AT2G14260.3	proline iminopeptidase	122	2646	322812	30040	9.306	1019	0.385	568	0.215	0.605	0.395	78516	55037	60494	98725	30040	0
MKT281671_1_4_APOV	6591546	0.68	592175	595192	AT3G06950.1	Pseudouridine synthase family protein	122	3018	368196	30226	8.209	1262	0.418	724	0.24	0.59	0.41	91224	69799	68544	108403	30226	0
MKT282190_1_4	6301798	0.65	595193	597924	AT1G27680.1	ADPGLC-PPase large subunit	122	2732	333304	19561	5.869	1127	0.413	650	0.238	0.609	0.391	83498	60708	61876	107661	19561	0
MKT282250_1_4	1028154	0.11	597925	598498	AT3G02560.3	Ribosomal protein S7e family protein	121	574	69454	6742	9.707	247	0.43	141	0.246	0.569	0.431	17772	11367	15634	17939	6742	0
MKT283955_1_4	6417938	0.66	598499	600446	AT1G22870.3	kinase family with ARM repeat domain-containing protein	121	1948	235708	12358	5.243	771	0.396	449	0.23	0.601	0.399	59627	41700	47362	74661	12358	0
MKT284160_1_4	6692070	0.69	600447	602599	AT4G35520.5	MUTL protein homolog 3	121	2153	260513	19658	7.546	940	0.437	522	0.242	0.576	0.424	71053	47462	54635	67705	19658	0
MKT285757_1_4	5033042	0.52	602600	603267	AT3G61500.2	BPS1-like protein	117	668	78156	7130	9.123	303	0.454	143	0.214	0.551	0.449	16818	13444	18392	22372	7130	0
MKT286562_1_4_APOV	5952288	0.61	603268	605764	AT5G35670.1	IQ-domain 33	121	2497	302137	12043	3.986	1018	0.408	586	0.235	0.577	0.423	90893	59873	62813	76515	12043	0
MKT287698_1_4_APOV	4470961	0.46	605765	608649	AT1G10510.1	RNI-like superfamily protein	121	2885	349085	22422	6.423	1406	0.487	822	0.285	0.578	0.422	84270	63169	74574	104650	22422	0
MKT288332_1_4_APOV	6028063	0.62	608650	611298	AT4G27120.3	DDRGK domain protein	121	2649	320529	23750	7.41	1183	0.447	635	0.24	0.596	0.404	86629	52086	67874	90190	23750	0
MKT288424_1_4	5444407	0.56	611299	612582	AT3G47810.3	Calcineurin-like metallo-phosphoesterase superfamily protein	121	1284	155364	9323	6.001	518	0.403	307	0.239	0.597	0.403	38360	29165	29676	48840	9323	0
MKT293201_1_4	4201648	0.43	612583	613677	AT5G64840.1	general control non-repressible 5	122	1095	133590	4751	3.556	329	0.3	190	0.174	0.55	0.45	36799	22516	35458	34066	4751	0
MKT293539_1_4	4748233	0.49	613678	614212	AT1G56570.2	Tetratricopeptide repeat (TPR)-like superfamily protein	116	535	62060	1847	2.976	224	0.419	115	0.215	0.607	0.393	17856	12360	11273	18724	1847	0
MKT295445_1_4_APOV	5811787	0.60	614213	616181	AT3G24080.4	KRR1 family protein	122	1969	240218	6347	2.642	627	0.318	342	0.174	0.521	0.479	73604	32800	79219	48248	6347	0
MKT296549_1_4_APOV	6278817	0.65	616182	618832	AT5G44750.2	DNA-directed DNA polymerase	121	2651	320771	16372	5.104	897	0.338	531	0.2	0.623	0.377	82611	56894	57784	107110	16372	0
MKT297810_1_4_APOV	6080665	0.63	618833	621751	AT1G50575.1	Putative lysine decarboxylase family protein	122	2919	356118	40479	11.367	1348	0.462	795	0.272	0.577	0.423	88656	64746	68602	93635	40479	0
MKT297825_1_4	4172196	0.43	621752	622580	AT1G43760.1	DNAse I-like superfamily protein	116	829	96164	13186	13.712	364	0.439	185	0.223	0.55	0.45	21277	17353	19920	24428	13186	0
MKT298063_1_4	6281464	0.65	622581	625000	No_hit	No_hit	118	2420	285560	39886	13.968	1332	0.55	909	0.376	0.535	0.465	63508	54685	59655	67826	39886	0
MKT299474_1_4_APOV	4945511	0.51	625001	626553	AT3G63290.1	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	122	1553	189466	5613	2.963	537	0.346	310	0.2	0.586	0.414	55670	34887	41154	52142	5613	0
MKT300606_1_4_APOV	5485629	0.57	626554	629118	AT3G26085.4	CAAX amino terminal protease family protein	117	2565	300105	27264	9.085	1158	0.451	663	0.258	0.606	0.394	74259	51780	55666	91136	27264	0

MKT301981_1_4_APOV	4415583	0.46	629119	631273	AT1G76280.2	Tetratricopeptide repeat (TPR)-like superfamily protein	118	2155	254290	20698	8.14	905	0.42	529	0.245	0.594	0.406	63181	43002	51901	75508	20698	0
MKT302745_1_4	1005876	0.10	631274	632162	AT5G62570.4	Calmodulin binding protein-like protein	86	889	76454	12850	16.807	418	0.47	223	0.251	0.596	0.404	19026	10776	15023	18779	12850	0
MKT303404_1_4	5679082	0.59	632163	634078	AT4G08500.1	MAPK/ERK kinase kinase 1	117	1916	224172	28638	12.775	852	0.445	470	0.245	0.588	0.412	59793	34565	46311	54865	28638	0
MKT304100_1_4_APOV	5232286	0.54	634079	637444	AT3G03790.1	ankyrin repeat family protein / regulator of chromosome condensation (RCC1) family protein	116	3366	390456	22114	5.664	1210	0.359	714	0.212	0.577	0.423	93944	73558	82293	118547	22114	0
MKT305891_1_4	812190	0.08	637445	638491	AT1G50200.2	Alanyl-tRNA synthetase	116	1047	121452	9602	7.906	472	0.451	253	0.242	0.579	0.421	29090	21638	25506	35616	9602	0
MKT306820_1_4	3561608	0.37	638492	640642	AT5G17250.1	Alkaline-phosphatase-like family protein	117	2151	251667	24219	9.623	861	0.4	509	0.237	0.591	0.409	57839	42131	50941	76537	24219	0
MKT307031_1_4_APOV	1024908	0.11	640643	642006	AT1G17665.1	CA-responsive protein	118	1364	160952	17022	10.576	685	0.502	405	0.297	0.569	0.431	41343	28775	33276	40536	17022	0
MKT308263_1_4	5222283	0.54	642007	642774	AT3G52220.1	leukocyte immunoglobulin-like receptor family A protein	116	768	89088	4232	4.75	285	0.371	156	0.203	0.559	0.441	22838	18388	19029	24601	4232	0
MKT308611_1_4	5248963	0.54	642775	644208	AT5G32470.1	heme oxygenase-like, multi-helical	117	1434	167778	13176	7.853	500	0.349	270	0.188	0.593	0.407	39855	28225	34590	51932	13176	0
MKT308778_1_4	4700797	0.49	644209	647200	AT3G24255.3	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	117	2992	350064	24697	7.055	1336	0.447	789	0.264	0.574	0.426	100406	61526	77306	86129	24697	0
MKT308997_1_4_APOV	5758217	0.59	647201	650141	AT5G23520.2	smr (Small MutS Related) domain-containing protein	117	2941	344097	16478	4.789	1269	0.431	722	0.245	0.577	0.423	96040	68498	70020	93061	16478	0
MKT310237_1_4_APOV	4802240	0.50	650142	652985	AT1G63160.1	replication factor C 2	118	2844	335592	19395	5.779	1165	0.41	678	0.238	0.597	0.403	85001	63524	63871	103801	19395	0
MKT311863_1_4_APOV	3604755	0.37	652986	654673	AT5G60540.1	pyridoxine biosynthesis 2	116	1688	195808	14553	7.432	854	0.506	494	0.293	0.567	0.433	43423	38118	40381	59333	14553	0
MKT312086_1_4_APOV	4685918	0.48	654674	657515	AT1G01930.1	zinc finger protein-like protein	116	2842	329672	12821	3.889	1132	0.398	658	0.232	0.598	0.402	88760	60709	66794	100588	12821	0
MKT312515_1_4	1113042	0.11	657516	658399	AT1G19910.1	ATPase, F0/V0 complex, subunit C protein	117	884	103428	14501	14.02	372	0.421	208	0.235	0.518	0.482	17898	23160	20076	27793	14501	0
MKT312523_1_4_APOV	5863259	0.60	658400	661517	AT5G08720.1	polyketide cyclase/dehydrase/lipid transporter	117	3118	364806	31948	8.758	1222	0.392	669	0.215	0.585	0.415	94916	65866	72148	99928	31948	0
MKT312769_1_4_APOV	729720	0.08	661518	662657	AT5G41850.1	alpha/beta-Hydrolases superfamily protein	117	1140	133380	15190	11.389	625	0.548	370	0.325	0.576	0.424	31899	23186	27056	36049	15190	0
MKT314389_1_4	5578358	0.58	662658	664604	AT3G28480.1	Oxoglutarate/iron-dependent oxygenase	117	1947	227799	12243	5.374	757	0.389	450	0.231	0.593	0.407	55746	40977	46721	72112	12243	0
MKT314507_1_4	6009000	0.62	664605	665741	AT1G09795.1	ATP phosphoribosyl transferase 2	117	1137	133029	7346	5.522	598	0.526	373	0.328	0.63	0.37	34418	19326	27154	44785	7346	0
MKT314708_1_4	670813	0.07	665742	666088	AT3G26480.2	Transducin family protein / WD-40 repeat family protein	113	347	39211	8366	21.336	264	0.761	164	0.473	0.461	0.539	6060	7824	8774	8187	8366	0
MKT314787_1_4	5951265	0.61	666089	669200	AT2G04620.1	zinc transporter-like protein	118	3112	367216	7436	2.025	943	0.303	605	0.194	0.514	0.486	76912	103696	71081	108091	7436	0
MKT315244_1_4_APOV	5282476	0.55	669201	670688	AT2G46060.2	transmembrane protein-like protein	117	1488	174096	10737	6.167	522	0.351	312	0.21	0.6	0.4	48734	33638	31736	49251	10737	0
MKT315917_1_4	4848419	0.50	670689	671490	AT1G14590.1	Nucleotide-diphospho-sugar transferase family protein	116	802	93032	4612	4.957	435	0.542	252	0.314	0.557	0.443	23371	19467	19671	25911	4612	0
MKT316089_1_4	5479968	0.57	671491	673196	AT2G46900.1	transcription factor-like protein	117	1706	199602	5484	2.747	516	0.302	327	0.192	0.555	0.445	49856	42379	43962	57921	5484	0
MKT316544_1_4_APOV	6030174	0.62	673197	676460	AT5G03430.1	phosphoadenosine phosphosulfate (PAPS) reductase family protein	118	3264	385152	28627	7.433	1157	0.354	624	0.191	0.601	0.399	93081	73344	68883	121217	28627	0
MKT317772_1_4	4591165	0.47	676461	678128	AT2G04842.2	threonyl-tRNA synthetase, putative / threonine-tRNA ligase	116	1668	193488	6306	3.259	649	0.389	323	0.194	0.6	0.4	50914	35617	39274	61377	6306	0
MKT320490_1_4_APOV	5008998	0.52	678129	681868	AT3G15080.1	Polynucleotidyl transferase, ribonuclease H-like superfamily protein	116	3740	433840	21221	4.891	1778	0.475	1067	0.285	0.587	0.413	116203	76985	93524	125907	21221	0
MKT322600_1_4	3207772	0.33	681869	683981	AT2G20420.1	ATP citrate lyase (ACL) family protein	118	2113	249334	19488	7.816	973	0.46	539	0.255	0.603	0.397	65256	39726	51463	73401	19488	0
MKT323905_1_4_APOV	4296963	0.44	683982	686999	AT5G12920.4	Transducin/WD40 repeat-like superfamily protein	118	3018	356124	25279	7.098	1289	0.427	711	0.236	0.631	0.369	91465	61165	60934	117281	25279	0
MKT325055_1_4	5847092	0.60	687000	688181	AT3G60740.3	ARM repeat superfamily protein	117	1182	138294	7783	5.628	494	0.418	282	0.239	0.608	0.392	35012	23317	27756	44426	7783	0
MKT326621_1_4	5695306	0.59	688182	689760	AT3G24255.7	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	117	1579	184743	13292	7.195	671	0.425	416	0.263	0.571	0.429	49173	26071	47513	48694	13292	0
MKT328764_1_4	4866496	0.50	689761	690460	AT3G15040.1	senescence regulator (Protein of unknown function, DUF584)	117	700	81900	2621	3.2	233	0.333	140	0.2	0.494	0.506	16650	21841	18275	22513	2621	0
MKT331516_1_4_APOV	5438801	0.56	690461	691847	AT5G19970.1	GRAS family transcription factor family protein	117	1387	162279	4219	2.6	528	0.381	311	0.224	0.44	0.56	31439	40569	48028	38024	4219	0
MKT332424_1_4_APOV	6056277	0.62	691848	694473	AT3G10380.2	subunit of exocyst complex 8	117	2626	307242	32364	10.534	1134	0.432	643	0.245	0.585	0.415	76162	49709	64504	84503	32364	0
MKT333354_1_4	5495085	0.57	694474	696445	AT4G24490.2	RAB geranylgeranyl transferase alpha subunit 1	117	1972	230724	17888	7.753	917	0.465	471	0.239	0.589	0.411	59966	42946	44559	65365	17888	0
MKT334782_1_4	3996777	0.41	696446	700721	AT3G61170.1	Tetratricopeptide repeat (TPR)-like superfamily protein	117	4276	500292	53744	10.743	1733	0.405	1015	0.237	0.595	0.405	103460	80990	99650	162448	53744	0
MKT337520_1_4_APOV	4220252	0.44	700722	702792	AT5G48390.1	Tetratricopeptide repeat (TPR)-like superfamily protein	117	2071	242307	11887	4.906	846	0.408	518	0.25	0.529	0.471	63219	60457	47896	58848	11887	0
MKT339163_1_4	862587	0.09	702793	703326	ATMG00750.1	GAG/POL/ENV polyprotein	114	534	60876	4351	7.147	257	0.481	172	0.322	0.564	0.436	15180	12754	11973	16618	4351	0
MKT341624_1_4_APOV	4968686	0.51	703327	705719	AT2G40760.1	Rhodanese/Cell cycle control phosphatase superfamily protein	117	2393	279981	24855	8.877	1078	0.45	618	0.258	0.562	0.438	65074	48318	63266	78468	24855	0
MKT341643_1_4_APOV	6126497	0.63	705720	708894	AT1G19690.1	NAD(P)-binding Rossmann-fold superfamily protein	118	3175	374650	20252	5.406	1363	0.429	769	0.242	0.583	0.417	95419	69555	78155	111269	20252	0
MKT344417_1_4	3779039	0.39	708895	710213	AT2G26140.1	FTSH protease 4	117	1319	154323	15816	10.249	465	0.353	282	0.214	0.614	0.386	37625	24657	28772	47453	15816	0

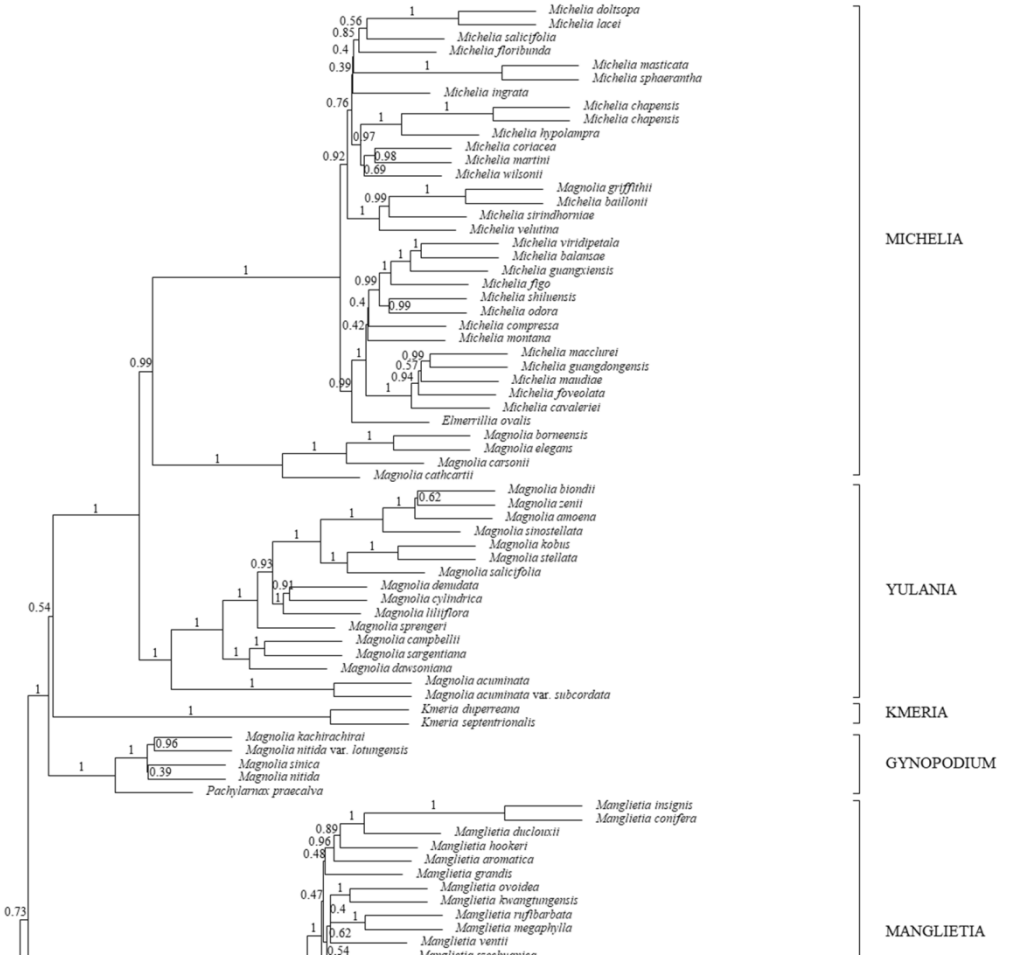
MKT346077_1_4_APOV	6340744	0.65	710214	713563	AT5G17240.2	SET domain group 40	117	3350	391950	30590	7.805	1262	0.377	716	0.214	0.589	0.411	100737	68240	80201	112182	30590	0
MKT346101_1_4	4094906	0.42	713564	714691	AT5G19900.5	PRLI-interacting factor	117	1128	131976	1141	0.865	285	0.253	171	0.152	0.489	0.511	33370	28858	37936	30671	1141	0
MKT346845_1_4_APOV	6318586	0.65	714692	718372	AT1G12370.1	photolyase 1	117	3681	430677	23559	5.47	1437	0.39	802	0.218	0.58	0.42	97645	75253	95457	138763	23559	0
MKT347521_1_4	2624200	0.27	718373	721227	AT1G21630.4	Calcium-binding EF hand family protein	117	2855	334035	36303	10.868	1427	0.5	865	0.303	0.565	0.435	82611	48705	81123	85293	36303	0
MKT348011_1_4_APOV	4371174	0.45	721228	723088	AT1G03687.1	DTW domain-containing protein	117	1861	217737	17072	7.841	915	0.492	562	0.302	0.522	0.478	48167	47284	48607	56607	17072	0
MKT348468_1_4	4196936	0.43	723089	724052	AT5G14210.3	Leucine-rich repeat protein kinase family protein	117	964	112788	12912	11.448	498	0.517	309	0.321	0.578	0.422	27565	17778	24343	30190	12912	0
MKT348660_1_4_APOV	5511544	0.57	724053	726475	AT5G04440.2	RAP release 2, galactose-binding-like domain protein, putative (DUF1997)	118	2423	285914	13277	4.644	1016	0.419	632	0.261	0.564	0.436	64462	57589	61207	89379	13277	0
MKT349073_1_4	4343316	0.45	726476	727809	AT1G16240.4	syntaxin of plants 51	117	1334	156078	11122	7.126	468	0.351	283	0.212	0.598	0.402	41298	24634	33668	45356	11122	0
MKT350500_1_4	6267454	0.65	727810	730019	AT2G45540.6	WD-40 repeat family protein / beige-like protein	118	2210	260780	30117	11.549	832	0.376	454	0.205	0.615	0.385	64599	48909	39818	77337	30117	0
MKT351432_1_4	3653810	0.38	730020	730769	AT3G56960.2	phosphatidyl inositol monophosphate 5 kinase 4	113	750	84750	4808	5.673	498	0.664	340	0.453	0.544	0.456	22538	16855	19639	20910	4808	0
MKT351705_1_4	4757976	0.49	730770	732200	AT4G31800.2	WRKY DNA-binding protein 18	113	1431	161703	12356	7.641	925	0.646	686	0.479	0.549	0.451	40342	36370	31134	41501	12356	0
MKT351756_1_4_APOV	3807734	0.39	732201	733216	AT4G31460.1	Ribosomal L28 family	117	1016	118872	6053	5.092	424	0.417	270	0.266	0.525	0.475	29573	22171	31370	29705	6053	0
MKT351865_1_4	4321629	0.45	733217	735176	AT2G39750.1	S-adenosyl-L-methionine-dependent methyltransferases superfamily protein	117	1960	229320	13075	5.702	985	0.503	597	0.305	0.537	0.463	58011	51009	48958	58267	13075	0
MKT353296_1_4_APOV	5429841	0.56	735177	737415	AT5G07380.6	hypothetical protein	117	2239	261963	11202	4.276	933	0.417	505	0.226	0.607	0.393	64146	47818	50827	87970	11202	0
MKT353714_1_4_APOV	4624087	0.48	737416	739110	AT5G64370.1	beta-ureidopropionase	116	1695	196620	7080	3.601	633	0.373	376	0.222	0.574	0.426	46654	36729	43946	62211	7080	0
MKT354514_1_4	3004076	0.31	739111	739870	AT1G27530.1	ubiquitin-fold modifier-conjugating enzyme	117	760	88920	3401	3.825	364	0.479	230	0.303	0.475	0.525	20814	20840	23997	19868	3401	0
MKT355030_1_4	4107606	0.42	739871	742088	AT5G66150.3	Glycosyl hydrolase family 38 protein	118	2218	261724	8701	3.324	947	0.427	533	0.24	0.592	0.408	67391	56732	46387	82513	8701	0
MKT355607_1_4	6477267	0.67	742089	745353	AT4G02600.2	Seven transmembrane MLO family protein	118	3265	385270	23780	6.172	1332	0.408	763	0.234	0.589	0.411	91556	72142	76246	121546	23780	0
MKT358559_1_4_APOV	2358425	0.24	745354	747386	AT5G57160.1	DNA ligase IV	118	2033	239894	16489	6.873	870	0.428	491	0.242	0.605	0.395	61138	40021	48323	73923	16489	0
MKT358844_1_4_APOV	5265487	0.54	747387	749886	AT3G04490.3	exportin-4 protein	117	2500	292500	15201	5.197	811	0.324	443	0.177	0.6	0.4	73073	54728	56222	93276	15201	0
MKT358915_1_4	969003	0.10	749887	753152	AT5G12200.1	pyrimidine 2	118	3266	385388	40408	10.485	1679	0.514	1026	0.314	0.593	0.407	93337	66939	73369	111335	40408	0
MKT359827_1_4_APOV	4276064	0.44	753153	754577	AT5G35690.1	zinc metalloproteinase-like protein	117	1425	166725	3556	2.133	573	0.402	335	0.235	0.568	0.432	49548	33176	37372	43073	3556	0
MKT362323_1_4	4344347	0.45	754578	755619	AT1G71070.1	Core-2/I-branching beta-1, 6-N-acetylglucosaminyltransferase family protein	114	1042	118788	3706	3.12	499	0.479	297	0.285	0.569	0.431	38287	20886	28713	27196	3706	0
MKT362454_1_4	5537321	0.57	755620	756401	AT1G50900.1	Ankyrin repeat family protein	116	782	90712	3876	4.273	384	0.491	256	0.327	0.547	0.453	26109	20720	18660	21347	3876	0
MKT362594_1_4_APOV	3994365	0.41	756402	758313	AT2G33260.1	Tryptophan/tyrosine permease	118	1912	225616	6942	3.077	763	0.399	425	0.222	0.54	0.46	51377	54264	46168	66865	6942	0
MKT363416_1_4_APOV	3641279	0.38	758314	761056	AT1G73180.2	Eukaryotic translation initiation factor eIF2A family protein	118	2743	323674	29868	9.228	1125	0.41	572	0.209	0.583	0.417	77562	59692	62760	93792	29868	0
MKT363585_1_4_APOV	4639193	0.48	761057	763415	AT4G27720.1	Major facilitator superfamily protein	117	2359	276003	10266	3.72	776	0.329	447	0.189	0.586	0.414	63079	55558	54338	92762	10266	0
MKT363600_1_4	5398685	0.56	763416	764534	AT1G20650.1	Protein kinase superfamily protein	117	1119	130923	8862	6.769	474	0.424	257	0.23	0.605	0.395	29004	22025	26193	44839	8862	0
MKT370789_1_4	3679374	0.38	764535	765376	AT5G13210.1	Uncharacterized conserved protein UCP015417, vWA	116	842	97672	5260	5.385	472	0.561	253	0.3	0.525	0.475	19635	21332	22596	28849	5260	0
Min.	294903	0.03					86	259	22533	988	0.865	52	0.026	21	0.01	0.41	0.342	6060	4478	3292	4278	988	0
Max.	8042130	0.83					125	4954	614296	61708	24.257	2094	0.848	1180	0.745	0.658	0.59	149292	107439	136815	190026	61708	0
Ave.	5098527	0.53					120	1913	230796	15973	6.948	804	0.430	465	0.251	0.578	0.422	57878	42128	47389	67426	15973	0



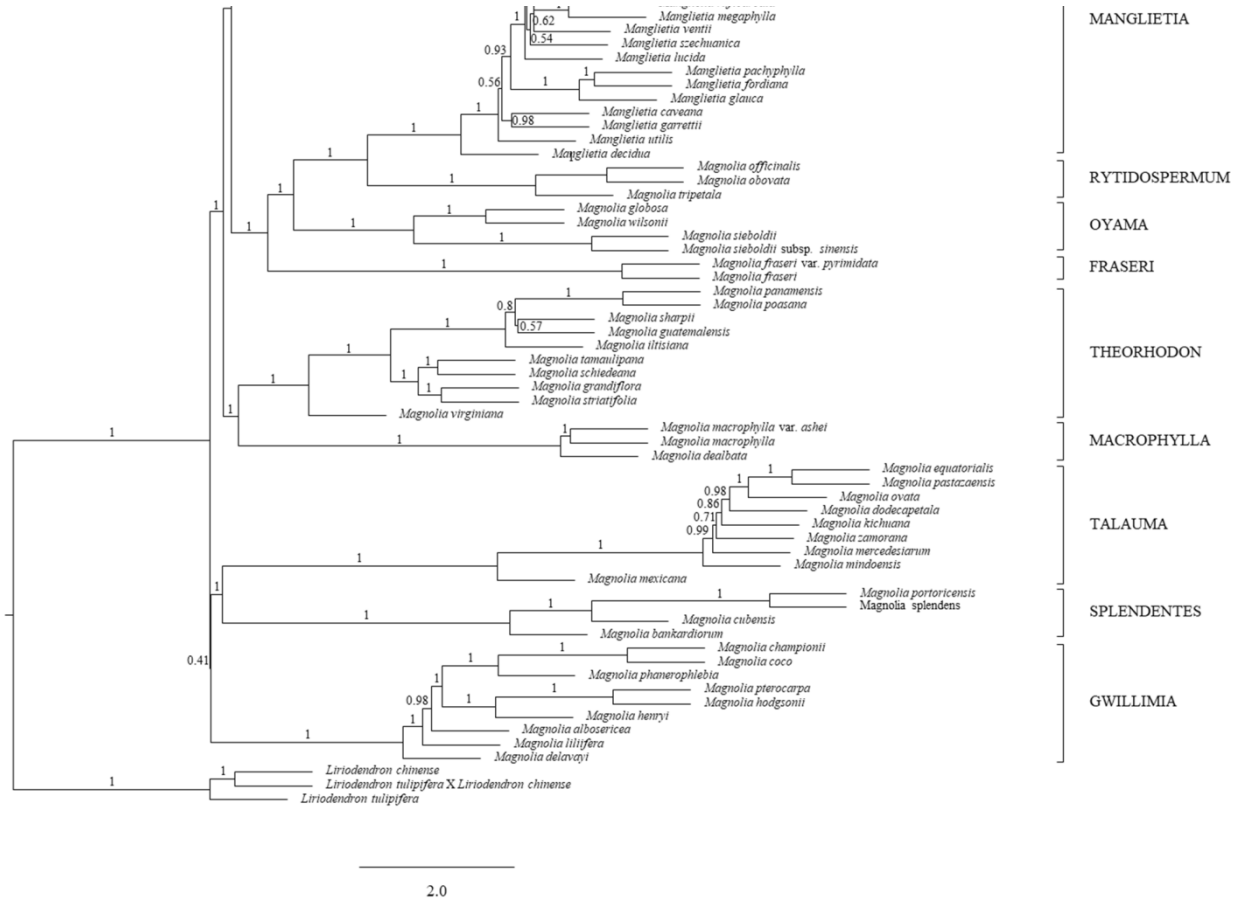
Appendix 31. (Continued)



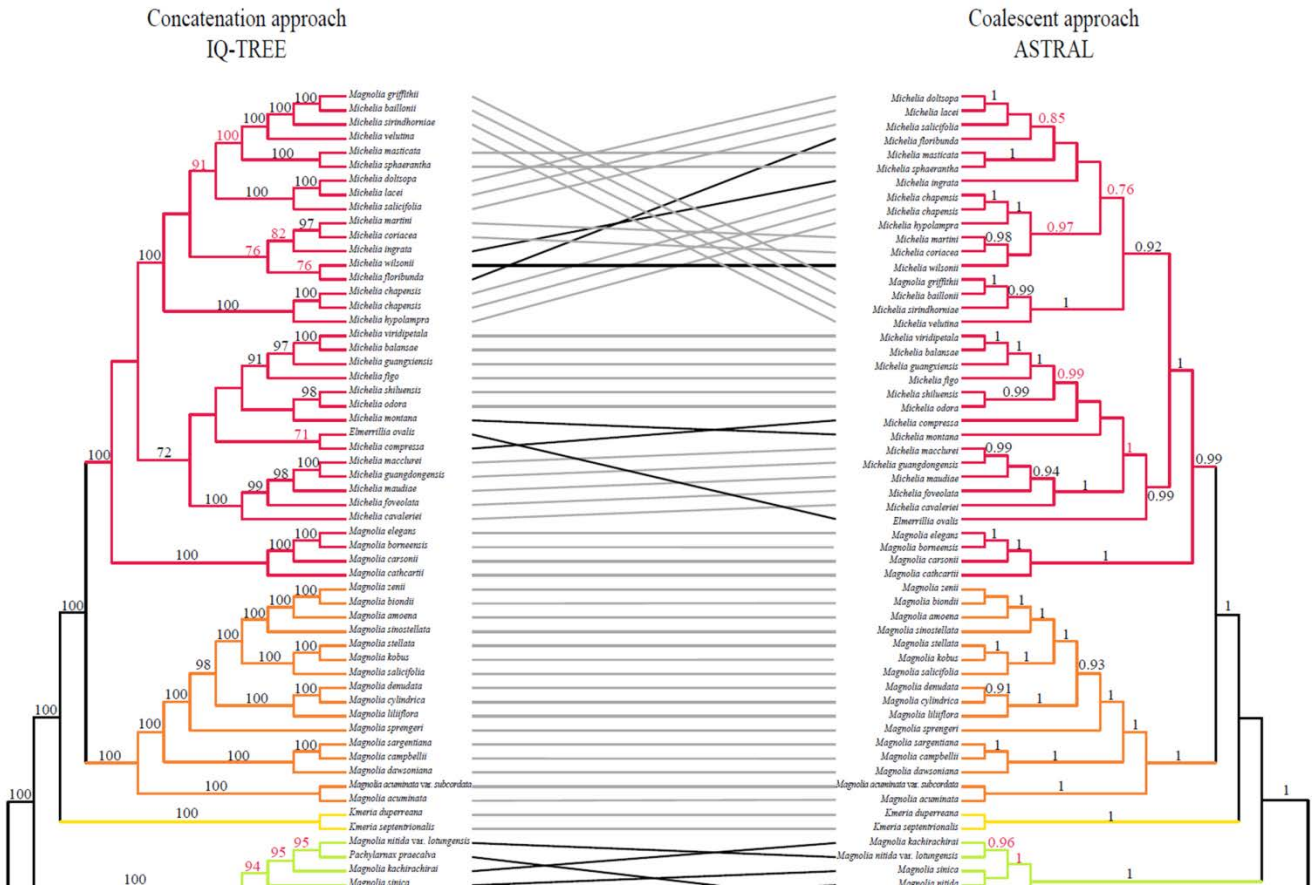
Appendix 31. Maximum likelihood tree of Magnoliaceae reconstructed by Raxml based on the supermatrix concatenated with 400 supercontigs obtained by HybPiper. Support values above branches indicate bootstrap (BS).



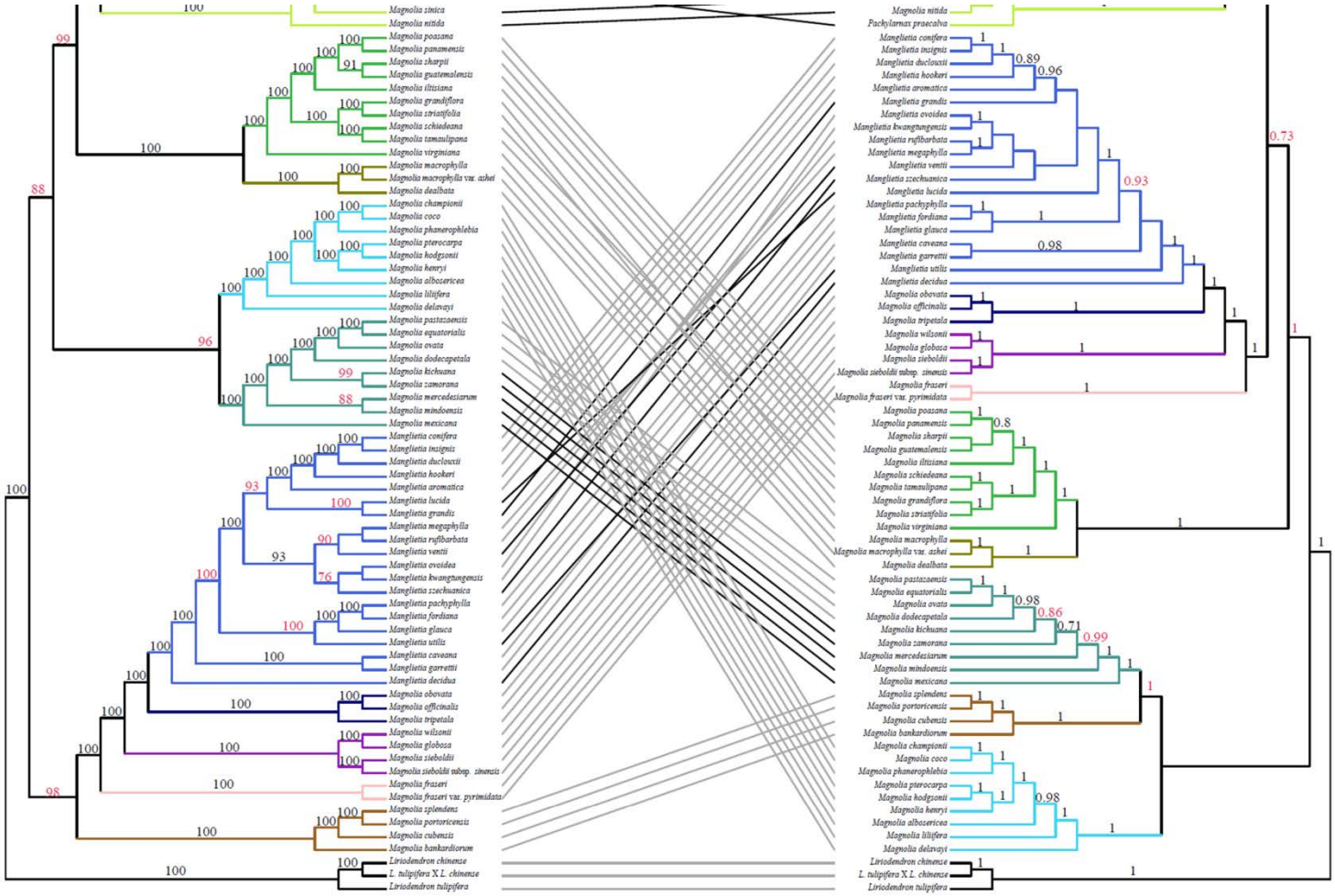
Appendix 32. (Continued)



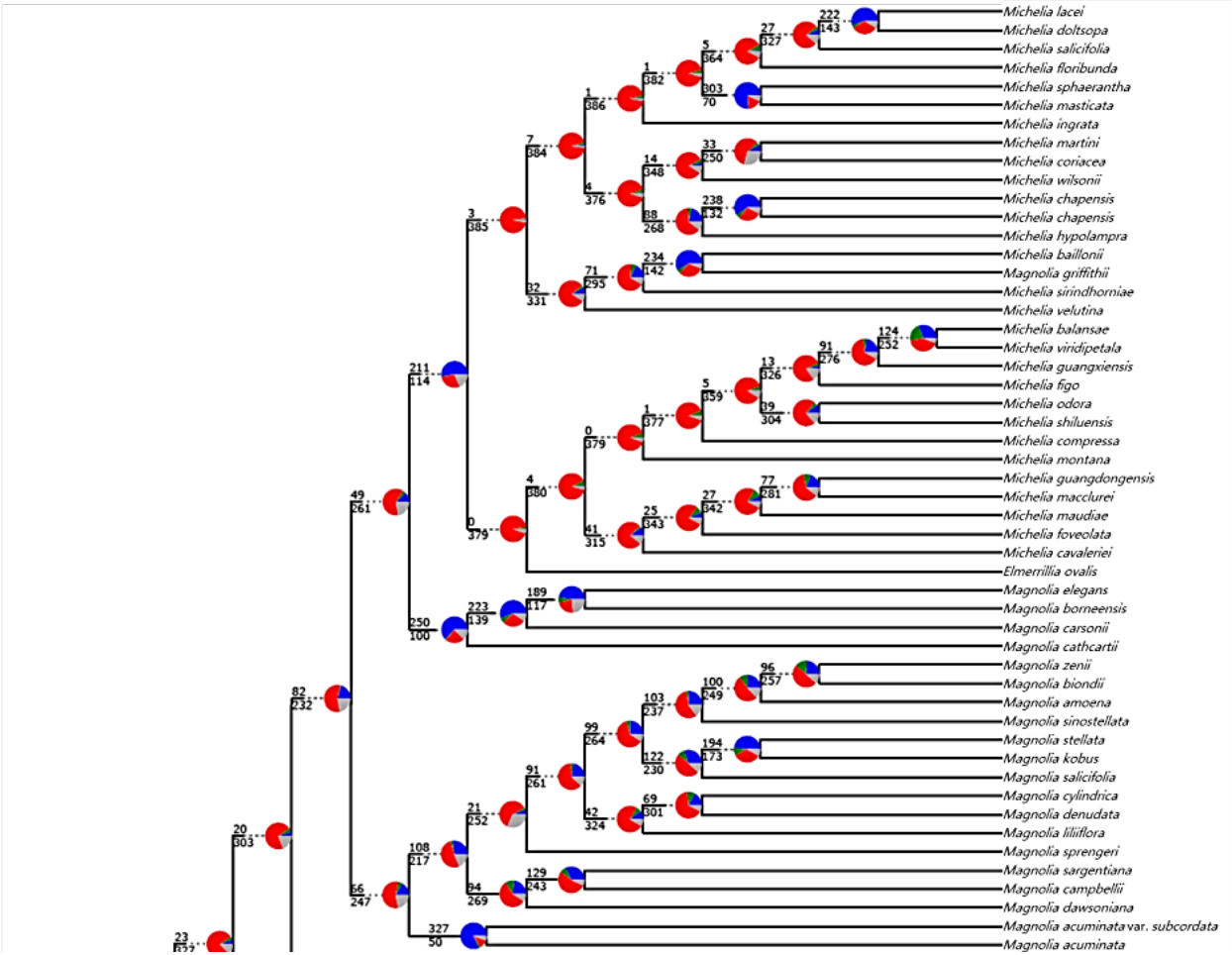
Appendix 32. Phylogenetic tree inferred under the coalescence approach using ASTRAL-III. Support values above branches indicate local posterior probability (LPP).



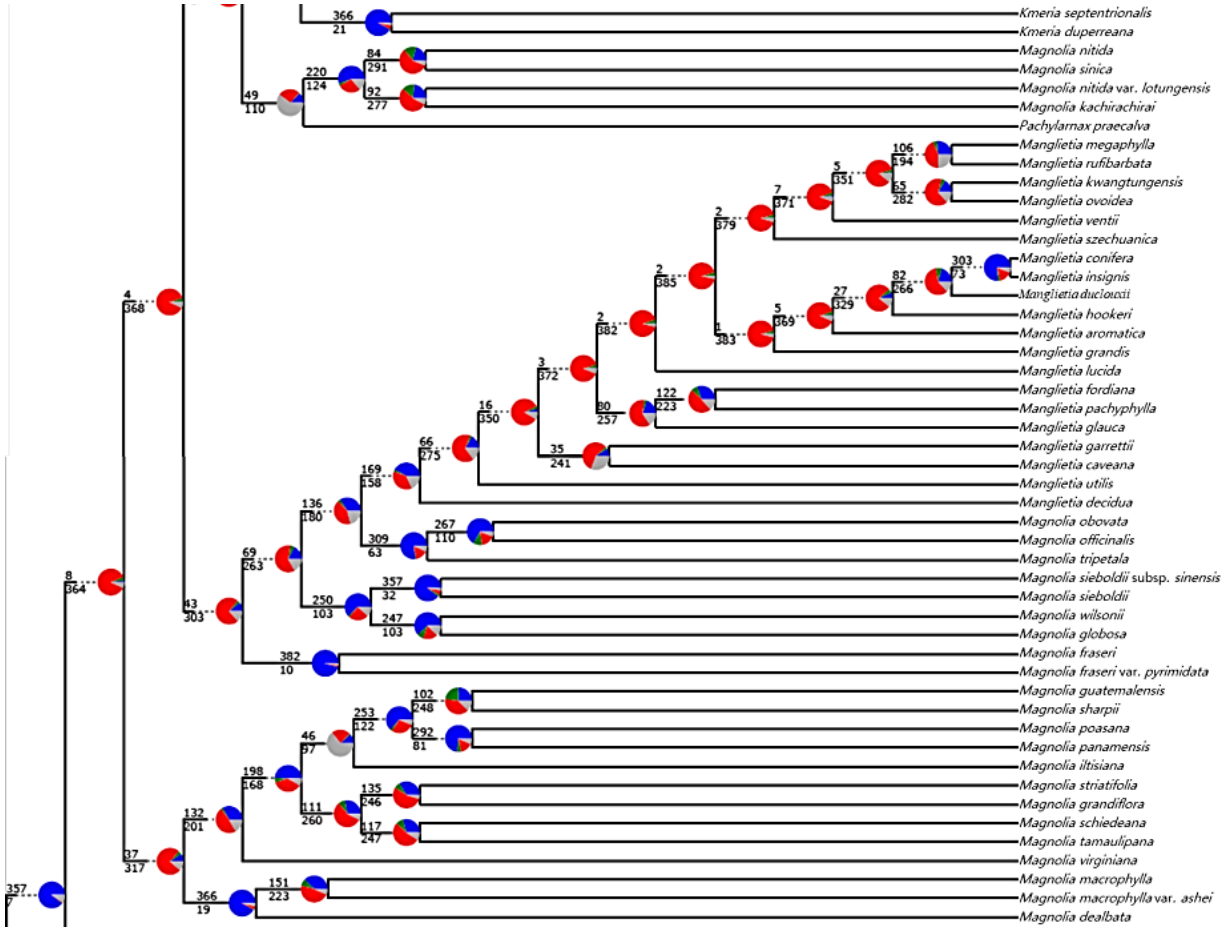
Appendix 33. (Continued)


Magnolia sinica
Magnolia nitida
Magnolia poasana
Magnolia panamensis
Magnolia sharpii
Magnolia guatemalensis
Magnolia iltisiana
Magnolia grandiflora
Magnolia striatifolia
Magnolia schiedeana
Magnolia tamaulipana
Magnolia virginiana
Magnolia macrophylla
Magnolia macrophylla var. ashei
Magnolia dealbata
Magnolia championii
Magnolia coco
Magnolia phanerophlebia
Magnolia pterocarpa
Magnolia hodgsonii
Magnolia henryi
Magnolia alboseircea
Magnolia liliifera
Magnolia delavayi
Magnolia pastazaensis
Magnolia equatorialis
Magnolia ovata
Magnolia dodecapetala
Magnolia kichuana
Magnolia zamorana
Magnolia mercedesiarum
Magnolia mindoensis
Magnolia mexicana
Manglietia conifera
Manglietia insignis
Manglietia duclouxii
Manglietia hookeri
Manglietia aromatica
Manglietia lucida
Manglietia grandis
Manglietia megaphylla
Manglietia ruflbarbata
Manglietia ventii
Manglietia ovoidea
Manglietia kwangtungensis
Manglietia szechuanica
Manglietia pachyphylla
Manglietia fordiana
Manglietia glauca
Manglietia caveana
Manglietia garrettii
Manglietia decidua
Magnolia obovata
Magnolia officinalis
Magnolia tripetala
Magnolia wilsonii
Magnolia globosa
Magnolia sieboldii
Magnolia sieboldii subsp. sinensis
Magnolia fraseri
Magnolia fraseri var. pyrimidata
Magnolia splendens
Magnolia portoricensis
Magnolia cubensis
Magnolia bankardiorum
Liriodendron chinense
L. tulipifera X L. chinense
Liriodendron tulipifera
Pachylarnax praecalva

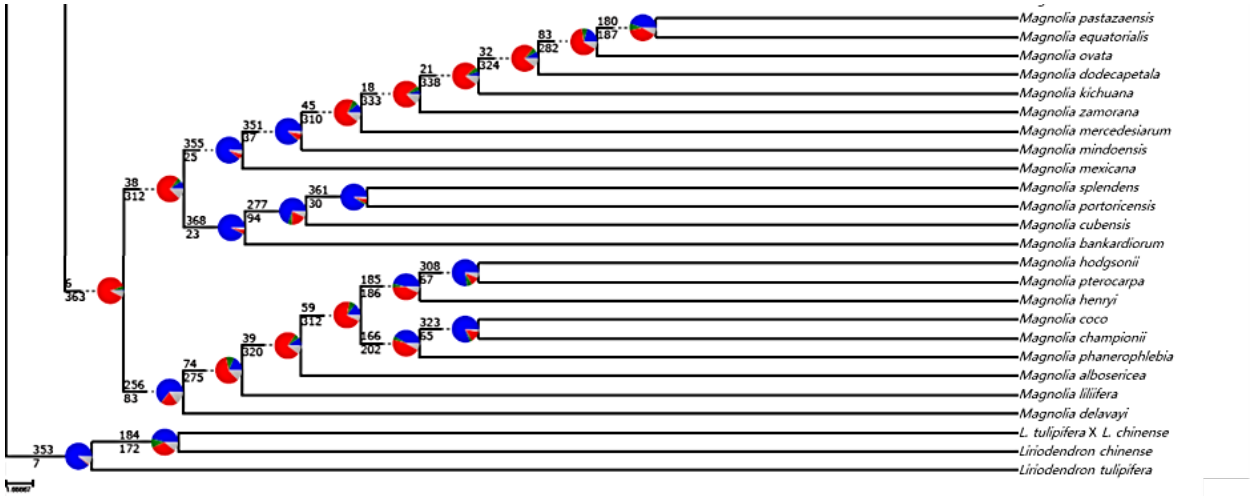
Appendix 33. Tanglegram of trees inferred under the concatenation approach (left, IQ-TREE) and the coalescent approach (right, ASTRAL-Ⅲ). Branch colors indicate major thirteen clades. Bootstrap support values (BS ≥70)and local posterior probabilities (LPP ≥0.7) are shown on branches. Red support values and black connecting lines indicate a conflicting position between the two topologies.



Appendix 34. (Continued)



Appendix 34. (Continued)



Appendix 34. gene tree conflict at each node relative to the coalescent ASTRAL tree as estimated by phyparts. Pie charts represent the proportion of gene trees in four categories: supporting that clade (blue), conflicting with that clade by supporting dominant alternative topology (green), conflicting with that clade by supporting many low-frequency topologies (red), and unsupporting that clade with BS < 33 % (grey). The number above and below the branches indicates the number of gene trees in concordant and in conflict, respectively.

Appendix 35. The number and the percentage of shared quartets with the concatenated ML tree (IQtree) for entire topologies and within each five sub-clade.

	position in concatenated supermatrix				Total topologies		MICHELIA clade		YULANIA clade		THEORHODON clade		GWILLIMIA and TALAUMA clade		subclade including SPELENDENTES, FRASERI, RYTIDOSPERMUM-OYAMA, RYTIDOSPERMUM, and MANGLIETIA	
Alignment_name	start	end	Arabidopsis_ID	Description	No of quartets resolved identically	shared quartet percentage(%)	No of quartets resolved identically	shared quartet percentage(%)	No of quartets resolved identically	shared quartet percentage(%)	No of quartets resolved identically	shared quartet percentage(%)	No of quartets resolved identically	shared quartet percentage(%)	No of quartets resolved identically	shared quartet percentage(%)
ref	1	765376	N/A	N/A	9691375	100.0	52360	100.0	1820	100.0	210	100.0	3060	100.0	40920	100.0
MKT001844_1_4_APOV	1	3247	AT2G48120.2	pale cress protein (PAC)	6834394	70.5	16873	32.2	1062	58.4	146	69.5	2163	70.7	28138	68.8
MKT002001_1_4_APOV	3248	5685	AT4G09010.2	ascorbate peroxidase 4	6509323	67.2	18849	36.0	1277	70.2	164	78.1	2179	71.2	23769	58.1
MKT004737_1_4	5686	6968	AT3G05850.1	MuDR family transposase	1799048	18.6	9078	17.3	857	47.1	55	26.2	1262	41.2	6142	15.0
MKT004964_1_4	6969	7545	AT3G19615.1	beta-1, 4-xylosidase	2374827	24.5	29029	55.4	1182	64.9	103	49.0	2179	71.2	7237	17.7
MKT005032_1_4	7546	8520	AT2G20635.1	protein kinase and Mad3-BUB1-I domain-containing protein	5892909	60.8	19167	36.6	877	48.2	145	69.0	2535	82.8	23304	57.0
MKT005035_1_4_APOV	8521	10575	AT2G20635.1	protein kinase and Mad3-BUB1-I domain-containing protein	5944449	61.3	18717	35.7	972	53.4	163	77.6	2053	67.1	30397	74.3
MKT006060_1_4_APOV	10576	13623	AT1G49380.1	cytochrome c biogenesis protein family	5682849	58.6	21131	40.4	931	51.2	93	44.3	2068	67.6	25624	62.6
MKT008026_1_4_APOV	13624	16783	AT3G56040.1	UDP-glucose pyrophosphorylase 3	7311508	75.4	18363	35.1	1015	55.8	156	74.3	2665	87.1	29202	71.4
MKT012393_1_4_APOV	16784	20588	AT3G13940.1	DNA binding / DNA-directed RNA polymerase	4222532	43.6	21794	41.6	1452	79.8	161	76.7	2248	73.5	29897	73.1
MKT012543_1_4	20589	21029	AT4G29570.1	Cytidine/deoxycytidylate deaminase family protein	1415408	14.6	10323	19.7	677	37.2	42	20.0	186	6.1	3017	7.4
MKT012837_1_4_APOV	21030	22766	AT5G10920.1	L-Aspartase-like family protein	3901793	40.3	20362	38.9	1160	63.7	156	74.3	2299	75.1	20636	50.4
MKT014126_1_4	22767	23931	AT3G26680.3	DNA repair metallo-beta-lactamase family protein	4080623	42.1	10430	19.9	1303	71.6	146	69.5	1473	48.1	11456	28.0
MKT014169_1_4_APOV	23932	25827	AT5G45170.1	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein	6103625	63.0	17073	32.6	1035	56.9	72	34.3	2167	70.8	10428	25.5
MKT014423_1_4_APOV	25828	28527	AT5G17290.1	autophagy protein Apg5 family	6776534	69.9	18184	34.7	1105	60.7	161	76.7	2592	84.7	25610	62.6
MKT014504_1_4_APOV	28528	30618	AT3G26710.1	cofactor assembly of complex C	7182837	74.1	26520	50.6	951	52.3	171	81.4	2605	85.1	24302	59.4
MKT014815_1_4	30619	31601	AT5G61030.2	glycine-rich RNA-binding protein 3	4266498	44.0	10287	19.6	469	25.8	146	69.5	2352	76.9	15030	36.7
MKT015133_1_4	31602	32752	AT4G32010.2	HSI2-like 1	6457048	66.6	19375	37.0	599	32.9	171	81.4	2388	78.0	29136	71.2
MKT017247_1_4	32753	35477	AT2G44660.1	ALG6, ALG8 glycosyltransferase family	4005135	41.3	27342	52.2	1093	60.1	123	58.6	2288	74.8	25080	61.3
MKT017888_1_4	35478	36899	AT5G23060.1	calcium sensing receptor	7270562	75.0	24417	46.6	861	47.3	139	66.2	2357	77.0	27381	66.9
MKT018003_1_4	36900	37249	AT5G58760.2	damaged DNA binding 2	1846311	19.1	6975	13.3	1153	63.4	126	60.0	1225	40.0	10981	26.8
MKT018104_1_4	37250	38830	AT5G58330.3	lactate/malate dehydrogenase family protein	6134472	63.3	28327	54.1	822	45.2	171	81.4	2369	77.4	28781	70.3
MKT018636_1_4_APOV	38831	42939	AT4G35560.2	Transducin/WD40 repeat-like superfamily protein	6967236	71.9	16117	30.8	1219	67.0	198	94.3	2494	81.5	22058	53.9
MKT021441_1_4	42940	44114	AT3G30200.1	Plant transposase (Ptta/En/Spm family)	3899179	40.2	34695	66.3	1033	56.8	1	0.5	19	0.6	25905	63.3
MKT021766_1_4_APOV	44115	45975	AT3G52905.1	Polynucleotidyl transferase, ribonuclease H-like superfamily protein	6628617	68.4	13312	25.4	916	50.3	170	81.0	2304	75.3	26499	64.8
MKT021934_1_4_APOV	45976	48130	AT2G24830.1	zinc finger (CCCH-type) family protein / D111/G-patch domain-containing protein	6388760	65.9	20560	39.3	1197	65.8	173	82.4	2384	77.9	29104	71.1
MKT023081_1_4_APOV	48131	49833	AT1G53710.1	Calcineurin-like metallo-phosphoesterase superfamily protein	7514867	77.5	28630	54.7	1339	73.6	190	90.5	2185	71.4	27065	66.1
MKT023139_1_4	49834	51979	AT5G11700.1	ephrin type-B receptor	5405359	55.8	16039	30.6	991	54.5	121	57.6	2576	84.2	26559	64.9
MKT024581_1_4	51980	52925	AT5G11100.1	Calcium-dependent lipid-binding (CaLB domain) family protein	6720222	69.3	25097	47.9	791	43.5	143	68.1	2380	77.8	32901	80.4
MKT024877_1_4	52926	55204	AT2G13440.1	glucose-inhibited division family A protein	5263295	54.3	20436	39.0	1207	66.3	148	70.5	1923	62.8	30535	74.6
MKT025491_1_4_APOV	55205	58139	AT5G64250.2	Aldolase-type TIM barrel family protein	6850530	70.7	22507	43.0	1385	76.1	164	78.1	2082	68.0	16158	39.5
MKT025734_1_4	58140	60024	AT1G21610.1	wound-responsive family protein	6712615	69.3	13345	25.5	1371	75.3	102	48.6	2541	83.0	28404	69.4
MKT025845_1_4	60025	63747	AT5G04070.1	NAD(P)-binding Rossmann-fold superfamily protein	5392169	55.6	9508	18.2	1089	59.8	163	77.6	2161	70.6	28926	70.7
MKT027074_1_4	63748	64861	AT3G26900.3	shikimate kinase like 1	6957012	71.8	24390	46.6	908	49.9	124	59.0	2292	74.9	24130	59.0
MKT027421_1_4_APOV	64862	66193	AT1G10830.1	15-cis-zeta-carotene isomerase	4943260	51.0	8746	16.7	877	48.2	146	69.5	2242	73.3	24184	59.1
MKT028511_1_4_APOV	66194	69835	AT1G07910.1	RNAligase	8042130	83.0	26665	50.9	1099	60.4	136	64.8	2501	81.7	29754	72.7
MKT033363_1_4	69836	71213	AT1G27595.1	symplekin	5259530	54.3	15519	29.6	1376	75.6	161	76.7	2315	75.7	23857	58.3
MKT033924_1_4_APOV	71214	72600	AT3G16760.1	Tetratricopeptide repeat (TPR)-like superfamily protein	7064886	72.9	12358	23.6	984	54.1	81	38.6	2189	71.5	26045	63.6
MKT035534_1_4	72601	73896	AT4G18370.2	DEGP protease 5	6499007	67.1	10230	19.5	1074	59.0	171	81.4	2513	82.1	29229	71.4
MKT037336_1_4_APOV	73897	77110	AT4G04880.1	adenosine/AMP deaminase family protein	5850077	60.4	18661	35.6	893	49.1	127	60.5	2468	80.7	21090	51.5
MKT040158_1_4_APOV	77111	79154	AT5G54855.1	Pollen Ole e 1 allergen and extensin family protein	6340409	65.4	16890	32.3	878	48.2	156	74.3	1928	63.0	20434	49.9
MKT041541_1_4_APOV	79155	83810	AT2G43400.2	electron-transfer flavoprotein:ubiquinone oxidoreductase	6816859	70.3	15539	29.7	1061	58.3	171	81.4	2426	79.3	28364	69.3
MKT041966_1_4	83811	84258	AT3G09720.2	P-loop containing nucleoside triphosphate hydrolases superfamily protein	3311048	34.2	8934	17.1	687	37.7	164	78.1	1940	63.4	8733	21.3
MKT042175_1_4	84259	85886	AT1G23400.1	RNA-binding CRS1 / YhbY (CRM) domain-containing protein	4125158	42.6	7272	13.9	859	47.2	108	51.4	2152	70.3	25243	61.7
MKT042873_1_4	85887	89814	AT1G33360.1	ATP-dependent Clp protease	7800869	80.5	20568	39.3	1246	68.5	172	81.9	2224	72.7	30557	74.7
MKT043000_1_4	89815	90358	AT4G24670.2	tryptophan aminotransferase related 2	818337	8.4	7240	13.8	229	12.6	0	0.0	1286	42.0	6035	14.7

MKT043957_1_4_APOV	90359	92252	AT5G49530.1	SIN-like family protein	7656722	79.0	18930	36.2	1223	67.2	149	71.0	2217	72.5	26972	65.9
MKT044207_1_4_APOV	92253	95118	AT5G25770.1	alpha/beta-Hydrolases superfamily protein	1534487	15.8	14432	27.6	308	16.9	82	39.0	1278	41.8	4433	10.8
MKT044398_1_4	95119	95651	AT4G11560.1	bromo-adjacent homology (BAH) domain-containing protein	4398439	45.4	12337	23.6	751	41.3	149	71.0	2252	73.6	16291	39.8
MKT044450_1_4	95652	99045	AT5G47800.4	Phototropic-responsive NPH3 family protein	6398556	66.0	14064	26.9	1280	70.3	130	61.9	2584	84.4	21807	53.3
MKT044548_1_4	99046	99355	AT1G51440.1	alpha/beta-Hydrolases superfamily protein	691900	7.1	7030	13.4	165	9.1	0	0.0	254	8.3	7869	19.2
MKT046452_1_4	99356	101084	AT3G52850.1	vacuolar sorting receptor homolog 1	2001402	20.7	8661	16.5	1303	71.6	66	31.4	2166	70.8	19724	48.2
MKT048020_1_4_APOV	101085	104579	AT4G17760.2	PCNA domain-containing protein	8023889	82.8	20521	39.2	1356	74.5	183	87.1	2324	75.9	30460	74.4
MKT049010_1_4_APOV	104580	107186	AT5G41480.1	Folylpolyglutamate synthetase family protein	6307964	65.1	18243	34.8	1341	73.7	163	77.6	2397	78.3	31560	77.1
MKT049457_1_4	107187	111041	AT2G14820.2	Phototropic-responsive NPH3 family protein	6609925	68.2	24240	46.3	1379	75.8	159	75.7	2268	74.1	28405	69.4
MKT049651_1_4_APOV	111042	113677	AT5G02250.1	Ribonuclease II/R family protein	6016303	62.1	28918	55.2	1642	90.2	157	74.8	2357	77.0	27442	67.1
MKT049743_1_4	113678	115467	AT1G23000.1	Heavy metal transport/detoxification superfamily protein	6735633	69.5	9502	18.1	938	51.5	198	94.3	2190	71.6	24595	60.1
MKT049745_1_4	115468	116613	AT1G78550.2	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	802160	8.3	4324	8.3	684	37.6	89	42.4	1319	43.1	4395	10.7
MKT049974_1_4_APOV	116614	119088	AT5G10320.6	ATP synthase subunit B	7878227	81.3	22741	43.4	1002	55.1	156	74.3	2341	76.5	25413	62.1
MKT050498_1_4_APOV	119089	120826	AT1G74640.1	alpha/beta-Hydrolases superfamily protein	5318644	54.9	13030	24.9	902	49.6	145	69.0	2477	80.9	9748	23.8
MKT052244_1_4_APOV	120827	124039	AT2G35610.1	xyloglucanase 113	7400748	76.4	20967	40.0	1397	76.8	173	82.4	2368	77.4	27088	66.2
MKT052493_1_4	124040	128993	AT4G26100.1	casein kinase 1	7364902	76.0	23113	44.1	1381	75.9	120	57.1	2471	80.8	31160	76.1
MKT054033_1_4_APOV	128994	132006	AT4G10030.1	alpha/beta-Hydrolases superfamily protein	6632503	68.4	19639	37.5	1182	64.9	141	67.1	2391	78.1	23358	57.1
MKT054141_1_4_APOV	132007	134844	AT2G30410.3	tubulin folding cofactor A (KIESEL)	2588738	26.7	15453	29.5	1097	60.3	170	81.0	2173	71.0	14637	35.8
MKT055672_1_4_APOV	134845	136192	AT5G50230.1	Transducin/WD40 repeat-like superfamily protein	3551893	36.7	28062	53.6	927	50.9	114	54.3	2042	66.7	10195	24.9
MKT056344_1_4	136193	137466	AT4G18760.1	receptor like protein 51	4779630	49.3	16171	30.9	1334	73.3	166	79.0	2210	72.2	23674	57.9
MKT058473_1_4_APOV	137467	139371	AT5G63200.1	tetratricopeptide repeat (TPR)-containing protein	5952853	61.4	18466	35.3	901	49.5	98	46.7	2662	87.0	27425	67.0
MKT058531_1_4	139372	140686	AT1G47290.1	3beta-hydroxysteroid-dehydrogenase/decarboxylase isoform 1	5450317	56.2	17437	33.3	1371	75.3	171	81.4	2282	74.6	25580	62.5
MKT059069_1_4_APOV	140687	142325	AT5G19940.2	Plastid-lipid associated protein PAP / fibrillin family protein	4951049	51.1	14097	26.9	1126	61.9	128	61.0	2101	68.7	22014	53.8
MKT059496_1_4_APOV	142326	144633	AT5G23395.1	Cox19-like CHCH family protein	6975694	72.0	13177	25.2	1305	71.7	136	64.8	2016	65.9	22473	54.9
MKT062212_1_4	144634	146198	AT1G02410.3	cytochrome c oxidase assembly protein CtaG / Cox11 family	3626791	37.4	22571	43.1	1458	80.1	86	41.0	2231	72.9	17693	43.2
MKT062415_1_4_APOV	146199	148682	AT5G10070.2	RNase L inhibitor protein-like protein	5923779	61.1	20259	38.7	923	50.7	120	57.1	2133	69.7	22145	54.1
MKT063487_1_4	148683	149659	AT2G21550.2	Bifunctional dihydrofolate reductase/thymidylate synthase	6939603	71.6	16682	31.9	1435	78.8	156	74.3	2389	78.1	28654	70.0
MKT063650_1_4_APOV	149660	151797	AT3G07060.1	NHL domain-containing protein	5301046	54.7	18770	35.8	1293	71.0	94	44.8	2165	70.8	22583	55.2
MKT064181_1_4_APOV	151798	153469	AT3G32930.2	6, 7-dimethyl-8-ribityllumazine synthase	4529337	46.7	12643	24.1	1347	74.0	94	44.8	2254	73.7	20512	50.1
MKT065092_1_4_APOV	153470	155131	AT5G18660.1	NAD(P)-binding Rossmann-fold superfamily protein	4879250	50.3	6323	12.1	1172	64.4	79	37.6	2495	81.5	19669	48.1
MKT065135_1_4_APOV	155132	157958	AT2G42080.1	Chaperone DnaJ-domain superfamily protein	7236018	74.7	25915	49.5	1160	63.7	88	41.9	2447	80.0	25571	62.5
MKT065481_1_4_APOV	157959	160072	AT1G72440.1	CCAAT-binding factor	5943351	61.3	20256	38.7	1313	72.1	116	55.2	2324	75.9	26178	64.0
MKT072919_1_4_APOV	160073	162184	AT3G59650.2	mitochondrial ribosomal protein L51/S25/CI-B8 family protein	4869021	50.2	21344	40.8	1323	72.7	53	25.2	2354	76.9	12627	30.9
MKT074080_1_4_APOV	162185	163577	AT1G75200.1	flavodoxin family protein / radical SAM domain-containing protein	5665175	58.5	14204	27.1	1203	66.1	126	60.0	2245	73.4	29550	72.2
MKT074616_1_4	163578	165286	AT5G04040.2	Patatin-like phospholipase family protein	1636297	16.9	2685	5.1	936	51.4	71	33.8	2458	80.3	20106	49.1
MKT074911_1_4	165287	165739	AT4G01550.1	NAC domain containing protein 69	4410817	45.5	17565	33.5	660	36.3	71	33.8	2105	68.8	25910	63.3
MKT075332_1_4	165740	166070	AT3G51360.8	Eukaryotic aspartyl protease family protein	3566258	36.8	12060	23.0	1063	58.4	82	39.0	1334	43.6	5931	14.5
MKT075417_1_4_APOV	166071	168228	AT2G42770.1	Peroxisomal membrane 22 kDa (Mpv17/PMP22) family protein	6477236	66.8	15725	30.0	1030	56.6	94	44.8	2317	75.7	25793	63.0
MKT076221_1_4	168229	168797	AT5G54930.1	AT hook motif-containing protein	5780837	59.6	13204	25.2	1484	81.5	106	50.5	2432	79.5	26010	63.6
MKT076335_1_4_APOV	168798	170610	AT2G43370.2	RNA-binding (RRM/RBD/RNP motifs) family protein	5993340	61.8	17187	32.8	1194	65.6	94	44.8	2257	73.8	15230	37.2
MKT077005_1_4_APOV	170611	173407	AT3G24320.2	MUTL protein homolog 1	6567486	67.8	21233	40.6	1386	76.2	79	37.6	2249	73.5	27691	67.7
MKT077685_1_4	173408	174376	AT5G51340.1	Tetratricopeptide repeat (TPR)-like superfamily protein	4479883	46.2	13720	26.2	1130	62.1	62	29.5	2307	75.4	26390	64.5
MKT079447_1_4_APOV	174377	177235	AT4G02790.1	GTP-binding family protein	2121508	21.9	16593	31.7	273	15.0	73	34.8	2177	71.1	7753	18.9
MKT080632_1_4	177236	179951	AT3G04500.3	RNA-binding (RRM/RBD/RNP motifs) family protein	6234343	64.3	19246	36.8	1276	70.1	86	41.0	2532	82.7	30908	75.5
MKT081437_1_4_APOV	179952	183449	AT5G27560.4	DUF1995 domain protein, putative (DUF1995)	6343306	65.5	19774	37.8	1216	66.8	100	47.6	2566	83.9	22548	55.1
MKT082329_1_4	183450	184199	AT4G24620.2	phosphoglucose isomerase 1	6166067	63.6	8838	16.9	595	32.7	92	43.8	2457	80.3	24855	60.7
MKT083137_1_4	184200	184756	AT5G42400.8	SET domain protein 25	3879736	40.0	15144	28.9	977	53.7	106	50.5	2440	79.7	26996	66.0
MKT083367_1_4_APOV	184757	188093	AT3G25470.1	bacterial hemolysin-like protein	5475560	56.5	25724	49.1	1049	57.6	89	42.4	2257	73.8	28440	69.5
MKT083464_1_4_APOV	188094	190103	AT3G24200.2	FAD/NAD(P)-binding oxidoreductase family protein	6544627	67.5	11345	21.7	978	53.7	72	34.3	2201	71.9	31531	77.1
MKT084780_1_4_APOV	190104	192885	AT3G01920.1	DHBP synthase RibB-like alpha/beta domain-containing protein	7111116	73.4	26206	50.0	1233	67.7	100	47.6	2049	67.0	33837	82.7
MKT085635_1_4	192886	194541	AT5G20570.1	RING-box 1	5927414	61.2	15004	28.7	782	43.0	104	49.5	2278	74.4	25713	62.8
MKT086766_1_4_APOV	194542	197376	AT1G59990.2	DEA(D/H)-box RNA helicase family protein	4279869	44.2	18671	35.7	1141	62.7	110	52.4	2463	80.5	13577	33.2
MKT087337_1_4	197377	200538	AT1G07510.1	FTSH protease 10	7475425	77.1	25868	49.4	1106	60.8	100	47.6	2609	85.3	27308	66.7
MKT087636_1_4_APOV	200539	202489	AT5G63040.1	transmembrane protein	6889555	71.1	29812	56.9	1279	70.3	86	41.0	2487	81.3	22587	55.2
MKT088403_1_4	202490	203998	AT3G57940.2	GNAT acetyltransferase (DUF699)	6252221	64.5	17423	33.3	1038	57.0	76	36.2	2273	74.3	26325	64.3
MKT089525_1_4_APOV	203999	206371	AT3G14910.1	Rab3 GTPase-activating protein non-catalytic subunit	7117239	73.4	18306	35.0	833	45.8	116	55.2	2510	82.0	29979	73.3
MKT094099_1_4	206372	207201	AT4G05530.1	indole-3-butyric acid response 1	5140677	53.0	19321	36.9	1195	65.7	100	47.6	2267	74.1	24729	60.4
MKT095133_1_4_APOV	207202	209047	AT2G22370.1	mediator of RNA polymerase II transcription subunit	4733026	48.8	12450	23.8	818	44.9	100	47.6	2542	83.1	24716	60.4
MKT095310_1_4	209048	209331	ATMG00860.1	DNA/RNA polymerases superfamily protein	752832	7.8	2115	4.0	28	1.5	18	8.6	303	9.9	5430	13.3
MKT095730_1_4_APOV	209332	212294	AT1G77090.1	thylakoid lumenal protein (Mog1/PsbP/DUF1795-like photosystem II reaction center PsbP family protein)	6107387	63.0	15332	29.3	851	46.8	104	49.5	2457	80.3	27022	66.0
MKT097806_1_4	212295	213067	No_hit	No_hit	3765436	38.9	12097	23.1	927	50.9	100	47.6	1554	50.8	20009	48.9
MKT097815_1_4_APOV	213068	214983	AT4G03200.1	catalytics	5593567	57.7	13182	25.2	1051	57.7	98	46.7	2085	68.1	27464	67.1
MKT099172_1_4_APOV	214984	216950	AT3G16270.3	ENTH/VHS family protein	3380850	34.9	18155	34.7	791	43.5	104	49.5	2139	69.9	27743	67.8
MKT099267_1_4	216951	218100	AT4G09680.3	conserved telomere maintenance component 1	4131289	42.6	18566	35.5	906	49.8	59	28.1	2303	75.3	18728	45.8
MKT099416_1_4_APOV	218101	220113	AT4G33030.1	sulfoquinovosyldiacylglycerol 1	4978938	51.4	16474	31.5	796	43.7	98	46.7	2426	79.3	29969	73.2
MKT100456_1_4	220114	221116	AT1G04210.1	Leucine-rich repeat protein kinase family protein	5029597	51.9	22697	43.3	887	48.7	95	45.2	2120	69.3	11407	27.9
MKT102093_1_4_APOV	221117	223541	AT5G48470.1	hypothetical protein	5292916	54.6	21792	41.6	809	44.5	86	41.0	2385	77.9	24681	60.3
MKT102398_1_4	223542	225493	AT1G72790.1	hydroxyproline-rich glycoprotein family protein	5576755	57.5	13709	26.2	1125	61.8	82	39.0	2103	68.7	14211	34.7

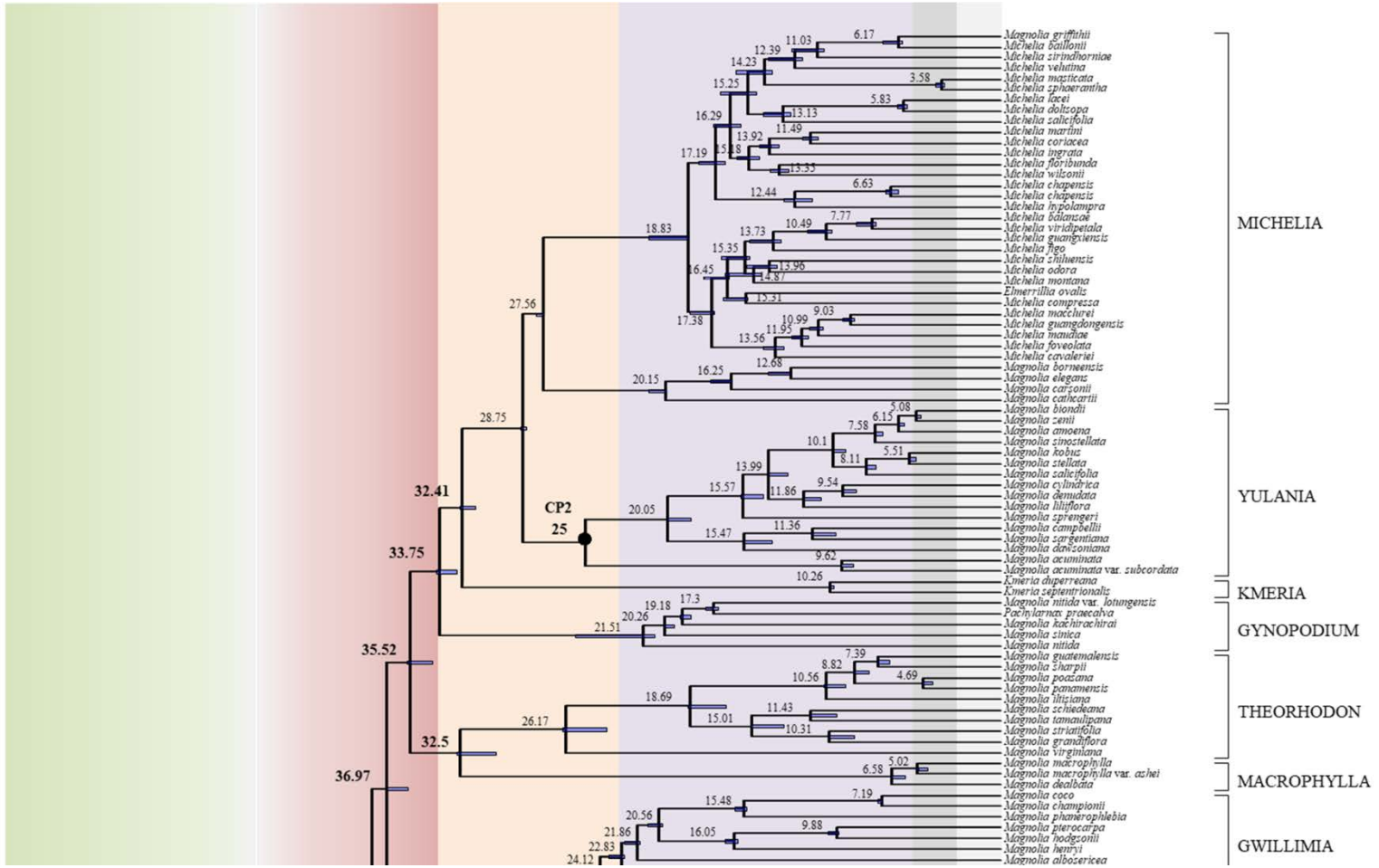
MKT102617_1_4_APOV	225494	227525	ATMG00520.1	Intron maturase, type II family protein	1159413	12.0	16436	31.4	167	9.2	0	0.0	0	0.0	0	0.0
MKT102671_1_4	227526	228415	AT5G51980.2	Transducin/WD40 repeat-like superfamily protein	4312982	44.5	8472	16.2	931	51.2	68	32.4	1883	61.5	12391	30.3
MKT103416_1_4	228416	230097	AT2G24270.2	aldehyde dehydrogenase 11A3	6657763	68.7	21578	41.2	776	42.6	116	55.2	2304	75.3	28158	68.8
MKT103490_1_4	230098	232680	AT4G35830.2	aconitase 1	6178139	63.7	20993	40.1	632	34.7	79	37.6	2676	87.5	33823	82.7
MKT103531_1_4_APOV	232681	233731	AT1G55880.1	Pyridoxal-5'-phosphate-dependent enzyme family protein	2664964	27.5	7671	14.7	755	41.5	2	1.0	1574	51.4	14638	35.8
MKT104268_1_4	233732	234267	AT5G61450.1	P-loop containing nucleoside triphosphate hydrolases superfamily protein	5818593	60.0	23433	44.8	868	47.7	69	32.9	2319	75.8	25264	61.7
MKT104669_1_4	234268	234817	AT3G48110.1	glycine-tRNA ligase	2160240	22.3	19759	37.7	559	30.7	41	19.5	2159	70.6	19623	48.0
MKT106488_1_4	234818	235609	AT2G20000.2	CDC27 family protein	2173860	22.4	9725	18.6	393	21.6	116	55.2	2386	78.0	24003	58.7
MKT108799_1_4_APOV	235610	236926	AT2G19270.1	mitotic checkpoint protein PRCC-carboxy-term protein	3917177	40.4	9301	17.8	1030	56.6	52	24.8	2311	75.5	17882	43.7
MKT109897_1_4	236927	237741	AT1G43760.1	DNAse I-like superfamily protein	5570634	57.5	30811	58.8	743	40.8	0	0.0	2365	77.3	29508	72.1
MKT110241_1_4_APOV	237742	239554	AT3G07670.1	Rubisco methyltransferase family protein	4148923	42.8	18749	35.8	720	39.6	110	52.4	2112	69.0	19996	48.9
MKT110690_1_4	239555	240400	AT1G78780.2	pathogenesis-related family protein	4574295	47.2	9619	18.4	836	45.9	62	29.5	1714	56.0	22879	55.9
MKT111153_1_4_APOV	240401	242304	AT5G51220.2	ubiquinol-cytochrome C chaperone family protein	1449058	15.0	15221	29.1	907	49.8	64	30.5	2527	82.6	7621	18.6
MKT111535_1_4_APOV	242305	243869	AT5G16850.2	telomerase reverse transcriptase	6063557	62.6	31259	59.7	988	54.3	98	46.7	2419	79.1	28042	68.5
MKT111570_1_4_APOV	243870	245790	AT2G21710.2	Mitochondrial transcription termination factor family protein	5333822	55.0	23114	44.1	878	48.2	95	45.2	2105	68.8	25458	62.2
MKT111920_1_4	245791	247289	AT5G66060.2	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	4393078	45.3	14080	26.9	1005	55.2	100	47.6	1726	56.4	18613	45.5
MKT113256_1_4_APOV	247290	249531	AT3G52180.3	dual specificity protein phosphatase (DsPTP1) family protein	6454436	66.6	23743	45.3	702	38.6	88	41.9	2393	78.2	31219	76.3
MKT114467_1_4	249532	250180	AT1G43760.1	DNAse I-like superfamily protein	5238713	54.1	9421	18.0	748	41.1	70	33.3	2363	77.2	33627	82.2
MKT115451_1_4_APOV	250181	251973	AT5G63060.1	Sec14p-like phosphatidylinositol transfer family protein	5126653	52.9	20107	38.4	1109	60.9	106	50.5	1852	60.5	27883	68.1
MKT115677_1_4_APOV	251974	254787	AT5G22820.3	ARM repeat superfamily protein	5216263	53.8	22972	43.9	959	52.7	88	41.9	2264	74.0	26790	65.5
MKT116135_1_4	254788	256819	AT4G33700.3	CBS domain protein (DUF21)	6412838	66.2	12932	24.7	991	54.5	110	52.4	2517	82.3	27827	68.0
MKT116442_1_4_APOV	256820	259718	AT1G31780.1	oligomeric golgi complex subunit	6816230	70.3	21490	41.0	960	52.7	89	42.4	2424	79.2	28113	68.7
MKT117656_1_4_APOV	259719	263104	AT3G27110.2	Peptidase family M48 family protein	5145483	53.1	26858	51.3	831	45.7	100	47.6	2439	79.7	25038	61.2
MKT117762_1_4	263105	264036	AT1G14390.1	Leucine-rich repeat protein kinase family protein	866563	8.9	7185	13.7	353	19.4	98	46.7	1595	52.1	7646	18.7
MKT118146_1_4	264037	264482	AT1G66030.1	cytochrome P450, family 96, subfamily A, polypeptide 14 pseudogene	2648078	27.3	18102	34.6	809	44.5	64	30.5	2009	65.7	5743	14.0
MKT120073_1_4_APOV	264483	266358	AT1G05410.2	CDPK adapter, putative (DUF1423)	7566737	78.1	25220	48.2	904	49.7	106	50.5	2551	83.4	29521	72.1
MKT120644_1_4	266359	266990	AT2G03670.1	cell division cycle 48B	3545738	36.6	22583	43.1	620	34.1	80	38.1	2018	65.9	22276	54.4
MKT120725_1_4	266991	268525	AT5G39890.1	2-aminoethanethiol dioxygenase, putative (DUF1637)	5812741	60.0	14150	27.0	808	44.4	100	47.6	2414	78.9	20345	49.7
MKT122427_1_4_APOV	268526	270534	AT2G20210.1	RNI-like superfamily protein	3566221	36.8	15157	28.9	212	11.6	35	16.7	2363	77.2	19751	48.3
MKT124409_1_4_APOV	270535	273356	AT5G42765.1	plasma membrane fusion protein	7382302	76.2	24784	47.3	881	48.4	89	42.4	2627	85.8	29091	71.1
MKT124578_1_4_APOV	273357	276513	AT3G20480.5	tetraacyldisaccharide 4'-kinase family protein	5573992	57.5	18306	35.0	901	49.5	98	46.7	2206	72.1	28108	68.7
MKT125774_1_4_APOV	276514	280078	AT3G18480.1	CCAAT-displacement protein alternatively spliced product	7130823	73.6	27878	53.2	818	44.9	104	49.5	2290	74.8	31494	77.0
MKT125823_1_4	280079	280936	AT5G58090.1	O-Glycosyl hydrolases family 17 protein	5345157	55.2	24489	46.8	553	30.4	105	50.0	2118	69.2	14825	36.2
MKT126260_1_4_APOV	280937	284015	AT5G64630.1	Transducin/WD40 repeat-like superfamily protein	5996728	61.9	31365	59.9	1069	58.7	116	55.2	2735	89.4	25876	63.2
MKT126264_1_4	284016	284697	AT2G25600.1	Shaker pollen inward K+ channel	5161722	53.3	8689	16.6	942	51.8	76	36.2	2536	82.9	23491	57.4
MKT126492_1_4	284698	286302	ATMG00860.1	DNA/RNA polymerases superfamily protein	5327885	55.0	16452	31.4	803	44.1	76	36.2	2306	75.4	19902	48.6
MKT126679_1_4	286303	287739	AT5G05170.1	Cellulose synthase family protein	4772635	49.2	22041	42.1	577	31.7	104	49.5	2287	74.7	24583	60.1
MKT127097_1_4_APOV	287740	290151	AT2G28450.2	zinc finger (CCCH-type) family protein	6010375	62.0	33200	63.4	757	41.6	90	42.9	2068	67.6	25348	61.9
MKT127492_1_4_APOV	290152	291423	AT2G40316.3	autophagy-like protein	6508336	67.2	17257	33.0	1118	61.4	88	41.9	1846	60.3	29776	72.8
MKT129330_1_4_APOV	291424	293069	AT1G26840.1	origin recognition complex protein 6	642730	6.6	2020	3.9	161	8.8	40	19.0	1967	64.3	4920	12.0
MKT129653_1_4_APOV	293070	294320	AT5G52180.1	transmembrane protein 161AB protein	3666126	37.8	7179	13.7	865	47.5	88	41.9	2414	78.9	19728	48.2
MKT130843_1_4_APOV	294321	297457	AT2G26340.1	hypothetical protein	3775559	39.0	16787	32.1	881	48.4	35	16.7	2192	71.6	25092	61.3
MKT130987_1_4_APOV	297458	299909	AT4G13670.1	plastid transcriptionally active 5	6093666	62.9	9213	17.6	848	46.6	110	52.4	2249	73.5	22150	54.1
MKT131170_1_4	299910	300168	AT3G42170.2	BED zinc finger and hAT dimerization domain-containing protein DAYSLEEPER	587896	6.1	11292	21.6	207	11.4	0	0.0	1	0.0	5485	13.4
MKT131604_1_4_APOV	300169	302013	AT5G16690.2	origin recognition complex subunit 3	3783840	39.0	12435	23.7	885	48.6	76	36.2	2497	81.6	23862	58.3
MKT132265_1_4	302014	302292	AT3G49160.1	pyruvate kinase family protein	1338477	13.8	3776	7.2	504	27.7	40	19.0	2111	69.0	1621	4.0
MKT136353_1_4	302293	303912	AT3G51800.3	metallopeptidase M24 family protein	7349891	75.8	29491	56.3	650	35.7	61	29.0	2317	75.7	27782	67.9
MKT137339_1_4	303913	304336	AT2G40730.1	kinase family with ARM repeat domain-containing protein	294903	3.0	3539	6.8	106	5.8	25	11.9	463	15.1	4402	10.8
MKT138013_1_4	304337	306323	AT4G17610.1	tRNA/rRNA methyltransferase (SpoU) family protein	6343230	65.5	22995	43.9	970	53.3	100	47.6	2389	78.1	27153	66.4
MKT138505_1_4	306324	306827	AT3G24255.5	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	5466991	56.4	12983	24.8	656	36.0	76	36.2	2193	71.7	26224	64.1
MKT138586_1_4	306828	308806	AT3G50420.2	Pentatricopeptide repeat (PPR) superfamily protein	6055257	62.5	23509	44.9	835	45.9	44	21.0	2449	80.0	34570	84.5
MKT138928_1_4	308807	310021	AT1G52590.1	Putative thiol-disulfide oxidoreductase DCC	1694953	17.5	13692	26.1	466	25.6	100	47.6	1453	47.5	9742	23.8
MKT139741_1_4_APOV	310022	312055	AT4G37510.1	Ribonuclease III family protein	6163832	63.6	13557	25.9	899	49.4	94	44.8	2403	78.5	9866	24.1
MKT143784_1_4	312056	312786	AT2G02070.2	indeterminate(ID)-domain 5	5123700	52.9	12819	24.5	966	53.1	88	41.9	1411	46.1	21808	53.3
MKT146240_1_4_APOV	312787	313739	AT3G17712.3	hypothetical protein	5779418	59.6	12176	23.3	900	49.5	100	47.6	1890	61.8	24397	59.6
MKT148312_1_4	313740	316128	AT2G31260.1	autophagy 9 (APG9)	6407936	66.1	17792	34.0	986	54.2	86	41.0	2105	68.8	21640	52.9
MKT149396_1_4_APOV	316129	319092	AT3G17040.2	high chlorophyll fluorescent 107	5788573	59.7	12945	24.7	687	37.7	58	27.6	2599	84.9	28121	68.7
MKT149614_1_4_APOV	319093	321664	AT1G56090.1	Tetratricopeptide repeat (TPR)-like superfamily protein	1933514	20.0	11647	22.2	791	43.5	37	17.6	1481	48.4	13101	32.0
MKT152047_1_4_APOV	321665	324216	AT1G72640.1	NAD(P)-binding Rossmann-fold superfamily protein	6468341	66.7	16841	32.2	717	39.4	58	27.6	2072	67.7	27276	66.7
MKT153301_1_4	324217	325397	AT2G02650.1	Ribonuclease H-like superfamily protein	5336449	55.1	22318	42.6	1105	60.7	100	47.6	2297	75.1	30371	74.2
MKT153988_1_4	325398	328025	AT1G55250.4	histone mono-ubiquitination 2	6299980	65.0	9255	17.7	471	25.9	70	33.3	2209	72.2	25329	61.9
MKT154349_1_4_APOV	328026	329450	AT1G63680.3	ALBINO OR PALE-GREEN 13	6580912	67.9	19557	37.4	1021	56.1	96	45.7	1917	62.6	23288	56.9
MKT154711_1_4_APOV	329451	331990	AT2G44420.3	protein N-terminal asparagine amidohydrolase family protein	6571439	67.8	16525	31.6	962	52.9	75	35.7	2189	71.5	30800	75.3
MKT155109_1_4	331991	333084	AT3G47420.3	putative glycerol-3-phosphate transporter 1	5971795	61.6	17534	33.5	676	37.1	82	39.0	2160	70.6	19821	48.4
MKT155265_1_4	333085	335215	AT5G13240.1	transcription regulator	4915041	50.7	21616	41.3	1009	55.4	106	50.5	1895	61.9	28017	68.5
MKT155305_1_4	335216	336318	AT5G01881.1	transmembrane protein	7124267	73.5	17331	33.1	678	37.3	63	30.0	2275	74.3	24914	60.9
MKT157257_1_4_APOV	336319	338901	AT5G25070.1	neurofilament light protein	5840731	60.3	16279	31.1	1109	60.9	106	50.5	2202	72.0	26963	65.9
MKT157285_1_4_APOV	338902	342663	AT1G77320.2	transcription coactivator	6849934	70.7	19019	36.3	1217	66.9	79	37.6	2440	79.7	31972	78.1

MKT157286_1_4_APOV	342664	344506	AT1G77290.3	Glutathione S-transferase family protein	6345469	65.5	14259	27.2	1151	63.2	89	42.4	2362	77.2	29754	72.7
MKT159057_1_4	344507	345907	AT5G35360.3	acetyl Co-enzyme a carboxylase biotin carboxylase subunit	6337292	65.4	15765	30.1	838	46.0	88	41.9	2469	80.7	26869	65.7
MKT160185_1_4_APOV	345908	347771	AT4G26980.1	RNI-like superfamily protein	5829771	60.2	10764	20.6	951	52.3	100	47.6	2106	68.8	26173	64.0
MKT160703_1_4_APOV	347772	349783	AT1G34770.3	melanoma-associated antigen G1-like protein	6104807	63.0	12434	23.7	954	52.4	76	36.2	2431	79.4	24015	58.7
MKT160851_1_4_APOV	349784	352088	AT5G55760.1	sirtuin 1	5621780	58.0	5636	10.8	819	45.0	76	36.2	2277	74.4	19319	47.2
MKT161286_1_4	352089	352893	AT3G61182.1	low-molecular-weight cysteine-rich 54	5740167	59.2	10750	20.5	947	52.0	105	50.0	2045	66.8	20992	51.3
MKT162606_1_4_APOV	352894	354991	AT4G30580.1	Phospholipid/glycerol acyltransferase family protein	6282415	64.8	28505	54.4	720	39.6	86	41.0	2281	74.5	26872	65.7
MKT164012_1_4_APOV	354992	356653	AT5G06430.1	Thioredoxin superfamily protein	4840152	49.9	14544	27.8	868	47.7	100	47.6	2169	70.9	24703	60.4
MKT164029_1_4	356654	357067	AT5G49430.2	WD40/YVTN repeat and Bromo-WDR9-I-like domain-containing protein	3420719	35.3	15914	30.4	744	40.9	82	39.0	2196	71.8	8268	20.2
MKT164244_1_4	357068	358678	AT4G37200.1	Thioredoxin superfamily protein	4213728	43.5	21553	41.2	750	41.2	46	21.9	2146	70.1	15263	37.3
MKT165315_1_4	358679	360141	AT4G13620.1	Integrase-type DNA-binding superfamily protein	5284441	54.5	9129	17.4	917	50.4	116	55.2	2378	77.7	27875	68.1
MKT167910_1_4_APOV	360142	361819	AT5G49570.1	peptide-N-glycanase 1	6410732	66.1	21951	41.9	672	36.9	64	30.5	2123	69.4	20175	49.3
MKT168213_1_4	361820	365408	AT2G28470.5	beta-galactosidase 8	6492693	67.0	17104	32.7	1139	62.6	82	39.0	2321	75.8	27568	67.4
MKT169758_1_4_APOV	365409	368249	AT5G24850.1	cryptochrome 3	6521445	67.3	11840	22.6	823	45.2	73	34.8	2202	72.0	17613	43.0
MKT169891_1_4	368250	369195	AT4G24380.2	dihydrofolate reductase	4792672	49.5	4897	9.4	161	8.8	100	47.6	2254	73.7	9540	23.3
MKT175152_1_4_APOV	369196	371468	AT2G20495.2	Serine/Threonine-kinase	6362197	65.6	11400	21.8	1013	55.7	104	49.5	2475	80.9	24834	60.7
MKT176042_1_4	371469	373004	AT1G64760.2	O-Glycosyl hydrolases family 17 protein	5149915	53.1	21810	41.7	626	34.4	100	47.6	2076	67.8	23161	56.6
MKT176331_1_4	373005	374852	AT3G16110.1	PDI-like 1-6	6279202	64.8	19695	37.6	1047	57.5	105	50.0	2531	82.7	20284	49.6
MKT177392_1_4_APOV	374853	377096	AT2G42780.2	transcription elongation factor B polypeptide	6704108	69.2	6474	12.4	909	49.9	58	27.6	2373	77.5	23942	58.5
MKT182888_1_4_APOV	377097	378557	AT1G09010.1	glycoside hydrolase family 2 protein	5168346	53.3	12409	23.7	883	48.5	98	46.7	2277	74.4	28096	68.7
MKT184400_1_4_APOV	378558	380212	AT2G20790.2	clathrin adaptor complexes medium subunit family protein	5761251	59.4	17224	32.9	708	38.9	94	44.8	2595	84.8	25477	62.3
MKT185663_1_4_APOV	380213	382654	AT5G17670.1	alpha/beta-Hydrolases superfamily protein	3557401	36.7	8910	17.0	1175	64.6	94	44.8	2239	73.2	19619	47.9
MKT185666_1_4_APOV	382655	386238	AT5G45360.1	F-box family protein	7065670	72.9	20061	38.3	1065	58.5	116	55.2	2681	87.6	26232	64.1
MKT186190_1_4_APOV	386239	388847	AT4G26410.1	chromosome-associated kinesin	6848223	70.7	8484	16.2	925	50.8	96	45.7	2411	78.8	31742	77.6
MKT187982_1_4	388848	390123	AT3G45690.1	Major facilitator superfamily protein	6345130	65.5	20768	39.7	717	39.4	76	36.2	2425	79.2	28451	69.5
MKT188496_1_4_APOV	390124	391549	AT5G01310.1	APRATAXIN-like protein	5379316	55.5	17216	32.9	562	30.9	58	27.6	2123	69.4	16991	41.5
MKT190086_1_4_APOV	391550	393609	AT1G53860.1	Remorin family protein	6648316	68.6	24483	46.8	902	49.6	88	41.9	1975	64.5	27707	67.7
MKT193152_1_4	393610	396747	AT5G01260.3	Carbohydrate-binding-like fold	5177067	53.4	18868	36.0	580	31.9	116	55.2	2596	84.8	18930	46.3
MKT193254_1_4	396748	397660	AT4G02070.2	MUTS homolog 6	5098520	52.6	16743	32.0	652	35.8	100	47.6	2270	74.2	25114	61.4
MKT194050_1_4_APOV	397661	399563	AT5G05490.1	Rad21/Rec8-like family protein	5348244	55.2	9177	17.5	1098	60.3	82	39.0	1798	58.8	21750	53.2
MKT194086_1_4_APOV	399564	402616	AT5G43600.1	ureidoglycolate amidohydrolase	3420563	35.3	24403	46.6	1166	64.1	100	47.6	2200	71.9	16043	39.2
MKT196134_1_4_APOV	402617	404733	AT4G38090.2	ribosomal protein S5 domain protein	3395913	35.0	13919	26.6	231	12.7	104	49.5	2454	80.2	18589	45.4
MKT196157_1_4_APOV	404734	406992	AT1G17760.1	Tetratricopeptide repeat (TPR)-like superfamily protein	5817428	60.0	21926	41.9	833	45.8	116	55.2	2236	73.1	29386	71.8
MKT197215_1_4	406993	408734	AT3G10230.1	lycopene cyclase	5154930	53.2	31298	59.8	647	35.5	86	41.0	2219	72.5	27986	68.4
MKT198187_1_4	408735	409605	AT3G54290.1	hemerythrin HHE cation-binding domain protein	6141486	63.4	25023	47.8	650	35.7	76	36.2	2017	65.9	25057	61.2
MKT198387_1_4_APOV	409606	410997	AT5G08320.1	E2F-associated phosphoprotein	5828156	60.1	18531	35.4	913	50.2	82	39.0	2449	80.0	20212	49.4
MKT198537_1_4	410998	411857	AT5G40410.1	Tetratricopeptide repeat (TPR)-like superfamily protein	6256824	64.6	22495	43.0	592	32.5	77	36.7	2386	78.0	26370	64.4
MKT198585_1_4	411858	412817	AT4G04650.1	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	4184400	43.2	8573	16.4	998	54.8	100	47.6	2224	72.7	26305	64.3
MKT199612_1_4	412818	415303	AT5G64460.5	Phosphoglycerate mutase family protein	6442183	66.5	18026	34.4	1015	55.8	100	47.6	2178	71.2	24029	58.7
MKT200802_1_4	415304	416318	AT1G08510.1	fatty acyl-ACP thioesterases B	5699554	58.8	11986	22.9	1138	62.5	116	55.2	2263	74.0	8808	21.5
MKT201180_1_4	416319	417181	AT2G05915.1	hypothetical protein	3219976	33.2	9277	17.7	769	42.3	94	44.8	1921	62.8	20102	49.1
MKT202602_1_4_APOV	417182	419286	AT4G11060.1	mitochondrially targeted single-stranded DNA binding protein	6023336	62.2	13914	26.6	723	39.7	94	44.8	2369	77.4	23875	58.3
MKT203107_1_4	419287	421262	AT2G17200.1	ubiquitin family protein	6909341	71.3	22441	42.9	834	45.8	116	55.2	2362	77.2	27619	67.5
MKT203205_1_4_APOV	421263	424284	AT3G58530.1	RNI-like superfamily protein	5268857	54.4	14708	28.1	715	39.3	88	41.9	1994	65.2	23855	58.3
MKT204768_1_4	424285	425093	AT1G12430.2	armadillo repeat kinesin 3	6144527	63.4	18976	36.2	572	31.4	94	44.8	2293	74.9	24228	59.2
MKT204875_1_4	425094	425744	AT4G39290.1	Galactose oxidase/kelch repeat superfamily protein	2453676	25.3	9318	17.8	155	8.5	43	20.5	1358	44.4	17713	43.3
MKT205092_1_4_APOV	425745	427790	AT2G34640.1	plastid transcriptionally active 12	6468526	66.7	15964	30.5	900	49.5	106	50.5	2341	76.5	21781	53.2
MKT205230_1_4	427791	428634	AT4G04640.1	ATPase, F1 complex, gamma subunit protein	3640489	37.6	7416	14.2	986	54.2	75	35.7	1856	60.7	15810	38.6
MKT206098_1_4_APOV	428635	430893	AT3G10970.3	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein	6248419	64.5	13941	26.6	761	41.8	104	49.5	2413	78.9	26092	63.8
MKT206466_1_4_APOV	430894	432895	AT2G43110.1	U3 containing 90S pre-ribosomal complex subunit	5992588	61.8	24095	46.0	833	45.8	80	38.1	2067	67.5	21315	52.1
MKT206470_1_4	432896	433637	AT1G67500.4	recovery protein 3	5737321	59.2	7539	14.4	885	48.6	58	27.6	2282	74.6	29241	71.5
MKT208284_1_4_APOV	433638	436674	AT3G43540.2	initiation factor 4F subunit (DUF1350)	4705404	48.6	16123	30.8	845	46.4	110	52.4	2346	76.7	23895	58.4
MKT208916_1_4	436675	437540	AT4G18930.1	RNA ligase/cyclic nucleotide phosphodiesterase family protein	4508008	46.5	4437	8.5	963	52.9	86	41.0	1885	61.6	6891	16.8
MKT208959_1_4	437541	437926	AT1G52680.1	late embryogenesis abundant protein-related / LEA protein-like protein	3745907	38.7	15614	29.8	230	12.6	82	39.0	1195	39.1	17218	42.1
MKT210113_1_4_APOV	437927	441232	AT3G59490.4	hypothetical protein	6855646	70.7	18753	35.8	678	37.3	76	36.2	2331	76.2	27797	67.9
MKT210707_1_4_APOV	441233	444446	AT4G01860.2	Transducin family protein / WD-40 repeat family protein	5320186	54.9	17237	32.9	839	46.1	76	36.2	2518	82.3	20084	49.1
MKT211758_1_4_APOV	444447	446564	AT4G15420.2	Ubiquitin fusion degradation UFD1 family protein	6330382	65.3	19495	37.2	1007	55.3	106	50.5	2190	71.6	26363	64.4
MKT212863_1_4_APOV	446565	449159	AT2G35500.1	shikimate kinase like 2	6211672	64.1	21655	41.4	764	42.0	94	44.8	2474	80.8	31818	77.8
MKT217609_1_4	449160	449744	AT2G39670.1	Radical SAM superfamily protein	3346336	34.5	11323	21.6	449	24.7	110	52.4	1206	39.4	5280	12.9
MKT223188_1_4_APOV	449745	452182	AT2G34860.2	DnaJ/Hsp40 cysteine-rich domain superfamily protein	5264433	54.3	17557	33.5	765	42.0	70	33.3	2290	74.8	23490	57.4
MKT223227_1_4	452183	453872	AT2G02410.12	yacP-like NYN domain protein	4392367	45.3	11500	22.0	510	28.0	49	23.3	2088	68.2	24239	59.2
MKT223537_1_4	453873	455061	AT4G35300.5	tonoplast monosaccharide transporter2	6730006	69.4	26578	50.8	858	47.1	94	44.8	2120	69.3	27005	66.0
MKT225133_1_4	455062	455579	AT2G03330.1	transmembrane protein	1636276	16.9	1742	3.3	105	5.8	59	28.1	1477	48.3	23813	58.2
MKT225962_1_4_APOV	455580	457410	AT3G21820.1	histone-lysine N-methyltransferase ATXR2	1086130	11.2	10071	19.2	220	12.1	49	23.3	520	17.0	5824	14.2
MKT227293_1_4_APOV	457411	459462	AT2G31840.2	Thioredoxin superfamily protein	5860511	60.5	9172	17.5	936	51.4	100	47.6	2160	70.6	23682	57.9
MKT228111_1_4	459463	462348	AT2G19490.1	recA DNA recombination family protein	3383995	34.9	18890	36.1	780	42.9	76	36.2	2298	75.1	15418	37.7
MKT228199_1_4	462349	464024	AT3G14770.1	Nodulin MtN3 family protein	6048637	62.4	25655	49.0	1066	58.6	110	52.4	2225	72.7	26288	64.2
MKT229513_1_4	464025	465218	AT4G20380.9	LSD1 zinc finger family protein	2625785	27.1	62	0.1	1203	66.1	76	36.2	2281	74.5	26580	65.0
MKT229926_1_4_APOV	465219	466569	AT3G62940.4	Cysteine proteinases superfamily protein	2583062	26.7	14519	27.7	1057	58.1	126	60.0	1881	61.5	20556	50.2

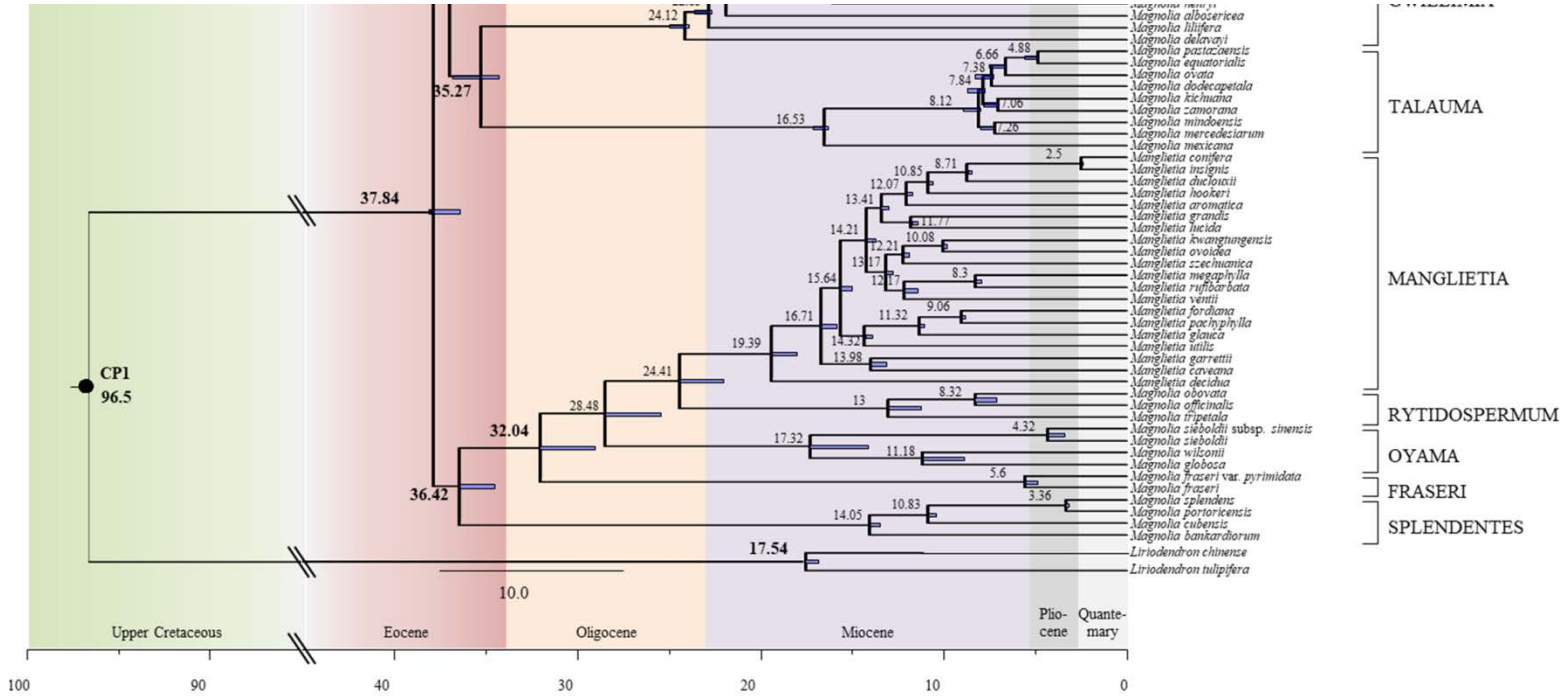
MKT231174_1_4	466570	467548	AT1G43760.1	DNAse I-like superfamily protein	5816470	60.0	12759	24.4	705	38.7	100	47.6	1361	44.5	29224	71.4
MKT232553_1_4	467549	470351	AT5G61380.1	CCT motif -containing response regulator protein	5370712	55.4	23273	44.4	847	46.5	53	25.2	2307	75.4	30543	74.6
MKT232706_1_4_APOV	470352	471172	AT4G00560.1	NAD(P)-binding Rossmann-fold superfamily protein	4684917	48.3	19053	36.4	860	47.3	105	50.0	1960	64.1	23332	57.0
MKT233179_1_4	471173	472344	AT5G20420.1	chromatin remodeling 42	5373818	55.4	14439	27.6	700	38.5	38	18.1	2156	70.5	21177	51.8
MKT233393_1_4	472345	473466	AT3G06530.3	ARM repeat superfamily protein	5036980	52.0	28032	53.5	931	51.2	82	39.0	2446	79.9	25685	62.8
MKT233399_1_4_APOV	473467	476034	AT3G06530.2	ARM repeat superfamily protein	7027274	72.5	29728	56.8	1097	60.3	88	41.9	2499	81.7	28261	69.1
MKT234475_1_4_APOV	476035	478821	AT1G76450.1	Photosystem II reaction center PsbP family protein	6235438	64.3	19263	36.8	751	41.3	82	39.0	2560	83.7	22144	54.1
MKT235083_1_4	478822	480433	AT4G21470.1	riboflavin kinase/FMN hydrolase	6354175	65.6	27285	52.1	975	53.6	61	29.0	2258	73.8	22096	54.0
MKT235890_1_4	480434	481578	AT1G50480.1	10-formyltetrahydrofolate synthetase	4072923	42.0	20215	38.6	607	33.4	88	41.9	2241	73.2	24503	59.9
MKT236372_1_4_APOV	481579	486042	AT3G53900.1	uracil phosphoribosyltransferase	6282838	64.8	21743	41.5	953	52.4	89	42.4	2253	73.6	28261	69.1
MKT238438_1_4	486043	487019	AT3G61170.1	Tetratricopeptide repeat (TPR)-like superfamily protein	6104033	63.0	25532	48.8	830	45.6	94	44.8	2069	67.6	25079	61.3
MKT239819_1_4_APOV	487020	488471	AT3G45900.1	Ribonuclease P protein subunit P38-like protein	1807553	18.7	11519	22.0	79	4.3	88	41.9	2530	82.7	6975	17.0
MKT240204_1_4	488472	489508	AT2G26990.1	proteasome family protein	5137905	53.0	20230	38.6	772	42.4	110	52.4	2489	81.3	31196	76.2
MKT240662_1_4_APOV	489509	491840	AT5G24710.1	Transducin/WD40 repeat-like superfamily protein	6643406	68.5	22624	43.2	1155	63.5	82	39.0	2663	87.0	27722	67.7
MKT241357_1_4_APOV	491841	493766	AT5G66810.2	Ran-binding protein in the microtubule-organising centre protein	6557284	67.7	18213	34.8	815	44.8	64	30.5	2223	72.6	14035	34.3
MKT241546_1_4	493767	494843	AT3G01880.1	vacuolar sorting-associated protein (DUF946)	3853900	39.8	20875	39.9	876	48.1	100	47.6	2558	83.6	16607	40.6
MKT242726_1_4_APOV	494844	496737	AT1G48175.6	Cytidine/deoxycytidylate deaminase family protein	4126877	42.6	12981	24.8	560	30.8	89	42.4	2264	74.0	25689	62.8
MKT242935_1_4	496738	499039	AT5G64370.1	beta-ureidopropionase	5614690	57.9	18693	35.7	996	54.7	79	37.6	2244	73.3	23233	56.8
MKT243378_1_4	499040	499946	AT3G44690.1	hypothetical protein	4693313	48.4	18093	34.6	768	42.2	94	44.8	2077	67.9	18400	45.0
MKT244181_1_4	499947	501359	AT1G49340.4	Phosphatidylinositol 3- and 4-kinase family protein	6238225	64.4	20524	39.2	879	48.3	76	36.2	2159	70.6	24105	58.9
MKT244595_1_4	501360	501830	AT2G34970.1	Trimeric LpxA-like enzyme	1640658	16.9	1702	3.3	434	23.8	47	22.4	1106	36.1	11688	28.6
MKT245813_1_4_APOV	501831	503074	AT3G49070.2	transmembrane protein, putative (DUF677)	4523902	46.7	16227	31.0	1017	55.9	46	21.9	2055	67.2	23531	57.5
MKT246045_1_4	503075	504083	AT3G15110.1	transmembrane protein	3436468	35.5	6903	13.2	1066	58.6	92	43.8	2145	70.1	17736	43.3
MKT246079_1_4_APOV	504084	507305	AT2G17900.1	SET domain group 37	6756061	69.7	20156	38.5	1074	59.0	74	35.2	2178	71.2	22241	54.4
MKT246461_1_4_APOV	507306	509902	AT3G24560.2	Adenine nucleotide alpha hydrolases-like superfamily protein	6934339	71.6	20220	38.6	989	54.3	100	47.6	2440	79.7	27919	68.2
MKT248146_1_4	509903	511364	AT2G31660.1	ARM repeat superfamily protein	6290196	64.9	23881	45.6	1043	57.3	106	50.5	2398	78.4	27298	66.7
MKT248631_1_4_APOV	511365	515552	AT1G73440.1	calmodulin-like protein	2711403	28.0	16757	32.0	763	41.9	64	30.5	2595	84.8	21549	52.7
MKT249328_1_4_APOV	515553	518653	AT1G50000.1	methyltransferase	4745126	49.0	20380	38.9	719	39.5	110	52.4	2166	70.8	25594	62.5
MKT249944_1_4	518654	519279	AT2G23070.1	Protein kinase superfamily protein	3700753	38.2	15260	29.1	452	24.8	49	23.3	1978	64.6	22136	54.1
MKT250009_1_4_APOV	519280	522579	AT3G15090.1	GroES-like zinc-binding alcohol dehydrogenase family protein	7131975	73.6	19079	36.4	977	53.7	106	50.5	2125	69.4	24094	58.9
MKT251689_1_4_APOV	522580	526312	AT3G54170.1	FKBP12 interacting protein 37	5686765	58.7	30040	57.4	1039	57.1	116	55.2	2681	87.6	28031	68.5
MKT255591_1_4	526313	527109	AT4G39660.2	alanine:glyoxylate aminotransferase 2	5610258	57.9	16173	30.9	1107	60.8	100	47.6	2338	76.4	23196	56.7
MKT257161_1_4	527110	528687	AT4G02790.1	GTP-binding family protein	7083157	73.1	18771	35.8	731	40.2	82	39.0	2065	67.5	19160	46.8
MKT257387_1_4	528688	529198	AT1G16800.1	P-loop containing nucleoside triphosphate hydrolases superfamily protein	2618912	27.0	17512	33.4	243	13.4	49	23.3	1891	61.8	20130	49.2
MKT259369_1_4_APOV	529199	531127	AT3G28030.4	5'-3' exonuclease family protein	5925312	61.1	18163	34.7	938	51.5	62	29.5	2359	77.1	23590	57.6
MKT261594_1_4	531128	532594	AT5G06440.1	polyketide cyclase/dehydrase/lipid transport superfamily protein	6225153	64.2	15735	30.1	1113	61.2	94	44.8	2390	78.1	26647	65.1
MKT264772_1_4_APOV	532595	535233	AT5G19130.1	GPI transamidase component family protein / Gaa1-like family protein	5249725	54.2	25798	49.3	1049	57.6	90	42.9	2350	76.8	24054	58.8
MKT265035_1_4_APOV	535234	537935	AT3G12080.1	GTP-binding family protein	6599883	68.1	28183	53.8	440	24.2	100	47.6	2218	72.5	26505	64.8
MKT265344_1_4_APOV	537936	540437	AT2G44760.1	dihydroorotate dehydrogenase (DUF3598)	3456709	35.7	23121	44.2	875	48.1	54	25.7	1902	62.2	10960	26.8
MKT267759_1_4	540438	541396	AT2G18030.1	Peptide methionine sulfoxide reductase family protein	4952493	51.1	9362	17.9	831	45.7	104	49.5	2072	67.7	26798	65.5
MKT267794_1_4_APOV	541397	542964	AT5G39410.1	Saccharopine dehydrogenase	5439310	56.1	27001	51.6	1065	58.5	76	36.2	2342	76.5	27939	68.3
MKT268004_1_4_APOV	542965	546451	AT4G34140.1	0D111/G-patch domain-containing protein	3398918	35.1	25576	48.8	666	36.6	98	46.7	2389	78.1	22823	55.8
MKT268009_1_4_APOV	546452	549086	AT3G27670.1	ARM repeat superfamily protein	6081580	62.8	31877	60.9	755	41.5	116	55.2	2236	73.1	29673	72.5
MKT271231_1_4_APOV	549087	551548	AT5G48830.2	phosphoglycolate phosphatase	6086893	62.8	22005	42.0	860	47.3	106	50.5	2248	73.5	27710	67.7
MKT272162_1_4_APOV	551549	553902	AT2G20980.1	minichromosome maintenance 10	6738232	69.5	26614	50.8	844	46.4	86	41.0	2346	76.7	31367	76.7
MKT272727_1_4_APOV	553903	556533	AT5G64860.1	disproportionating enzyme	5520392	57.0	19856	37.9	1048	57.6	76	36.2	1946	63.6	28049	68.5
MKT272827_1_4	556534	560525	AT3G59060.4	phytochrome interacting factor 3-like 6	7556290	78.0	23138	44.2	969	53.2	116	55.2	2746	89.7	33570	82.0
MKT273349_1_4_APOV	560526	563217	AT1G08750.3	Peptidase C13 family	6778655	69.9	25894	49.5	1114	61.2	94	44.8	2355	77.0	28523	69.7
MKT274838_1_4	563218	564530	AT5G53330.1	Ubiquitin-associated/translation elongation factor EF1B protein	6029146	62.2	8984	17.2	902	49.6	100	47.6	2222	72.6	27715	67.7
MKT275800_1_4_APOV	564531	566105	AT3G17611.1	RHOMBOID-like protein 14	6058671	62.5	4450	8.5	1137	62.5	100	47.6	2349	76.8	26132	63.9
MKT276078_1_4_APOV	566106	567506	AT5G52810.1	NAD(P)-binding Rossmann-fold superfamily protein	3953999	40.8	16904	32.3	960	52.7	82	39.0	2291	74.9	7248	17.7
MKT276084_1_4	567507	568144	AT1G77280.2	kinase with adenine nucleotide alpha hydrolases-like domain-containing protein	5260019	54.3	12896	24.6	1039	57.1	116	55.2	2296	75.0	20491	50.1
MKT277188_1_4	568145	569070	AT4G08685.1	Pollen Ole e 1 allergen and extensin family protein	5827801	60.1	6330	12.1	713	39.2	61	29.0	2333	76.2	19186	46.9
MKT277229_1_4	569071	570867	AT1G33410.2	SUPPRESSOR OF AUXIN RESISTANCE1	6364178	65.7	26119	49.9	1151	63.2	94	44.8	2440	79.7	27735	67.8
MKT277271_1_4_APOV	570868	574955	AT1G50120.1	immunoglobulin	6383863	65.9	22400	42.8	1165	64.0	88	41.9	2507	81.9	28981	70.8
MKT277532_1_4	574956	579564	AT5G66920.1	SKU5 similar 17	6075083	62.7	14897	28.5	1087	59.7	106	50.5	2578	84.2	22017	53.8
MKT277935_1_4_APOV	579565	581846	AT5G56960.1	basic helix-loop-helix (bHLH) DNA-binding family protein	6801546	70.2	23416	44.7	995	54.7	126	60.0	2627	85.8	27243	66.6
MKT278004_1_4_APOV	581847	584629	AT1G55280.1	Lipase/lipooxygenase, PLAT/LH2 family protein	6306073	65.1	20747	39.6	957	52.6	76	36.2	2209	72.2	23036	56.3
MKT279186_1_4_APOV	584630	587677	AT3G09180.3	mediator of RNA polymerase II transcription subunit	6667342	68.8	25580	48.9	1122	61.6	86	41.0	2186	71.4	28626	70.0
MKT279537_1_4	587678	589528	AT1G80410.1	tetratricopeptide repeat (TPR)-containing protein	6638937	68.5	19090	36.5	841	46.2	94	44.8	2213	72.3	25421	62.1
MKT280150_1_4_APOV	589529	592174	AT2G14260.3	proline iminopeptidase	6639921	68.5	31201	59.6	1045	57.4	94	44.8	2416	79.0	25036	61.2
MKT281671_1_4_APOV	592175	595192	AT3G06950.1	Pseudouridine synthase family protein	6591546	68.0	17391	33.2	978	53.7	76	36.2	2403	78.5	27653	67.6
MKT282190_1_4	595193	597924	AT1G27680.1	ADPGLC-PPase large subunit	6301798	65.0	17898	34.2	1021	56.1	86	41.0	2100	68.6	25697	62.8
MKT282250_1_4	597925	598498	AT3G02560.3	Ribosomal protein S7e family protein	1028154	10.6	427	0.8	251	13.8	69	32.9	2048	66.9	11430	27.9
MKT283955_1_4	598499	600446	AT1G22870.3	kinase family with ARM repeat domain-containing protein	6417938	66.2	23636	45.1	1065	58.5	88	41.9	2511	82.1	30324	74.1
MKT284160_1_4	600447	602599	AT4G35520.5	MUTL protein homolog 3	6692070	69.1	16109	30.8	881	48.4	46	21.9	2571	84.0	26199	64.0
MKT285757_1_4	602600	603267	AT3G61500.2	BPS1-like protein	5033042	51.9	7131	13.6	846	46.5	86	41.0	2369	77.4	17367	42.4
MKT286562_1_4_APOV	603268	605764	AT5G35670.1	IQ-domain 33	5952288	61.4	15477	29.6	999	54.9	67	31.9	1954	63.9	23364	57.1

MKT287698_1_4_APOV	605765	608649	AT1G10510.1	RNI-like superfamily protein	4470961	46.1	18052	34.5	951	52.3	106	50.5	2292	74.9	13755	33.6
MKT288332_1_4_APOV	608650	611298	AT4G27120.3	DDRGK domain protein	6028063	62.2	19387	37.0	987	54.2	82	39.0	2269	74.2	25865	63.2
MKT288424_1_4	611299	612582	AT3G47810.3	Calcineurin-like metallo-phosphoesterase superfamily protein	5444407	56.2	8608	16.4	886	48.7	96	45.7	2345	76.6	20493	50.1
MKT293201_1_4	612583	613677	AT5G64840.1	general control non-repressible 5	4201648	43.4	10357	19.8	590	32.4	64	30.5	2511	82.1	29047	71.0
MKT293539_1_4	613678	614212	AT1G56570.2	Tetratricopeptide repeat (TPR)-like superfamily protein	4748233	49.0	10260	19.6	675	37.1	110	52.4	1453	47.5	22436	54.8
MKT295445_1_4_APOV	614213	616181	AT3G24080.4	KRR1 family protein	5811787	60.0	15867	30.3	885	48.6	76	36.2	2153	70.4	25420	62.1
MKT296549_1_4_APOV	616182	618832	AT5G44750.2	DNA-directed DNA polymerase	6278817	64.8	25457	48.6	1006	55.3	76	36.2	2484	81.2	33535	82.0
MKT297810_1_4_APOV	618833	621751	AT1G50575.1	Putative lysine decarboxylase family protein	6080665	62.7	13892	26.5	861	47.3	86	41.0	1938	63.3	21295	52.0
MKT297825_1_4	621752	622580	AT1G43760.1	DNAse I-like superfamily protein	4172196	43.1	6045	11.5	751	41.3	33	15.7	2400	78.4	21875	53.5
MKT298063_1_4	622581	625000	No_hit	No_hit	6281464	64.8	20155	38.5	723	39.7	98	46.7	2399	78.4	28374	69.3
MKT299474_1_4_APOV	625001	626553	AT3G63290.1	2-oxoglutarate (2OG) and Fe(II)-dependent oxygenase superfamily protein	4945511	51.0	18006	34.4	835	45.9	88	41.9	2321	75.8	24518	59.9
MKT300606_1_4_APOV	626554	629118	AT3G26085.4	CAAX amino terminal protease family protein	5485629	56.6	11509	22.0	973	53.5	94	44.8	2166	70.8	16598	40.6
MKT301981_1_4_APOV	629119	631273	AT1G76280.2	Tetratricopeptide repeat (TPR)-like superfamily protein	4415583	45.6	15318	29.3	1047	57.5	80	38.1	2282	74.6	21240	51.9
MKT302745_1_4	631274	632162	AT5G62570.4	Calmodulin binding protein-like protein	1005876	10.4	2825	5.4	196	10.8	3	1.4	1657	54.2	7359	18.0
MKT303404_1_4	632163	634078	AT4G08500.1	MAPK/ERK kinase kinase 1	5679082	58.6	25934	49.5	1099	60.4	106	50.5	2442	79.8	21686	53.0
MKT304100_1_4_APOV	634079	637444	AT3G03790.1	ankyrin repeat family protein / regulator of chromosome condensation (RCC1) family protein	5232286	54.0	14223	27.2	498	27.4	76	36.2	2193	71.7	20257	49.5
MKT305891_1_4	637445	638491	AT1G50200.2	Alanyl-tRNA synthetase	812190	8.4	2210	4.2	199	10.9	94	44.8	1937	63.3	4929	12.0
MKT306820_1_4	638492	640642	AT5G17250.1	Alkaline-phosphatase-like family protein	3561608	36.8	17093	32.6	460	25.3	100	47.6	2393	78.2	18120	44.3
MKT307031_1_4_APOV	640643	642006	AT1G17665.1	CA-responsive protein	1024908	10.6	6216	11.9	835	45.9	65	31.0	2071	67.7	3618	8.8
MKT308263_1_4	642007	642774	AT3G52220.1	leukocyte immunoglobulin-like receptor family A protein	5222283	53.9	9342	17.8	802	44.1	80	38.1	2018	65.9	17166	42.0
MKT308611_1_4	642775	644208	AT5G32470.1	heme oxygenase-like, multi-helical	5248963	54.2	13310	25.4	969	53.2	86	41.0	2385	77.9	17255	42.2
MKT308778_1_4	644209	647200	AT3G24255.3	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	4700797	48.5	22065	42.1	1075	59.1	126	60.0	2431	79.4	19679	48.1
MKT308997_1_4_APOV	647201	650141	AT5G23520.2	smr (Small MutS Related) domain-containing protein	5758217	59.4	21078	40.3	969	53.2	100	47.6	2283	74.6	21817	53.3
MKT310237_1_4_APOV	650142	652985	AT1G63160.1	replication factor C 2	4802240	49.6	20528	39.2	955	52.5	98	46.7	2531	82.7	19137	46.8
MKT311863_1_4_APOV	652986	654673	AT5G60540.1	pyridoxine biosynthesis 2	3604755	37.2	12480	23.8	613	33.7	22	10.5	2091	68.3	15890	38.8
MKT312086_1_4_APOV	654674	657515	AT1G01930.1	zinc finger protein-like protein	4685918	48.4	17789	34.0	769	42.3	100	47.6	2262	73.9	19468	47.6
MKT312515_1_4	657516	658399	AT1G19910.1	ATPase, F0/V0 complex, subunit C protein	1113042	11.5	3977	7.6	660	36.3	46	21.9	2400	78.4	6447	15.8
MKT312523_1_4_APOV	658400	661517	AT5G08720.1	polyketide cyclase/dehydrase/lipid transporter	5863259	60.5	13064	25.0	961	52.8	105	50.0	2063	67.4	18975	46.4
MKT312769_1_4_APOV	661518	662657	AT5G41850.1	alpha/beta-Hydrolases superfamily protein	729720	7.5	5108	9.8	547	30.1	88	41.9	1151	37.6	7522	18.4
MKT314389_1_4	662658	664604	AT3G28480.1	Oxoglutarate/iron-dependent oxygenase	5578358	57.6	12476	23.8	989	54.3	79	37.6	2189	71.5	21277	52.0
MKT314507_1_4	664605	665741	AT1G09795.1	ATP phosphoribosyl transferase 2	6009000	62.0	18354	35.1	724	39.8	94	44.8	2135	69.8	17012	41.6
MKT314708_1_4	665742	666088	AT3G26480.2	Transducin family protein / WD-40 repeat family protein	670813	6.9	6295	12.0	633	34.8	35	16.7	1098	35.9	3065	7.5
MKT314787_1_4	666089	669200	AT2G04620.1	zinc transporter-like protein	5951265	61.4	15773	30.1	921	50.6	80	38.1	2774	90.7	19764	48.3
MKT315244_1_4_APOV	669201	670688	AT2G46060.2	transmembrane protein-like protein	5282476	54.5	19232	36.7	1173	64.5	82	39.0	2238	73.1	18472	45.1
MKT315917_1_4	670689	671490	AT1G14590.1	Nucleotide-diphospho-sugar transferase family protein	4848419	50.0	15966	30.5	881	48.4	116	55.2	2199	71.9	14395	35.2
MKT316089_1_4	671491	673196	AT2G46900.1	transcription factor-like protein	5479968	56.5	6363	12.2	793	43.6	104	49.5	2679	87.5	19498	47.6
MKT316544_1_4_APOV	673197	676460	AT5G03430.1	phosphoadenosine phosphosulfate (PAPS) reductase family protein	6030174	62.2	17710	33.8	875	48.1	110	52.4	2222	72.6	19938	48.7
MKT317772_1_4	676461	678128	AT2G04842.2	threonyl-tRNA synthetase, putative / threonine-tRNA ligase	4591165	47.4	13522	25.8	665	36.5	94	44.8	2370	77.5	17683	43.2
MKT320490_1_4_APOV	678129	681868	AT3G15080.1	Polynucleotidyl transferase, ribonuclease H-like superfamily protein	5008998	51.7	16258	31.1	935	51.4	94	44.8	2346	76.7	18124	44.3
MKT322600_1_4	681869	683981	AT2G20420.1	ATP citrate lyase (ACL) family protein	3207772	33.1	10937	20.9	952	52.3	64	30.5	1120	36.6	17769	43.4
MKT323905_1_4_APOV	683982	686999	AT5G12920.4	Transducin/WD40 repeat-like superfamily protein	4296963	44.3	18389	35.1	776	42.6	88	41.9	2448	80.0	18957	46.3
MKT325055_1_4	687000	688181	AT3G60740.3	ARM repeat superfamily protein	5847092	60.3	24595	47.0	863	47.4	83	39.5	2128	69.5	20109	49.1
MKT326621_1_4	688182	689760	AT3G24255.7	RNA-directed DNA polymerase (reverse transcriptase)-related family protein	5695306	58.8	27263	52.1	853	46.9	73	34.8	2201	71.9	17144	41.9
MKT328764_1_4	689761	690460	AT3G15040.1	senescence regulator (Protein of unknown function, DUF584)	4866496	50.2	4804	9.2	668	36.7	94	44.8	1770	57.8	14231	34.8
MKT331516_1_4_APOV	690461	691847	AT5G19970.1	GRAS family transcription factor family protein	5438801	56.1	18627	35.6	880	48.4	116	55.2	2256	73.7	14203	34.7
MKT332424_1_4_APOV	691848	694473	AT3G10380.2	subunit of exocyst complex 8	6056277	62.5	12457	23.8	1087	59.7	88	41.9	2157	70.5	20998	51.3
MKT333354_1_4	694474	696445	AT4G24490.2	RAB geranylgeranyl transferase alpha subunit 1	5495085	56.7	12499	23.9	652	35.8	49	23.3	2455	80.2	21200	51.8
MKT334782_1_4	696446	700721	AT3G61170.1	Tetratricopeptide repeat (TPR)-like superfamily protein	3996777	41.2	22863	43.7	725	39.8	98	46.7	2032	66.4	18213	44.5
MKT337520_1_4_APOV	700722	702792	AT5G48390.1	Tetratricopeptide repeat (TPR)-like superfamily protein	4220252	43.5	15432	29.5	755	41.5	76	36.2	2285	74.7	21808	53.3
MKT339163_1_4	702793	703326	ATMG00750.1	GAG/POL/ENV polyprotein	862587	8.9	2531	4.8	441	24.2	75	35.7	1131	37.0	7431	18.2
MKT341624_1_4_APOV	703327	705719	AT2G40760.1	Rhodanese/Cell cycle control phosphatase superfamily protein	4968686	51.3	15898	30.4	688	37.8	94	44.8	2237	73.1	18077	44.2
MKT341643_1_4_APOV	705720	708894	AT1G19690.1	NAD(P)-binding Rossmann-fold superfamily protein	6126497	63.2	16143	30.8	873	48.0	59	28.1	2366	77.3	15311	37.4
MKT344417_1_4	708895	710213	AT2G26140.1	FTSH protease 4	3779039	39.0	21942	41.9	491	27.0	52	24.8	2205	72.1	16811	41.1
MKT346077_1_4_APOV	710214	713563	AT5G17240.2	SET domain group 40	6340744	65.4	16987	32.4	1072	58.9	88	41.9	2714	88.7	19851	48.5
MKT346101_1_4	713564	714691	AT5G19900.5	PRLI-interacting factor	4094906	42.3	8241	15.7	584	32.1	110	52.4	2360	77.1	18700	45.7
MKT346845_1_4_APOV	714692	718372	AT1G12370.1	photolyase 1	6318586	65.2	25766	49.2	909	49.9	94	44.8	2650	86.6	18925	46.2
MKT347521_1_4	718373	721227	AT1G21630.4	Calcium-binding EF hand family protein	2624200	27.1	17098	32.7	735	40.4	106	50.5	2417	79.0	9456	23.1
MKT348011_1_4_APOV	721228	723088	AT1G03687.1	DTW domain-containing protein	4371174	45.1	10144	19.4	599	32.9	76	36.2	2249	73.5	17709	43.3
MKT348468_1_4	723089	724052	AT5G14210.3	Leucine-rich repeat protein kinase family protein	4196936	43.3	17104	32.7	1105	60.7	106	50.5	2035	66.5	14568	35.6
MKT348660_1_4_APOV	724053	726475	AT5G04440.2	RAP release 2, galactose-binding-like domain protein, putative (DUF1997)	5511544	56.9	16907	32.3	999	54.9	116	55.2	2440	79.7	19513	47.7
MKT349073_1_4	726476	727809	AT1G16240.4	syntaxin of plants 51	4343316	44.8	15330	29.3	622	34.2	86	41.0	2182	71.3	19172	46.9
MKT350500_1_4	727810	730019	AT2G45540.6	WD-40 repeat family protein / beige-like protein	6267454	64.7	22388	42.8	1119	61.5	88	41.9	2762	90.3	21060	51.5
MKT351432_1_4	730020	730769	AT3G56960.2	phosphatidyl inositol monophosphate 5 kinase 4	3653810	37.7	20515	39.2	872	47.9	76	36.2	1440	47.1	8728	21.3
MKT351705_1_4	730770	732200	AT4G31800.2	WRKY DNA-binding protein 18	4757976	49.1	22096	42.2	991	54.5	70	33.3	2466	80.6	18646	45.6
MKT351756_1_4_APOV	732201	733216	AT4G31460.1	Ribosomal L28 family	3807734	39.3	16336	31.2	994	54.6	73	34.8	2369	77.4	17989	44.0
MKT351865_1_4	733217	735176	AT2G39750.1	S-adenosyl-L-methionine-dependent methyltransferases superfamily protein	4321629	44.6	20627	39.4	1101	60.5	100	47.6	2230	72.9	16161	39.5
MKT353296_1_4_APOV	735177	737415	AT5G07380.6	hypothetical protein	5429841	56.0	7876	15.0	877	48.2	89	42.4	2235	73.0	18169	44.4

MKT353714_1_4_APOV	737416	739110	AT5G64370.1 beta-ureidopropionase	4624087	47.7	15855	30.3	968	53.2	104	49.5	1752	57.3	16505	40.3
MKT354514_1_4	739111	739870	AT1G27530.1 ubiquitin-fold modifier-conjugating enzyme	3004076	31.0	15011	28.7	431	23.7	88	41.9	2278	74.4	13773	33.7
MKT355030_1_4	739871	742088	AT5G66150.3 Glycosyl hydrolase family 38 protein	4107606	42.4	22580	43.1	774	42.5	82	39.0	2757	90.1	16749	40.9
MKT355607_1_4	742089	745353	AT4G02600.2 Seven transmembrane MLO family protein	6477267	66.8	27024	51.6	919	50.5	80	38.1	2655	86.8	18356	44.9
MKT358559_1_4_APOV	745354	747386	AT5G57160.1 DNA ligase IV	2358425	24.3	18287	34.9	802	44.1	100	47.6	2291	74.9	16183	39.5
MKT358844_1_4_APOV	747387	749886	AT3G04490.3 exportin-4 protein	5265487	54.3	23752	45.4	714	39.2	79	37.6	2357	77.0	19218	47.0
MKT358915_1_4	749887	753152	AT5G12200.1 pyrimidine 2	969003	10.0	5628	10.7	793	43.6	54	25.7	621	20.3	8702	21.3
MKT359827_1_4_APOV	753153	754577	AT5G35690.1 zinc metalloproteinase-like protein	4276064	44.1	14649	28.0	863	47.4	82	39.0	2262	73.9	13710	33.5
MKT362323_1_4	754578	755619	AT1G71070.1 Core-2/I-branching beta-1, 6-N-acetylglucosaminyltransferase family protein	4344347	44.8	20775	39.7	699	38.4	76	36.2	1720	56.2	18666	45.6
MKT362454_1_4	755620	756401	AT1G50900.1 Ankyrin repeat family protein	5537321	57.1	18899	36.1	1231	67.6	116	55.2	2446	79.9	20394	49.8
MKT362594_1_4_APOV	756402	758313	AT2G33260.1 Tryptophan/tyrosine permease	3994365	41.2	8190	15.6	1150	63.2	106	50.5	1923	62.8	14781	36.1
MKT363416_1_4_APOV	758314	761056	AT1G73180.2 Eukaryotic translation initiation factor eIF2A family protein	3641279	37.6	11319	21.6	850	46.7	35	16.7	2378	77.7	15040	36.8
MKT363585_1_4_APOV	761057	763415	AT4G27720.1 Major facilitator superfamily protein	4639193	47.9	19339	36.9	795	43.7	104	49.5	2250	73.5	16823	41.1
MKT363600_1_4	763416	764534	AT1G20650.1 Protein kinase superfamily protein	5398685	55.7	12673	24.2	790	43.4	100	47.6	2224	72.7	18803	46.0
MKT370789_1_4	764535	765376	AT5G13210.1 Uncharacterized conserved protein UCP015417, vWA	3679374	38.0	16201	30.9	1096	60.2	79	37.6	2351	76.8	20580	50.3



Appendix 36. (Continued)



Appendix 36. Chronogram of Magnoliaceae estimated by treePL. Black dots on the node indicate calibration points. The x-axis represents time (mya), and node bars represent the 95 % interval of the age estimates.

Appendix 37. Divergence times and their 95% confidence intervals of subfamilies, major clades, deep nodes of the backbone, and temperate disjunction for Magnoliaceae estimated by treePL

	Divergence time (mya)	95 % CI
Subfamily		
Liriodendroideae	17.54	16.83-17.54
Magnolioideae	37.84	36.36-38.08
Major clades		
SPLENDENTES	14.05	13.47-14.06
FRASERI	5.60	4.89-5.63
RYTIDOSPERMUM-OYAMA	17.32	14.14-17.34
RYTIDOSPERMUM	13.00	11.25-13.02
MANGLIETIA	19.39	17.99-19.41
TALAUMA	16.53	16.32-17.13
GWILLIMIA	24.12	23.92-24.99
MACROPHYLLA	6.58	5.82-6.65
THEORHODON	26.17	23.76-26.37
GYNOPODIUM	21.51	20.82-25.63
KMERIA	10.26	10.10-10.33
MICHELIA	27.56	27.50-27.96
Backbone		
MICHELIA+YULANIA	28.73	28.56-28.89
MICHELIA+YULANIA+KMERIA	32.41	31.62-32.58
MICHELIA+YULANIA+KMERIA+GYNOPODIUM	33.75	32.74-33.96
THEORHODON+MACROPHYLLA	32.5	30.38-32.75
GWILLIMIA+TALAUMA	35.27	34.23-36.81
MICHELIA+YULANIA+KMERIA+GYNOPODIUM+THEORHODON+MACROPHYLLA	35.52	34.20-35.77
MICHELIA+YULANIA+KMERIA+GYNOPODIUM+THEORHODON+MACROPHYLLA+GWILLIMIA+TALAUMA	36.97	35.67-36.95
MANGLIETIA+RYTIDOSPERMUM	24.41	22.00-24.44
MANGLIETIA+RYTIDOSPERMUM+OYAMA	28.48	25.41-28.58
MANGLIETIA+RYTIDOSPERMUM+OYAMA+FRASERI	32.04	29.07-32.08
MANGLIETIA+RYTIDOSPERMUM+OYAMA+FRASERI+SPLENDENTES	36.42	34.52-36.46
Temperate Disjunction		
Magnolia acuminata	25	25
Magnolia tripetala	13	11.25-13.02
Liriodendron tulipifera	17.54	16.83-17.54