

SUPPLEMENTARY DATA

FIG. S1. Conserved C-terminal of Santalales B-class gene homologues: alignment showing the conserved C-terminal motifs of the B-class genes isolated in this study.

	PI motif	
PI (<i>Arabidopsis thaliana</i>)	---M-RDHDG--Q---FGYRVQPIQPNLQEKIMSLVID	[208]
FBPI (<i>Petunia hybrida</i>)	QQRENHDY-QN-HMP-FAFRVQPMQPNLQERL-----	[210]
pMADS2 (<i>Petunia hybrida</i>)	HQR-DRDY-EYQQMP-FALRVQPMQPNLHERM-----	[212]
DiiPI-1 (<i>Dillnia indica</i>)	HQGVDRDYHT--QMP-FAFRVQPMQPNLQERI-----	[189]
DiiPI-2 (<i>Dillnia indica</i>)	HQGVDRDYHN--QVP-FAFRVQPMQPNLQERI-----	[189]
VialPI-1 (<i>Viscum alniformosanae</i>)	---GGRGNHNPPDMP-FVFRVQPMQPNLQETIHTIQP-	[190]
ViarPI-2 (<i>Viscum articulatum</i>)	---GGRGYHNPHDMP-FPFRVQPMQPNLQERMQNIQL-	[190]
ViarPI-1 (<i>Viscum articulatum</i>)	---GGRGYHNPHDMP-FPFRVQPMQPNLQERMQNIQL-	[190]
OliPI (<i>Olex imbreata</i>)	H-SGPRDY-HPHDVP-FLFRVQPIQPNLQDRI-----	[203]
SaaPI (<i>Satum album</i>)	VAA-ARGY-HAHEMP-FAFRVQPMQPNLQERMKNIQL-	[204]
ThcPI (<i>Thesium chinensis</i>)	GTS--RGY-D--ELP-FAFRVQPMQPNLQERMHNIQL-	[188]
ChmPI (<i>Champereia manillana</i>)	-----P-QAP-FAFRVQPMQPNLQDRM-----	[195]
BalPI (<i>Balanophora laxiflora</i>)	GNA-GRDY-NP-QMP-FAFRVQPIQPNLQERI-----	[198]
BafPI (<i>Balanophora fungosa</i>)	GQA-GRDY-DA-QMP-FAFRVQPIQPNLQDRI-----	[199]
SchPI (<i>Schoepfia jasminodora</i>)	GNA--RNYGHHNQMP-FAFRVQPMQPNLQERM-----	[218]
LokPI (<i>Loranthus kanoi</i>)	HQH-----QMPNFAFRVQPMQPNLRDRI-----	[209]
LodPI (<i>Loranthus delivayi</i>)	HQH-----QMPNFTFRVQPMQPNLQDRI-----	[209]

	PI derived motif	EuAP3 motif	
AP3 (<i>Arabidopsis thaliana</i>)	AYALRFHQNHYYPNH--GLH-APSA	SDII-TFHLL	[232]
GP (<i>Petunia hybrida</i>)	ILALRLQPNHH--QPNHHHLH-SGGG	SDIT-TFALLE	[231]
DiiAP3 (<i>Dillnia indica</i>)	-----H-SGAGS	DLT-TFTLLE	[205]
BalAP3 (<i>Balanophora laxiflora</i>)	-FPIRLQPTQQQ-QHHHH-ILH--G--	ADIT-TYSLLE	[208]
PhTM6 (<i>Petunia hybrida</i>)	LYAFRLQTL----HP----NLQ-NGGGE	FSGR-DLRLA-	[225]
DiiTM6 (<i>Dillnia indica</i>)	NCSYRLH-----HE----NVH--QAGY	GIQ-DLRLS-	[211]
ViarTM6-1 (<i>Viscum articulatum</i>)	QYVFSL-----NHH-PQQGF	FSGH-DLRLA-	[209]
ViarTM6-2 (<i>Viscum articulatum</i>)	QYGFS-----HP----NVH-PPEGY	ESS-DLRHG-	[192]
VialTM6 (<i>Viscum alniformosanae</i>)	QYGFSQ-----PREGY	ESH-DLRLA-	[188]
SaaTM6 (<i>Satum album</i>)	LYAFSLHPH----HP----NLH-PEDGF	FSGH-DLRLG-	[213]
BafTM6 (<i>Balanophora fungosa</i>)	MYPFN-----YVNNPDI	FSGP-NLRLA-	[210]
BaLTM6 (<i>Balanophora laxiflora</i>)	MYPFN-----YVDNPGVYF	FSGP-DLRLA-	[210]
OliTM6 (<i>Olex imbreata</i>)	LYALGLHAG----HP----HVH-PAQGY	GPH-DLRLA-	[203]
ThcTM6 (<i>Thesium chinensis</i>)	LYAFSLHPQH---HL----HLH-PEG-	YGPHDLRLA-	[214]
SchTM6 (<i>Schoepfia jasminodora</i>)	LYAFSLHSN----TP----NIH-HEQGY	GNE-ALRLA-	[215]
ChmTM6 (<i>Champereia manillana</i>)	LYAFSVHPH----HP----NLH-PDDGY	FSGH-DLRLA-	[213]
LodTM6 (<i>Loranthus delivayi</i>)	MY-FGLHSN----AP----NLH-LEQGY	DSQ-DLRLA-	[215]
TapTM6 (<i>Taxillus pseudochinensis</i>)	MYAFGLHSS----TP----NLHQLDQGY	DSQ-DLRLA-	[216]
LokTM6 (<i>Loranthus kanoi</i>)	MY-FGLHSN----AP----NLH-LEQGY	DSQ-DLRLA-	[202]

PaleoAP3 motif

FIG. S2. *RPB2* gene tree showing the obtained *RPB2* sequences belong to the d clade. Phylogenetic analysis inferred from Bayesian analysis (BI) based on a 1719 nucleotide alignments. Numbers above the branches are Bayesian posterior probabilities, and values below are maximum likelihood branch support as determined by GARLI.

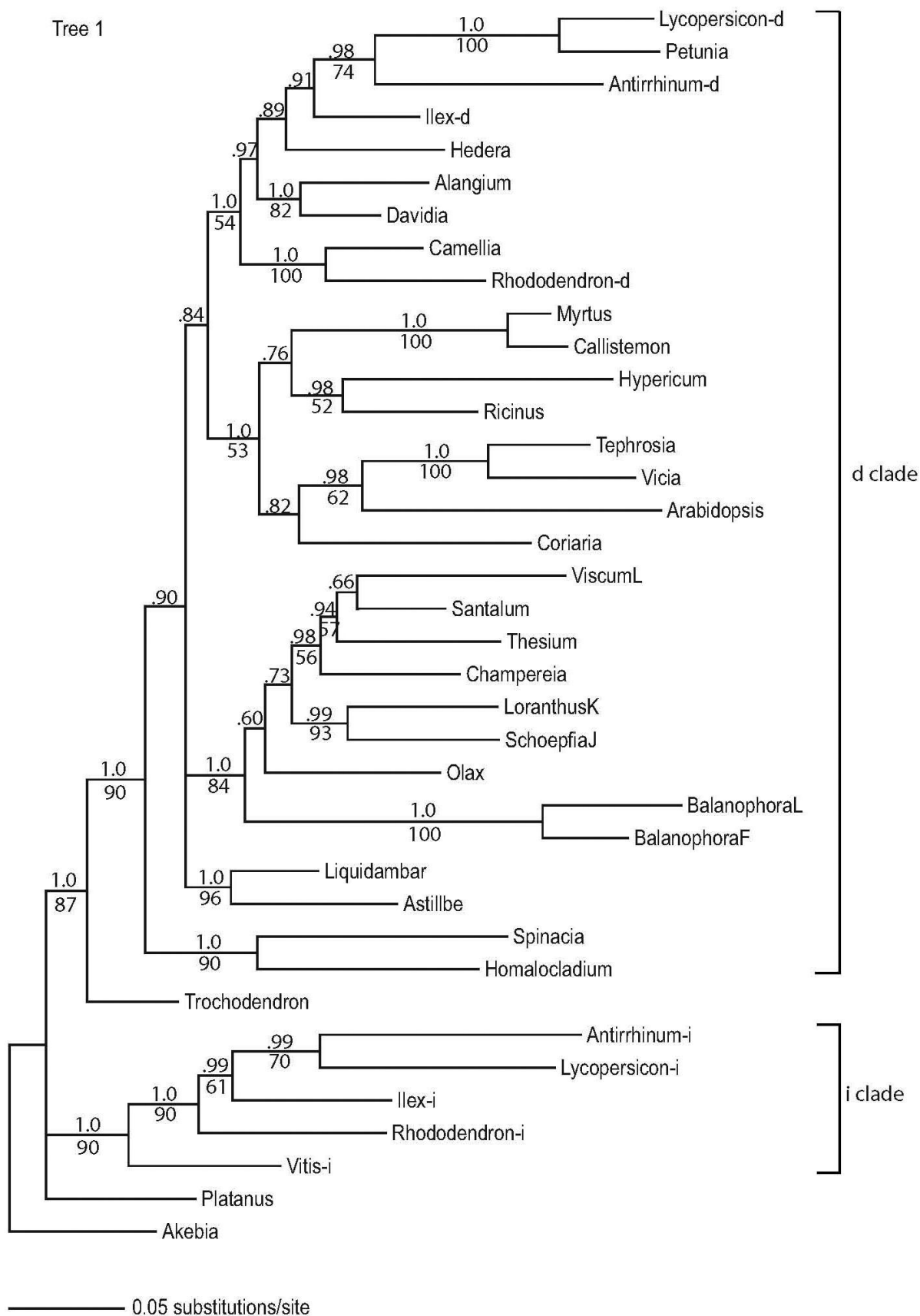


FIG. S3. Genomic structure of *Balanophora AP3* and *TM6* homologues. Grey boxes indicate exons and lines indicate introns (bp). White boxes indicate the novel exon (exon 6a) of *Balanophora AP3*.

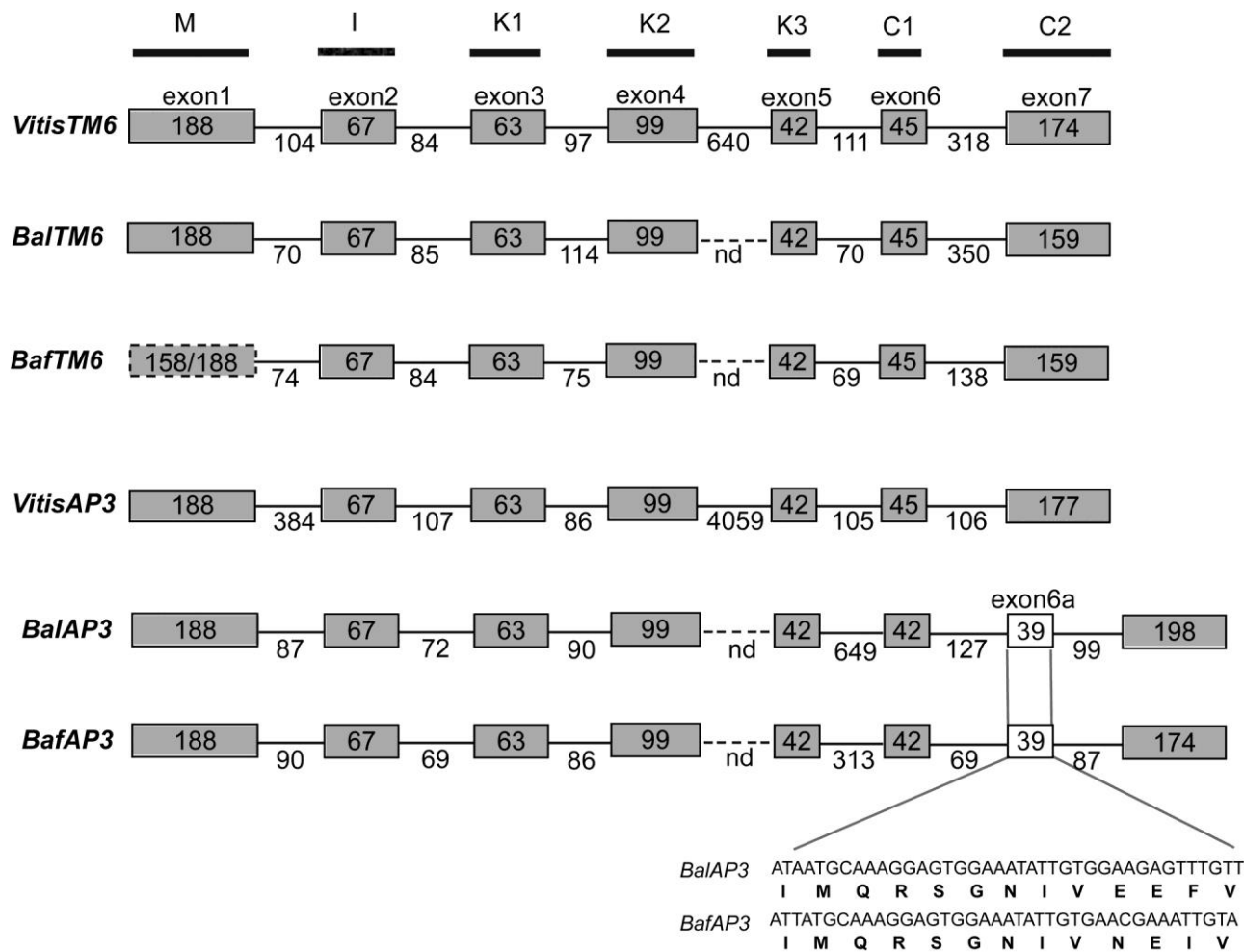


TABLE S1. Primers used in this study

(A) Primers used in amplifying and sequencing of 18S and *matR*

Primer Name	Position	Primer sequences (5' to 3')	Reference*
12F	18S fwd	TCCTGCCAGTASTCATATGC	(Malecot and Nickrent, 2008)
1769R	18S rev	CACCTACGGAAACCTTGTT	(Nickrent and Starr, 1994)
540f	18S fwd	TGGTGCCAGCAGCCGC	
1050f	18S fwd	GGTCGCAAGGCTGAAACT	
555r	18S rev	GCGGCTGCTGGCACCA	
1065r	18S rev	AGTTTCAGCCTTGCGACC	
26F	<i>matR</i> fwd	GACCGCTNACAGTAGTTCT	(Meng et al., 2002)
1858R	<i>matR</i> rev	TGCTTGTGGGCYRGGGAGAA	(Meng et al., 2002)
F2	<i>matR</i> fwd	GCCGCCTTCCTCATAGA	
F3	<i>matR</i> fwd	GTAAGCACCATCCAT	
R2	<i>matR</i> rev	TCTATGAGGAAGGCGGC	
R3	<i>matR</i> rev	ATGGATACGGTGCTTTAC	

(B) Primers used in 5'RACE of *Balanophora* B-class genes

Primer Name	Position	Primer sequences (5' to 3')
BalPICUTR1	<i>PI</i> rev	GTGGATAATACGAAGGCA
BalPIML1	<i>PI</i> rev	TTTATGAGCCCGTTTCTTCG
BalAP3KR2	<i>AP3</i> rev	CCTCTTCCATTTCTCCGTT
BalAP3KL1	<i>AP3</i> rev	TCTCAACAACAAACCCGAAT
BalTM6CUTR1	<i>TM6</i> rev	TTCACAAGGGGGGCAAC
BalTM6KL1	<i>TM6</i> rev	ACTCAGCTTGCATTTTCTCG

(C) Primers used in RT-PCR gene expression study

Primer Name	Locus	Primer sequences (5' to 3')
matrF	<i>matR</i> fwd	TATCGGCACTACCAKGTAAAC
SanmatrR3	<i>matR</i> rev	CCGTATTAAGTAATGGTTGTTGTTTC
Lfsx1-2	<i>LFY</i> fwd	CACCCACGACCNTTYATNGTNACNGARCCNGGNGA
BalLFYR	<i>LFY</i> rev	TTACAAATGGAAACGATTAGTGGTAG
SanRBP2F	<i>RBP2</i> fwd	TGGGTGGYATWCAYCGTGATCCTGA
SanRBP2R	<i>RBP2</i> rev	GAAAHGGTATRATYGAWGCACAAAC
BalPIKF1	<i>PI</i> fwd	GGGAGAAGAAGGCTGAG
BalPICUTR1	<i>PI</i> rev	GTGGATAATACGAAGGCA
BalAP3KF5	<i>AP3</i> fwd	AAACCAGGCAGTGGAATGGA
BalAP3CR2	<i>AP3</i> rev	TCCGCCTGTATTTGTTCTTC
BalTM6KF1	<i>TM6</i> fwd	GCGGAAAAGAAAGTATGAG
BalTM6CUTR1	<i>TM6</i> rev	TTCACAAGGGGGGCAAC
BalACTF	<i>ACTIN</i> fwd	AGGGAGATAGTGAGGGACA
BalACTR	<i>ACTIN</i> rev	CATCATACTCTGCTTTGGC

(D) Primers used in characterizing *BalAP3* & *BafAP3* genomic sequences

Primer Name	Locus	Primer sequences (5' to 3')
BalAP3MF2	<i>AP3</i> fwd	GCTTCACGATTACATCTC
BalAP3KR4	<i>AP3</i> rev	CTCAAGACCGTGCAATTCTGC
BalAP3E5F1	<i>AP3</i> fwd	TGGTGGTCAAACGGAGAAAT
BalAP3I6R1	<i>AP3</i> rev	GAGGGGGATCAGACCTTT
BalAP3KF2	<i>AP3</i> fwd	GAATGAAGAACAATAACAGG
BalAP3CR3	<i>AP3</i> rev	AGCAATGAGTAGGTGGTG
BalTM6MF1	<i>TM6</i> fwd	GGATCGAGAACTCAACAA
BalTM6KR2	<i>TM6</i> rev	TCTCTAATGTTCAAACCCTCCA
BalTM6KF2	<i>TM6</i> fwd	TGATTGATCTGGAGAAAAAAT
BalTM6CR2	<i>TM6</i> rev	GGGTACATGCTAGTAGAAGGGTT

* REFERENCES

- Malecot V, Nickrent DL. 2008.** Molecular phylogenetic relationships of Olacaceae and related Santalales. *Systematic Botany*, **33**: 97-106.
- Meng S-W, Zhi-Duan Chan, Li D-Z. 2002.** Phylogeny of Saururaceae base on mitochondrial *matR* gene sequence data. *Journal of Plant Research*, **115**: 71-76.
- Nickrent DL, Starr EM. 1994.** High rates of nucleotide substitution in nuclear small-subunit (18S) rDNA from holoparasitic flowering plants. *Journal of Molecular Evolution*, **39**: 62-70.

TABLE S2. Sequences used in phylogenetic construction and evolutionary rate analysis

Taxa	Species	nuclear				mitochondrial		RPB2/RPB2-d copy
		PI	AP3		FLO/LFY	18S rDNA	matR	
			paleoAP3/TM6	euAP3				
Basal eudicots								
Buxales								
Buxaceae	<i>Pachysandra procumbens</i>					AF094533	AF197784	
	<i>Pachysandra terminalis</i>	GU357455 (<i>PAtePI</i>)	<i>PAteAP3-1</i> (GU357454)					
Proteales			<i>PAteAP3-2</i> (GU357462)					
Platanaceae	<i>Platanus occidentalis</i>		<i>PloAP3-1</i> (AY162881)		AF106842	U42794	AF197793	
	<i>Platanus</i> sp.		<i>PloAP3-2</i> (AY162882)					AY566618
Ranunculales								
Lardizabalaceae	<i>Akebia quinata</i>	<i>AkqPI</i> (AY162837)	<i>AkqAP3-1</i> (AY162835)			L31795	AF197810	
	<i>Akebia longeracemosa</i>		<i>AkqAP3-2</i> (AY162839)					AY566613
Papaveraceae	<i>Eschscholzia californica</i>				AY188789			
Sabiales								
Sabiaceae	<i>Meliosma dilleniiifolia</i>	<i>MedMdPI</i> (AY436712)	<i>MedMdAP3-1</i> (AY436709)					
	<i>Meliosma squamulata</i>		<i>MedMdAP3-2</i> (AY436710)			DQ008728	DQ007426	
	<i>MedMdAP3-2</i> (AY436711)							
Trochodendrales								
Trochodendraceae	<i>Trochodendron aralioides</i>	<i>TraPI-1</i> (EF436259)	<i>TraAP3</i> (DQ453774)		AF230078	U42816	AF197792	AY563269
		<i>TraPI-2</i> (EF436260)						
Core eudicots								
Apiales								
Apiaceae	<i>Apium graveolens</i>					AF206852		
	<i>Daucus carota</i>	<i>MADS2</i> (AJ271148)		<i>MADS3</i> (AJ271149)				
	<i>Petroselinum crispum</i>						AY453081	
Aralidiaceae	<i>Hedera helix</i>							AJ563601
Aquifoliales								
Aquifoliaceae	<i>Ilex aquifolium</i>	<i>IxaGLO1</i> (GQ141105)	<i>IxaTM6</i> (DQ479357)	<i>IxaAP3</i> (DQ479356)			AY453090	
	<i>Ilex meseryeae</i>							AJ557240
	<i>Ilex opaca</i>					AF161010		
Asterales								
Asteraceae	<i>Chrysanthemum x morifolium</i>				AB451217			
	<i>Gerbera hybrida</i>	<i>GGLO1</i> (GHY9726)	<i>GDEF1</i> (AJ009724)	<i>GDEF2</i> (AJ009725)		AF107576		
	<i>Helianthus annuus</i>	<i>PMADS2</i> (X69947)	<i>Ham31</i> (AY173069)	<i>Ham91</i> (AY173070)			AY453114	
		<i>Ham31</i> (AY173069)	<i>Ham91</i> (AY173070)	<i>Ham63</i> (EF612598)				
Brassicales								
Brassicaceae	<i>Arabidopsis thaliana</i>	<i>PI</i> (D30807)		<i>AP3</i> (D21125)	DQ447103	X16077	NC_001284	z19121
Caricaceae	<i>Carica papaya</i>	<i>CpPI</i> (EF562500)	<i>CpTM6-1</i> (EF562498)	<i>CpTM6-2</i> (EF562499)		U42514	AF520141	
Caryophyllales								
Amaranthaceae	<i>Spinacia oleracea</i>	<i>SoPI</i> (AY604515)		<i>SoAP3</i> (AY604514)		L24420	AY453110	AF020840
Caryophyllaceae	<i>Silene latifolia</i>	<i>SLM2</i> (X80489)	<i>SIAP3A</i> (AB090863)	<i>SIAP3Y</i> (AB090864)				

Phytolaccaceae	<i>Silene coeli-rosa</i> <i>Phytolacca americana</i>		<i>PhaTM6-1</i> (DQ479365) <i>PhaTM6-2</i> (DQ479366)		AJ311804	U42793		
Polygonaceae	<i>Homalocladium platycladum</i>							DQ017114
Cornales								
Cornaceae	<i>Alangium platanifolium</i> <i>Davidia involucrata</i>							AJ555916 AJ557002
Hydrangeaceae	<i>Hydrangea macrophylla</i>	<i>HmPI</i> (AF230711)	<i>HmTM6</i> (AF230703)	<i>HmAP3</i> (AF230702)		U42781	AY453091	
Nyssaceae	<i>Nyssa sylvatica</i>	<i>NsGLO1</i> (GQ141111) <i>NsGLO2</i> (GQ141109)	<i>NsTM6</i> (GQ141155)	<i>NsDEF</i> (GQ141170)		X16603		
Styracaceae	<i>Styrax japonicus</i>	<i>SjGLO</i> (GQ141121)	<i>SjTM6</i> (GQ141163)	<i>SjDEF</i> (GQ141185)		L49296		
Cucurbitales								
Coriariaceae	<i>Coriaria sarmentosa</i>							DQ017097
Cucurbitaceae	<i>Cucumis sativus</i>	<i>CsPI</i> (AF043255)		<i>CsMADS1</i> (AY944060)	AF059320	AF206894		
Dilleniales								
Dilleniaceae	<i>Dillenia indica</i>	<i>DiiPI-1</i> (EF549702) <i>DiiPI-2</i> (EF549703)	<i>DiiTM6</i> (EF549705)	<i>DiiDEF</i> (EF549703)			AF520095	
	<i>Dillenia alata</i>					U38314		
Ericales								
Balsaminaceae	<i>Impatiens auriculata</i> <i>Impatiens alsamina</i>				AJ888755		AF520117	
Clethraceae	<i>Clethra tomentosa</i>	<i>CtGLO</i> (GQ141143)	<i>CtTM6</i> (GQ141180)	<i>CtDEF</i> (GQ141166)				AY566626
Ericaceae	<i>Rhododendron macrophyllum</i>							
Diapensiaceae	<i>Galax urceolata</i>	<i>GuGLO1</i> (GQ141151)	<i>GuTM6</i> (GQ141164)	<i>GuDEF</i> (GQ141187)		L49281		
Polemoniaceae	<i>Phlox paniculata</i>	<i>PpGLO</i> (GQ141129)	<i>PpTM6</i> (GQ141157)	<i>PpDEF</i> (GQ141172)				AY566627
Theaceae	<i>Camellia japonica</i>							
Fagales								
Betulaceae	<i>Betula pendula</i> <i>Juglans nigra</i> <i>Juglans regia</i>	<i>BpPI</i> (AJ488589)		<i>JrAP3</i> (AJ313089)	GU194836	AF206943	AY453121	
Fabales								
Fabaceae	<i>Lotus corniculatus</i>	<i>LcPIa</i> (AY770398) <i>LcPIb</i> (AY770399)	<i>LcTM6</i> (AY770401)	<i>LcAP3</i> (AY770400)	AY770393			
	<i>Pisum sativum</i> <i>Tephrosia purpurea</i> <i>Vicia sativa</i>				AF035163	U43011	AY453078	AJ556782 AJ556176
Gunnerales								
Gunneraceae	<i>Gunnera tinctoria</i>		<i>GtAP3-1</i> (AY337753) <i>GtAP3-2</i> (AY337754) <i>GtAP3-3</i> (AY337755) <i>GtAP3-4</i> (AY337756) <i>GtAP3-5</i> (AY337757)					
	<i>Gunnera manicata</i>					U43787	AF520163	
Lamiales								
Oleaceae	<i>Syringa vulgaris</i>	<i>SvPI</i> (AF052861)		<i>SvAP3</i> (AF052869)				
Plantaginaceae	<i>Antirrhinum majus</i>	<i>GLOBOSA</i> (X68831)		<i>DEFA</i> (X62810)	M55525	AJ236047	AY453102	AJ566619
Malpighiales								
Euphorbiaceae	<i>Ricinus communis</i>							XM_002519014
Hypericaceae	<i>Hypericum canariense</i>							AJ556993
Salicaceae	<i>Populus trichocarpa</i>	<i>PtPI</i>	<i>PTD</i> (AF057708)					

		(grail3.0002017601)			U93196	AY652861		AY674556
Myrtales	<i>Populus balsamifera</i> <i>Populus maximowiczii</i>							
Myrtaceae	<i>Callistemon subulatus</i> <i>Eucalyptus grandis</i> <i>Eucalyptus lehmannii</i> <i>Melaleuca quinquenervia</i> <i>Myrtus communis</i>	EGM2 (AF029976) MeqPI (EU004206)			AY640314	AM235528		DQ017092
Rosales								
Rosaceae	<i>Malus x domestica</i> <i>Prunus persica</i> <i>Taihangia rupestris</i>	MadMdPI (AJ291490) - TrPI (DQ248947)	MadMdTM6 (AB081093) MadMADS13 (AJ25116) - TrTM6 (DQ248946)		AB162028 EU375891	L28749		EU281109 AF520201
Saxifragales								
Altingiaceae	<i>Liquidambar</i> sp.							AY566623
Grossulariaceae	<i>Ribes aureum</i> <i>Ribes sanguineum</i>	- RsPI (AY337742)				L28143		
Hamamelidaceae	<i>Ribes</i> sp. <i>Corylopsis pauciflora</i>		CopTM6-1 (DQ479354) CopTM6-2 (DQ479355)	CopAP3 (DQ479353)			EF370723	
Saxifragaceae	<i>Astillbe</i> sp. <i>Saxifraga careyana</i>		SacTM6 (DQ479368)	SacAP3 (DQ479367)				AY566622
Santalales								
Balanophoraceae	<i>Balanophora fungosa</i>	BafPI (JQ613262)	BafTM6 (JQ613231)	BafAP3 (JQ613229)	JQ613242	JN392868	JQ613244	JQ613269
Loranthaceae	<i>Balanophora laxiflora</i> <i>Loranthus delavayi</i> <i>Loranthus kaoi</i>	BalPI (JQ613261) LodPI (JQ613264) LokPI (JQ613263)	BalTM6 (JQ613232) <i>LodTM6</i> (DQ453773) LokTM6 (JQ613241)	BalAP3 (JQ613230)	JQ613243	JN392870	JQ613245 JQ613248	JQ613270 JQ613249
Olacaceae	<i>Ola x imbricata</i>	OliPI (JQ613259)	OliTM6 (JQ613239)				JQ613222	JQ613246
Opiliaceae	<i>Champerea manillana</i>	ChmPI (JQ613258)	ChmTM6 (JQ613237)				JQ613223	JQ613247
Santalaceae	<i>Santalum album</i>	SaaPI (JQ613256)	SaaTM6 (JQ613238)				JQ613224	JQ613250
Thesiaceae	<i>Thesium chinense</i>	ThcPI (JQ613257)	ThcTM6 (JQ613235)				JQ613225	JQ613251
Schoepfiaceae	<i>Schoepfia jasminodora</i>	ScjPI (JQ613260)	ScjTM6 (JQ613240)				JQ613226	JQ613252
Viscaceae	<i>Viscum articulatum</i>	ViArPI-1 (JQ613255)	ViArTM6-1 (JQ613233)				JQ613228	
		ViArPI-2 (JQ613254)	ViArTM6-2 (JQ613234)					
	<i>Viscum aniliformosanae</i>	ViAIPI (JQ613253)	ViAITM6 (JQ613236)				JQ613227	JQ613265
Solanales								
Solanaceae	<i>Petunia hybrida</i> <i>Nicotiana sylvestris</i> <i>Lycopersicon esculentum</i>	FBPI (m91190) TPI (DQ674531)	PhTM6 (AF230704) TDR6 (X60759)	PhGP (X69946) LeAP3 (AF052868)	AF030171		AY453113	DQ020641 U28403
Vitales								
Vitaceae	<i>Vitis vinifera</i> <i>Vitis</i> sp.	MADS9 (DQ988043)	VvTM6 (DQ979341)	VvAP3 (EF418603)	AF450278		NC_012119	
						AF207053		

Note: sequences newly identified in this study are shown in bold.