

Supplemental Table S1. Positive selection analyses of UVR8 and RUP by branch-site model.

Gene	Branch	Branch-site model	-lnL	P-value	Positively selected sites
UVR8	Ancestral branch of Chlorophyte	Null	68435.19453		
		Alternative	68417.25078	0.000000002	125 A 0.999**, 130 S 0.980*, 273 H 0.976*, 320 I 0.976*, 325 S 0.987*, 327 C 1.000**, 343 W 1.000**, 379 M 0.992**, 387 S 0.973*, 398 G 0.990*, 409 L 0.989*, 441 T 0.989*, 625 T 0.961*, 723 G 0.951*, 864 R 0.977*
	Ancestral branch of land plants	Null	68446.03465		
		Alternative	68446.03505	0.977435425	
RUP	Ancestral branch of Chlorophyte	Null	74920.41872		890 E 0.983*, 914 T 0.983*, 963 S 0.961*, 966 T 0.982*, 967 G 0.987*, 969 I 0.993**, 974 S 0.996**, 983 I 0.975*, 985 R 0.983*, 986 K 0.988*, 1126 A 0.971*, 1127 C 0.964*, 1131 I 1.000**, 1132 C 0.984*, 1133 T 0.982*, 1135 A 0.988*, 1141 R 1.000**, 1174 G 0.997**, 1175 S 1.000**, 1184 E 0.987*, 1185 Y 0.998**, 1189 R 1.000**, 1193 T 0.963*, 1194 A 0.997**, 1196 F 0.999**, 1198 R 0.998**, 1216 Y 0.983*, 1245 C 0.996**, 1262 S 0.963*, 1281 S 0.999**, 1288 V 0.975*, 1289 E 0.973*, 1291 D 0.989*, 1295 G 0.999**, 1310 A 0.981*, 1348 T 0.986*, 1373 K 0.999**, 1417 - 0.953*, 1496 T 0.978*, 1513 R 0.995**, 1529 N 0.955*, 1530 E 0.970*, 1540 A 0.964*, 1549 W 0.997**, 1550 V 0.989*, 1675 S 0.975*, 1676 Q 0.983*, 1708 R 0.986*, 1713 C 0.999**, 1714 M 0.998**, 1720 G 0.985*, 1726 Q 0.955*, 1730 G 0.986*,
		Alternative	76569.64212	0	

Note: The number for amino acid residues identified by Bayes empirical bayes (BEB) analyses corresponds to their alignment positions. The posterior probability (PP) under BEB analyses is behind hyphen.

Supplemental Table S2. The information of plant genomes used in this study.

Phylum	Class	Order	Family	Species	Link		
Rhodophyta	Cyanidiophyceae	Cyanidiales	Cyanidiaceae	<i>Cyanidioschyzon merolae</i>	https://www.ncbi.nlm.nih.gov/genome/79		
				<i>Galdieria sulphuraria</i>	https://www.ncbi.nlm.nih.gov/genome/405		
	Florideophyceae	Gigartinales	Gigartinaceae	<i>Chondrus crispus</i>	https://www.ncbi.nlm.nih.gov/genome/12016		
	Bangiophyceae	Bangiales	Bangiaceae	<i>Porphyra umbilicalis</i>	https://www.ncbi.nlm.nih.gov/genome/12861		
Glaucophyta	Glaucozystophyceae	Glaucozystales	Cyanophoraceae	<i>Cyanophora paradoxa</i>	https://www.ncbi.nlm.nih.gov/genome/303		
Chlorophyta	Mamiellophyceae	Mamiellales	Bathycoccaceae	<i>Ostreococcus lucimarinus</i>	https://www.ncbi.nlm.nih.gov/genome/373		
				<i>Bathycoccus prasinos</i>	https://www.ncbi.nlm.nih.gov/genome/12309		
				Mamiellaceae	<i>Micromonas pusilla</i>	https://www.ncbi.nlm.nih.gov/genome/501	
	Trebouxiophyceae	T.ordo incertae sedis	Coccomyxaceae	<i>Coccomyxa subellipsoidea</i>	https://www.ncbi.nlm.nih.gov/genome/2692		
				Chlorellales	Chlorellaceae	<i>Chlorella variabilis</i>	https://www.ncbi.nlm.nih.gov/genome/694
						<i>Auxenochlorella protothecoides</i>	http://plantregmap.cbi.pku.edu.cn/
	Ulvophyceae	Ulvales	Ulvaceae	<i>Ulva mutabilis</i>	https://www.ncbi.nlm.nih.gov/genome/72458		
	Chlorophyceae	Chlamydomonadales	Chlamydomonadaceae	<i>Chlamydomonas reinhardtii</i>	https://phytozome.jgi.doe.gov/		
				Dunaliellaceae	<i>Dunaliella salina</i>	http://plantregmap.cbi.pku.edu.cn/	
				Volvoxaceae	<i>Volvox carteri</i>	http://plantregmap.cbi.pku.edu.cn/	
					<i>Gonium pectorale</i>	https://www.ncbi.nlm.nih.gov/genome/16856	
				Sphaeropleales	Selenastraceae	<i>Monoraphidium neglectum</i>	https://www.ncbi.nlm.nih.gov/genome/36372

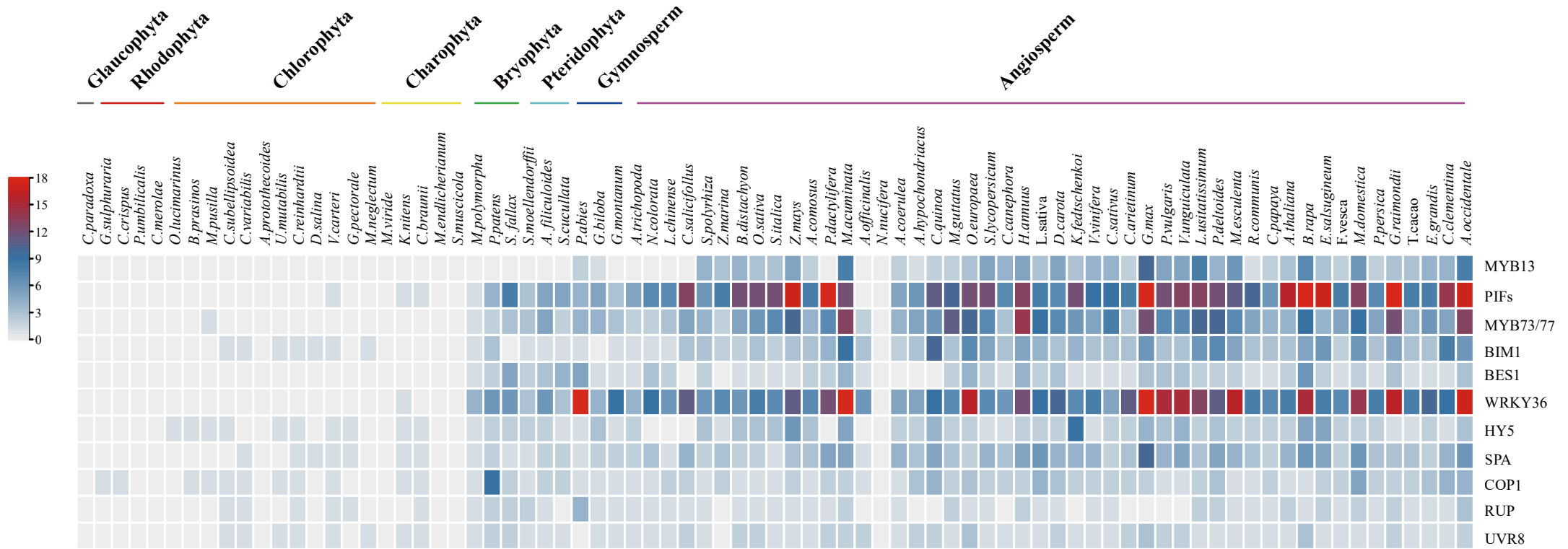
Streptophyta	Mesostigmatophyceae	Mesostigmatales	Mesostigmataceae	<i>Mesostigma viride</i>	https://www.ncbi.nlm.nih.gov/geo/query/acc.cgi?acc=GSE123852
	Klebsormidiophyceae	Klebsormidiales	Klebsormidiaceae	<i>Klebsormidium nitens</i>	https://www.ncbi.nlm.nih.gov/genome?term=Klebsormidium
	Charophyceae	Charales	Characeae	<i>Chara braunii</i>	https://bioinformatics.psb.ugent.be/orcae/
	Zygnematophyceae	Zygnematales	Mesotaeniaceae	<i>Mesotaenium endlicherianum</i>	https://www.ncbi.nlm.nih.gov/genome/33366
		Spirogloales	Spirogloaceae	<i>Spirogloea muscicola</i>	https://www.ncbi.nlm.nih.gov/genome/86225
Bryophyta	Marchantiopsida	Marchantiales	Marchantiaceae	<i>Marchantia polymorpha</i>	https://www.ncbi.nlm.nih.gov/genome/3220
	Bryopsida	Funariales	Funariaceae	<i>Physcomitrium patens</i>	https://www.ncbi.nlm.nih.gov/genome/383
	Sphagnopsida	Sphagnales	Sphagnaceae	<i>Sphagnum fallax</i>	https://phytozome.jgi.doe.gov/
Lycopodiophyta	Lycopodiopsida	Selaginellales	Selaginellaceae	<i>Selaginella moellendorffii</i>	https://www.ncbi.nlm.nih.gov/genome/411
Polypodiophyta	Polypodiopsida	Salviniales	Salviniaceae	<i>Azolla filiculoides</i>	https://www.fernbase.org/
				<i>Salvinia cucullata</i>	https://www.fernbase.org/
Gymnospermae	Pinopsida	Pinales	Pinaceae	<i>Picea abies</i>	https://www.ncbi.nlm.nih.gov/genome/11155
	Ginkgoopsida	Ginkgoales	Ginkgoaceae	<i>Ginkgo biloba</i>	http://gigadb.org/dataset/100209
	Gnetopsida	Gnetales	Gnetaceae	<i>Gnetum montanum</i>	https://datadryad.org/resource/doi:10.5061/dryad.0vm37.2
Angiospermae	basal Angiosperms	Amborellales	Amborellaceae	<i>Amborella trichopoda</i>	http://www.angiosperms.org/
		Nymphaeales	Nymphaeaceae	<i>Nymphaea colorata</i>	http://www.angiosperms.org/
	Magnoliidae	Magnoliales	Magnoliaceae	<i>Liriodendron chinense</i>	http://www.angiosperms.org/
		Laurales	Calycanthaceae	<i>Cinnamomum salicifollus</i>	http://www.angiosperms.org/
	Monocotyledoneae	Alismatales	Araceae	<i>Spirodela polyrhiza</i>	http://www.angiosperms.org/
			Zosteraceae	<i>Zostera marina</i>	http://www.angiosperms.org/
			Poales	Poaceae	<i>Brachypodium distachyon</i>	http://www.angiosperms.org/

			<i>Oryza sativa</i>	http://www.angiosperms.org/
			<i>Setaria italica</i>	http://www.angiosperms.org/
			<i>Zea mays</i>	http://www.angiosperms.org/
		Bromeliaceae	<i>Ananas comosus</i>	http://www.angiosperms.org/
	Arecales	Arecaceae	<i>Phoenix dactylifera</i>	http://www.angiosperms.org/
	Zingiberales	Musaceae	<i>Musa acuminata</i>	http://www.angiosperms.org/
	Asparagales	Asparagaceae	<i>Asparagus officinalis</i>	http://www.angiosperms.org/
Eudicotyledoneae	Proteales	Nelumbonaceae	<i>Nelumbo nucifera</i>	http://www.angiosperms.org/
	Ranunculales	Ranunculaceae	<i>Aquilegia coerulea</i>	http://www.angiosperms.org/
	Caryophyllales	Amaranthaceae	<i>Amaranthus</i> <i>hypochondriacus</i>	http://www.angiosperms.org/
			<i>Chenopodium quinoa</i>	http://www.angiosperms.org/
	Lamiales	Phrymaceae	<i>Mimulus guttatus</i>	http://www.angiosperms.org/
		Oleaceae	<i>Olea europaea</i>	http://www.angiosperms.org/
	Solanales	Solanaceae	<i>Solanum lycopersicum</i>	http://www.angiosperms.org/
	Gentianales	Rubiaceae	<i>Coffea canephora</i>	http://www.angiosperms.org/
Eudicotyledoneae	Asterales	Asteraceae	<i>Helianthus annuus</i> <i>Lactuca sativa</i>	http://www.angiosperms.org/
	Apiales	Apiaceae	<i>Daucus carota</i>	http://www.angiosperms.org/
	Saxifragales	Crassulaceae	<i>Kalanchoe</i> <i>fedtschenkoi</i>	http://www.angiosperms.org/
	Vitales	Vitaceae	<i>Vitis vinifera</i>	http://www.angiosperms.org/
	Cucurbitales	Cucurbitaceae	<i>Cucumis sativus</i>	http://www.angiosperms.org/
	Fabales	Fabaceae	<i>Cicer arietinum</i> <i>Glycine max</i> <i>Phaseolus vulgaris</i>	http://www.angiosperms.org/

			<i>Vigna unguiculata</i>	http://www.angiosperms.org/
	Malpighiales	Linaceae	<i>Linum usitatissimum</i>	http://www.angiosperms.org/
		Salicaceae	<i>Populus deltoides</i>	http://www.angiosperms.org/
		Euphorbiaceae	<i>Manihot esculenta</i>	http://www.angiosperms.org/
			<i>Ricinus communis</i>	http://www.angiosperms.org/
	Brassicales	Caricaceae	<i>Carica papaya</i>	http://www.angiosperms.org/
		Brassicaceae	<i>Arabidopsis thaliana</i>	http://www.angiosperms.org/
			<i>Brassica rapa</i>	http://www.angiosperms.org/
			<i>Eutrema salsugineum</i>	http://www.angiosperms.org/
	Rosales	Rosaceae	<i>Fragaria vesca</i>	http://www.angiosperms.org/
			<i>Malus domestica</i>	http://www.angiosperms.org/
Eudicotyledoneae	Rosales	Rosaceae	<i>Prunus persica</i>	http://www.angiosperms.org/
	Malvales	Malvaceae	<i>Gossypium raimondii</i>	http://www.angiosperms.org/
			<i>Theobroma cacao</i>	http://www.angiosperms.org/
	Myrtales	Myrtaceae	<i>Eucalyptus grandis</i>	http://www.angiosperms.org/
	Sapindales	Rutaceae	<i>Citrus clementina</i>	http://www.angiosperms.org/
		Anacardiaceae	<i>Anacardium occidentale</i>	http://www.angiosperms.org/

Supplemental Table S3. The information of queries in the similarity searches.

Transcription factors	BLASTP query (<i>Arabidopsis thaliana</i>)	Functional domain
BES1	AT1G19350	BES1_N domain
BIM1	AT5G08130	HLH domain
WRKY36	AT1G69810	WRKY domain
MYB73/MYB77	MYB73: AT4G37260 MYB77: AT3G50060	MYB domain
MYB13	AT1G06180	MYB domain
PIFs	PIF1: AT2G20180 PIF3: AT1G09530 PIF4: AT2G43010 PIF5: AT3G59060	bHLH domain
HY5/HYH	HY5: AT5G11260 HYH: AT3G17609	bZIP domain



Supplemental Figure S1. Heat map of orthologs numbers of UVR8-mediated signaling pathway in Archaeplastida.

C27 Region

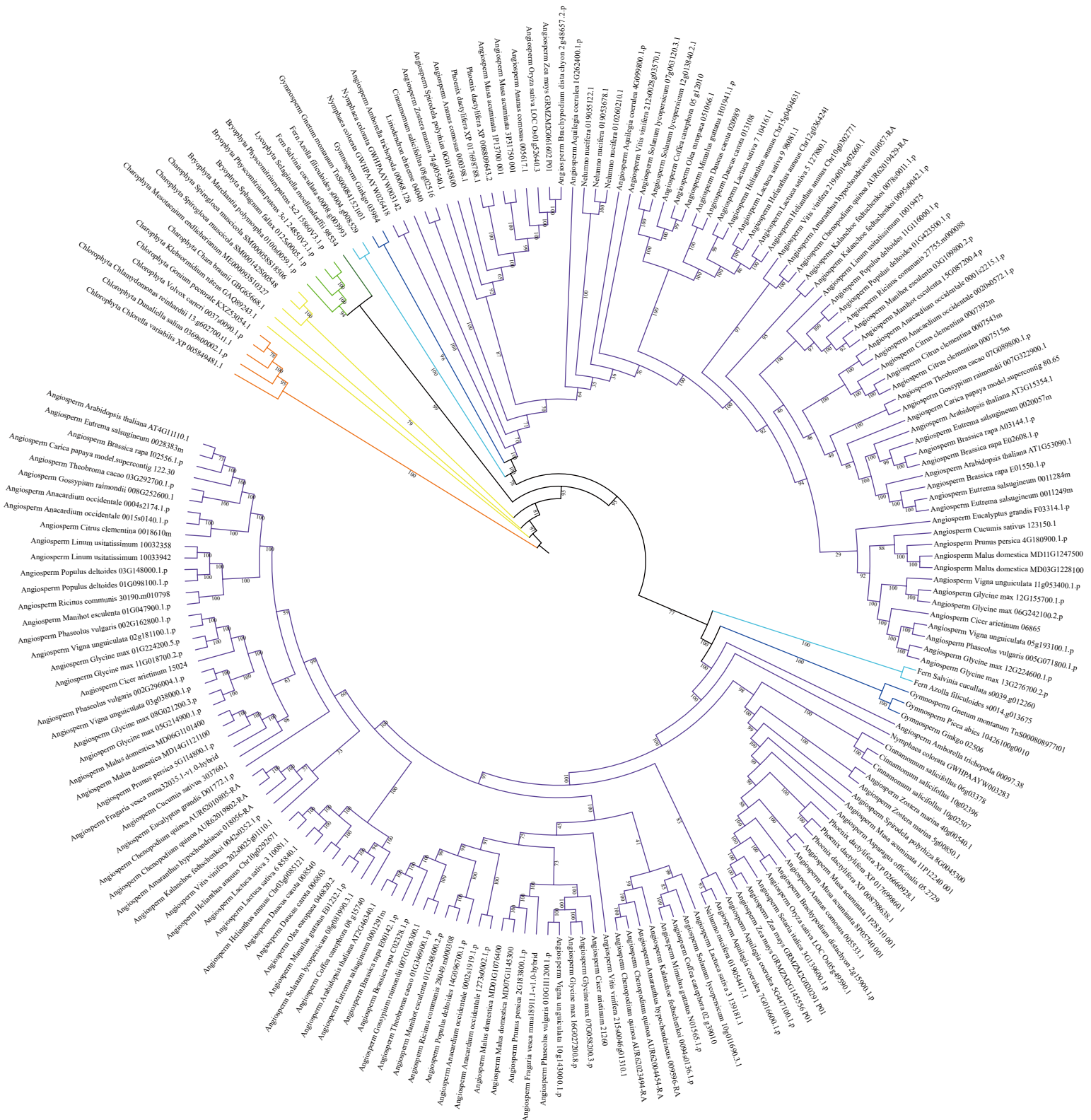
	390	400	
<i>A. trichopoda</i> _00017.257	I E S S	S . A E P F S G K . . . V A .	V L P S D
<i>A. thaliana</i> _AT5G63860.1	I E S S	N . I D P S S G K . . . S W .	V S P A E
<i>Z. mays</i> _30969448	L E S S	T . A A P F A A K . . . V W .	V S P S E
<i>G. biloba</i> _14008	I E T S	K . T T S L S G A . . . N W .	I S P S E
<i>G. Blume</i> _TnS000558519t02	V Q T S	N . K K L Q S G T . . . A W .	V S P A E
<i>A. filiculoides</i> _s0509.g074711	I E S S	T Y S S I R P G T . . A N W .	I A P C E
<i>S. cucullata</i> _s0112.g020798	V G S S	V . S S A S P V A . . S N W .	I A P S E
<i>S. moellendorffii</i> _438355	L E K S	P . E P A V T G S G V A N W .	I S P S E
<i>P. patens</i> _Pp3c10_2230V3.2	I E S S	G . S S N C T T S . . . N W .	I S P A E
<i>P. patens</i> _Pp3c3_15300V3.4	I E S S	P . S G N C A S S . . . N W .	I S P A E
<i>M. polymorpha</i> _Mapoly0023s0125.2	L E S S	R . T T T S T G S . . . H W .	I S P S E
<i>M. endlicherianum</i> _ME000204S03010	F . . .	. . . . . S L .	I F P L E
<i>S. muscicola</i> _SM000080S22914	I E R P	V S N G .	S G P S L R L L P H
<i>S. muscicola</i> _SM000048S16505	I E R P	V S N G .	S G P S L R L L P H
<i>S. muscicola</i> _SM000049S16745	I E R P	V S N G .	S G P S L R L L P H
<i>C. braunii</i> _g41650	I G K S	N . H S R I G G A . . A P W .	I A P S E
<i>K. nitens</i> _kf100419_0050	L A F S	K F N A D . A A L .	A T P A E
<i>M. viride</i> _Mv08436	L Q A M	A Q G G V T M M A T .	K G T A D G D A D
<i>C. variabilis</i> _XP_005847046.1	I T R Q	A Q P V V L Y G	V A P S D
<i>V. carteri</i> _Vocar.0017s0213.1	I L A T	A . G E D M G G A G M F A Y .	V A P A D
<i>C. reinhardtii</i> _Cre05.g230600.t1.1	I L A T	A . M A H D G G E G G L . Y .	V A P A D

C17 Region

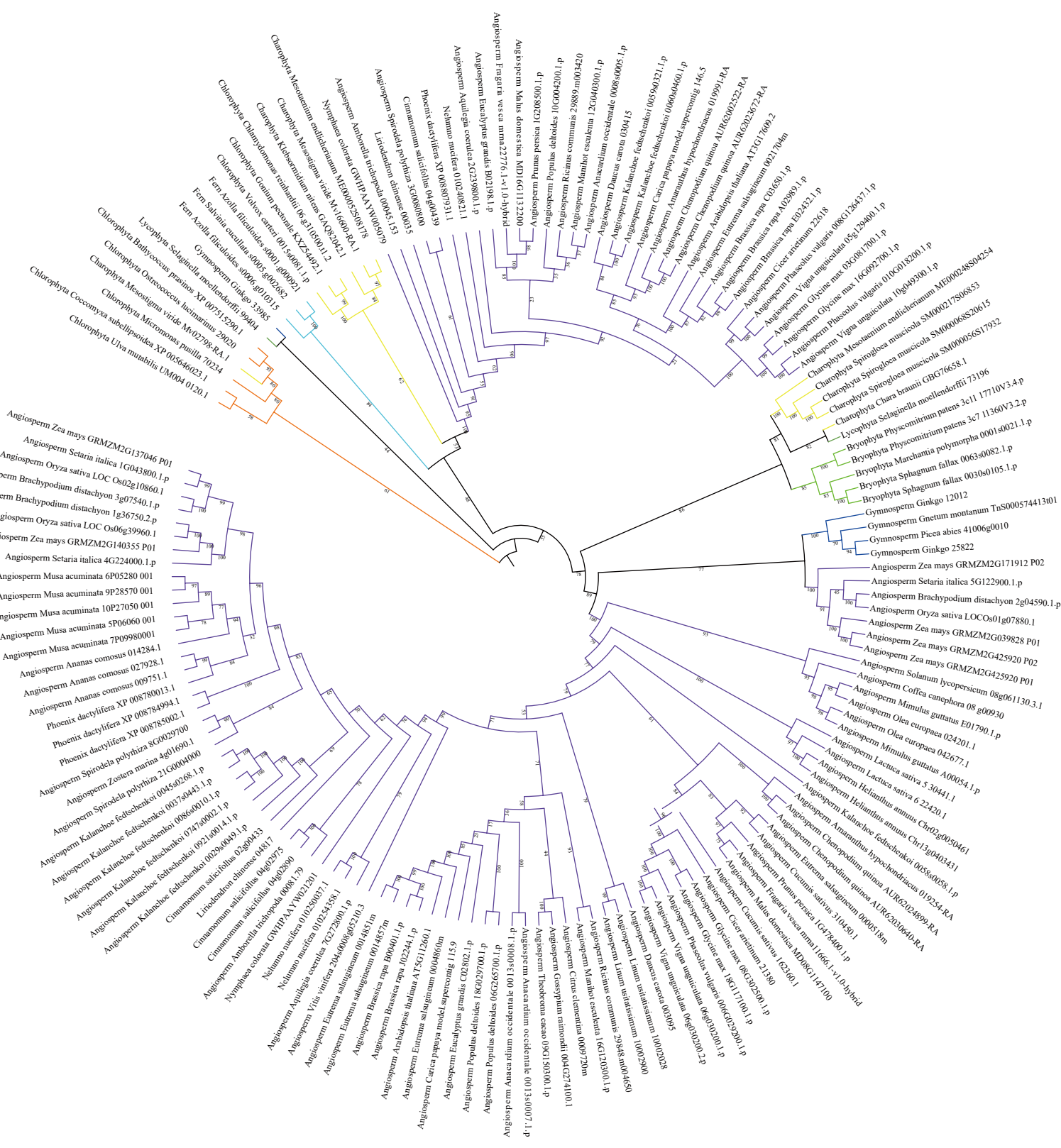
	410	420	430	
<i>A. trichopoda</i> _00017.257	. R Y A V V P	D E T A Q G Q P	P A T G R S G G N	D A S V P D N
<i>A. thaliana</i> _AT5G63860.1	. R Y A V V P	D E T G L T D G S S K	. . . . . G N G G	D I S V P Q T
<i>Z. mays</i> _30969448	. R Y A I V P	D E N V R K A G	G T A R G N G A	D A N V P E N
<i>G. biloba</i> _14008	. R Y A V V P	D E T Q V T G Q L S V V	P K N S S G	D A S V P D T
<i>G. Blume</i> _TnS000558519t02	. R Y A V V P	D E A G V	P D N	E A S V P Q A
<i>A. filiculoides</i> _s0509.g074711	. R Y A V V P	D E T V K T L A S R L H Q T T S V . .	C W Q . . . . .	. . . . .
<i>S. cucullata</i> _s0112.g020798	. R Y A V V P	D E T V K T L A N R L H Q T A S V . .	G N Q V P	Q A S D A S V P D T
<i>S. moellendorffii</i> _438355	. R Y A V V P	D E A V L	V G Q M G	D A S V P D T
<i>P. patens</i> _Pp3c10_2230V3.2	. R Y A V V P	D E T L G P L A R R L H Q T T N F E G E E L E V	P T A S D D S S G	D A N V P D T
<i>P. patens</i> _Pp3c3_15300V3.4	. R Y A V V P	D E T I G P L T N R L H Q T N Y M D G .	E L L V P N A V L G S S R	D A S V P D S
<i>M. polymorpha</i> _Mapoly0023s0125.2	. R Y A V V P	V E T V G D N E V	P	S S D A S V P D T
<i>M. endlicherianum</i> _ME000204S03010	. . . S V V V S	Q G V R M . . . . .	. . . . . D A N D A L A	D A S V P D A
<i>S. muscicola</i> _SM000080S22914	. R D A V V P	G E P M V E T M A A E P M	P	A S D A S V P N A
<i>S. muscicola</i> _SM000048S16505	. R D A V V P	G E P M V E T M A A E P L	P	A S D A S V P N A
<i>S. muscicola</i> _SM000049S16745	. R D A V V P	G E T M V E T M A A E P L	P	A S D A S V P N A
<i>C. braunii</i> _g41650	. R Y A V V P	D E S V D Q V L L . . . . .	. . . . . S S I C G T Y G T V P	E S
<i>K. nitens</i> _kf100419_0050	. R Y A I V P	E R P P V A F N H G G D T	P A C Q G D C A A	D V P V A
<i>M. viride</i> _Mv08436	. D S A V V P	. . . . . T W G A A V	P F S E G S	G L E V P V L
<i>C. variabilis</i> _XP_005847046.1	. R Y A V V P	D S A	P G A D E . . . . .	. . . . . V P S V
<i>V. carteri</i> _Vocar.0017s0213.1	. N R Y A V V	. . . . .	P G A D D P Y G N G S . .	T A V G A V P S M T V L D
<i>C. reinhardtii</i> _Cre05.g230600.t1.1	. R Y A V V	. . . . .	P G A D E P Y G N G A G G S S	V A A V P S M

<i>A. trichopoda</i> _00017.257	. . . . .	D V K R V R I
<i>A. thaliana</i> _AT5G63860.1	. . . . .	D V K R V R I
<i>Z. mays</i> _30969448	. . . . .	D V K R M R V Q S S
<i>G. biloba</i> _14008	. . . . .	D V K R M R N
<i>G. Blume</i> _TnS000558519t02	. . . . .	D M K R V R S G R
<i>A. filiculoides</i> _s0509.g074711	. . . . .	. . . . . K Q F I
<i>S. cucullata</i> _s0112.g020798	. . . . .	D F K R L R T A
<i>S. moellendorffii</i> _438355	. . . . .	D I K R I R T D
<i>P. patens</i> _Pp3c10_2230V3.2	. . . . .	D T K R M R T T L
<i>P. patens</i> _Pp3c3_15300V3.4	. . . . .	D K . . . T K R L R T A L
<i>M. polymorpha</i> _Mapoly0023s0125.2	. . . . .	D V K R L R T G F
<i>M. endlicherianum</i> _ME000204S03010	. . . . .	D T K R Q R K L
<i>S. muscicola</i> _SM000080S22914	. . . . .	D S . . . Q K R V R V A
<i>S. muscicola</i> _SM000048S16505	. . . . .	D S . . . Q K R V R V A
<i>S. muscicola</i> _SM000049S16745	. . . . .	D S . . . Q K R V R V A
<i>C. braunii</i> _g41650	. . . . .	D V K R Q K T V
<i>K. nitens</i> _kf100419_0050	. . . . .	. . . . . A K R P K I H
<i>M. viride</i> _Mv08436	. . . . .	. . . . . P K R A R H D
<i>C. variabilis</i> _XP_005847046.1	. . . . . P E A A T V P Q A G A V P	. . . . . D S . . . K R Q K V
<i>V. carteri</i> _Vocar.0017s0213.1	V I G A A A P F V Q A P Q G P L W G V S S A E E G A A V R G E A N T P G G E	D S R L P K R A R V S A E P C
<i>C. reinhardtii</i> _Cre05.g230600.t1.1	. . . . . G P D D M G T A G .	D S R D H K K A R T G G D M .

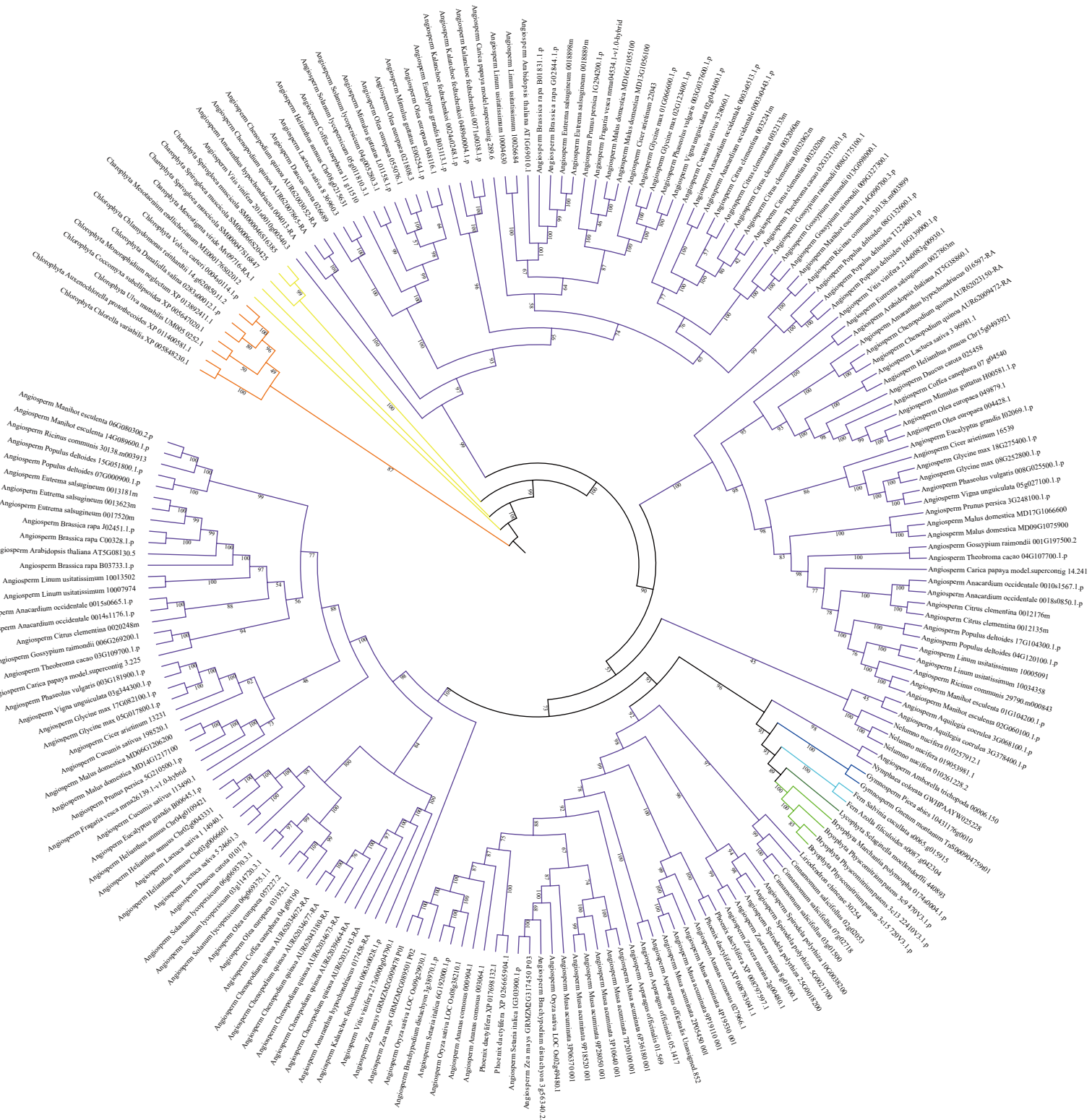
Supplemental Figure S2. The alignments of the C terminus of UVR8 proteins in representative green plants species.



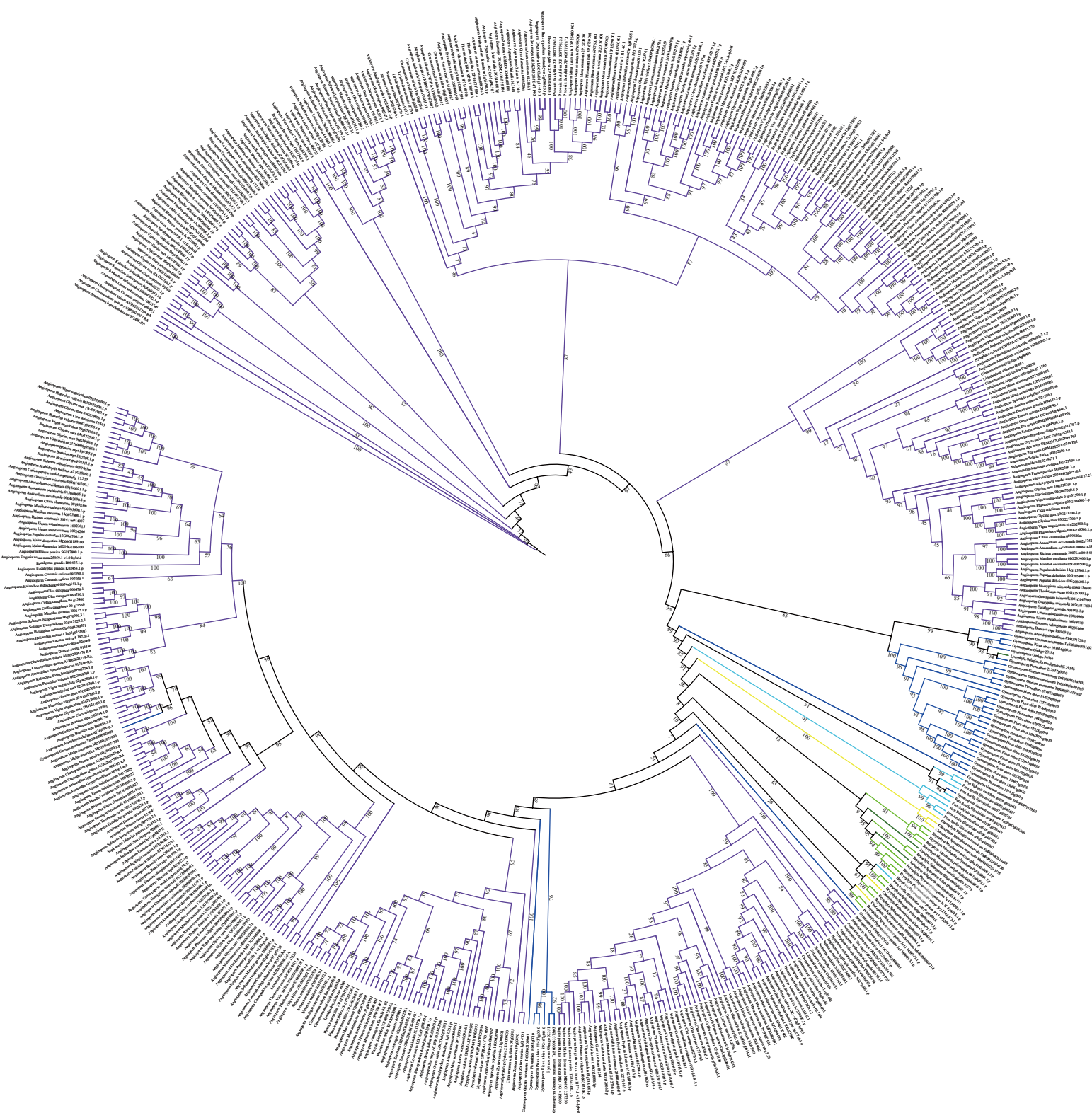
Supplemental Figure S4. Phylogenetic tree of SPA. Bootstrap values are labelled at each branch.



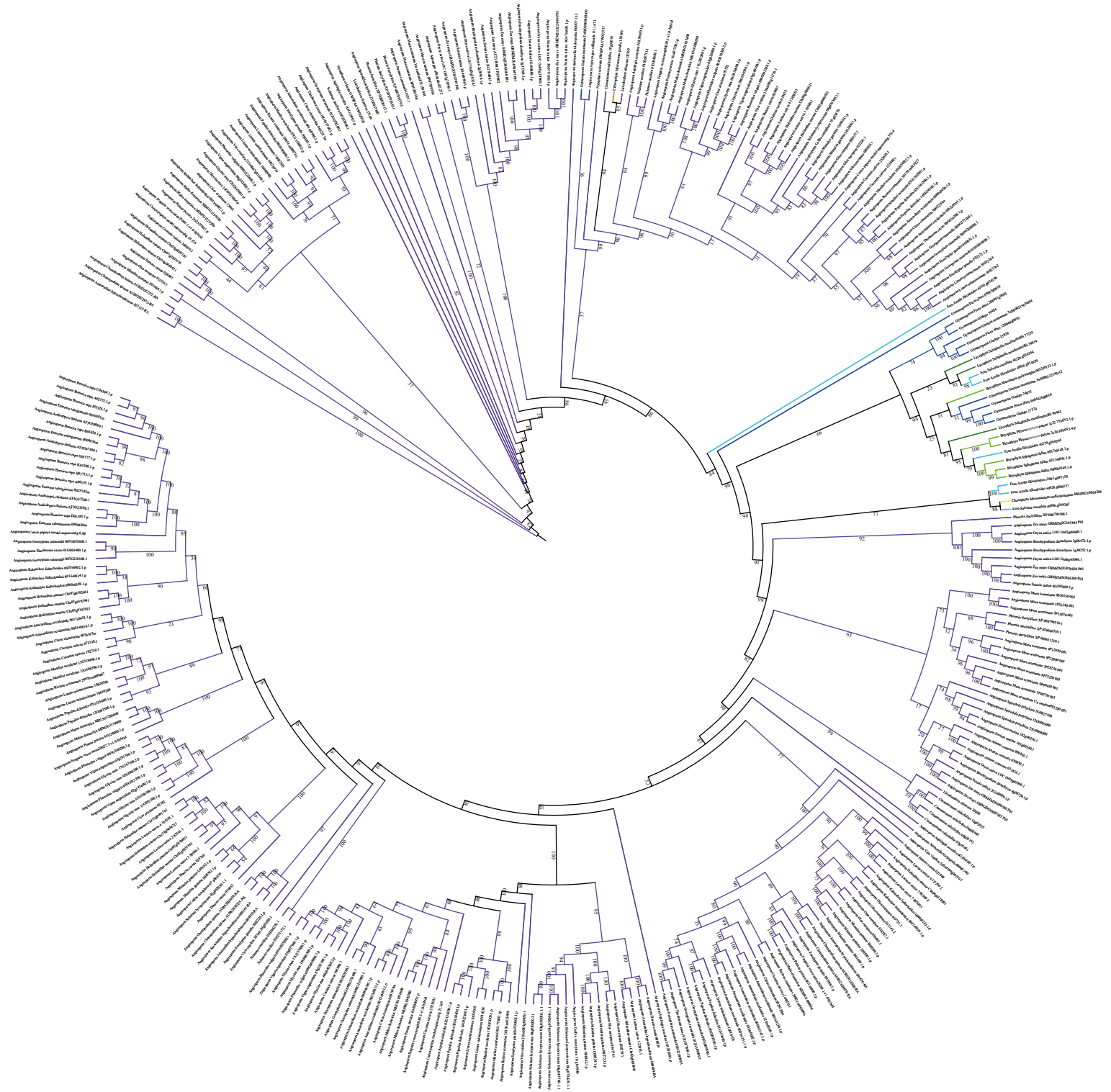
Supplemental Figure S5. Phylogenetic tree of HY5. Bootstrap values are labelled at each branch.



Supplemental Figure S7. Phylogenetic tree of BIM1. Bootstrap values are labelled at each branch.



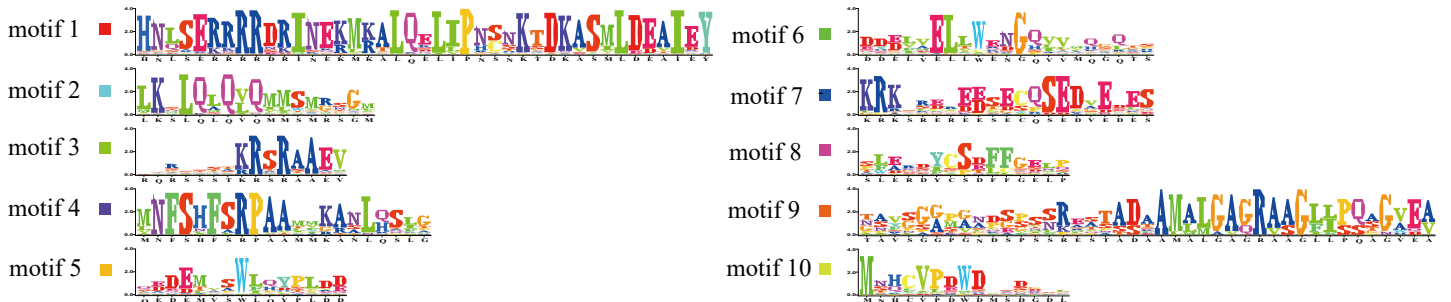
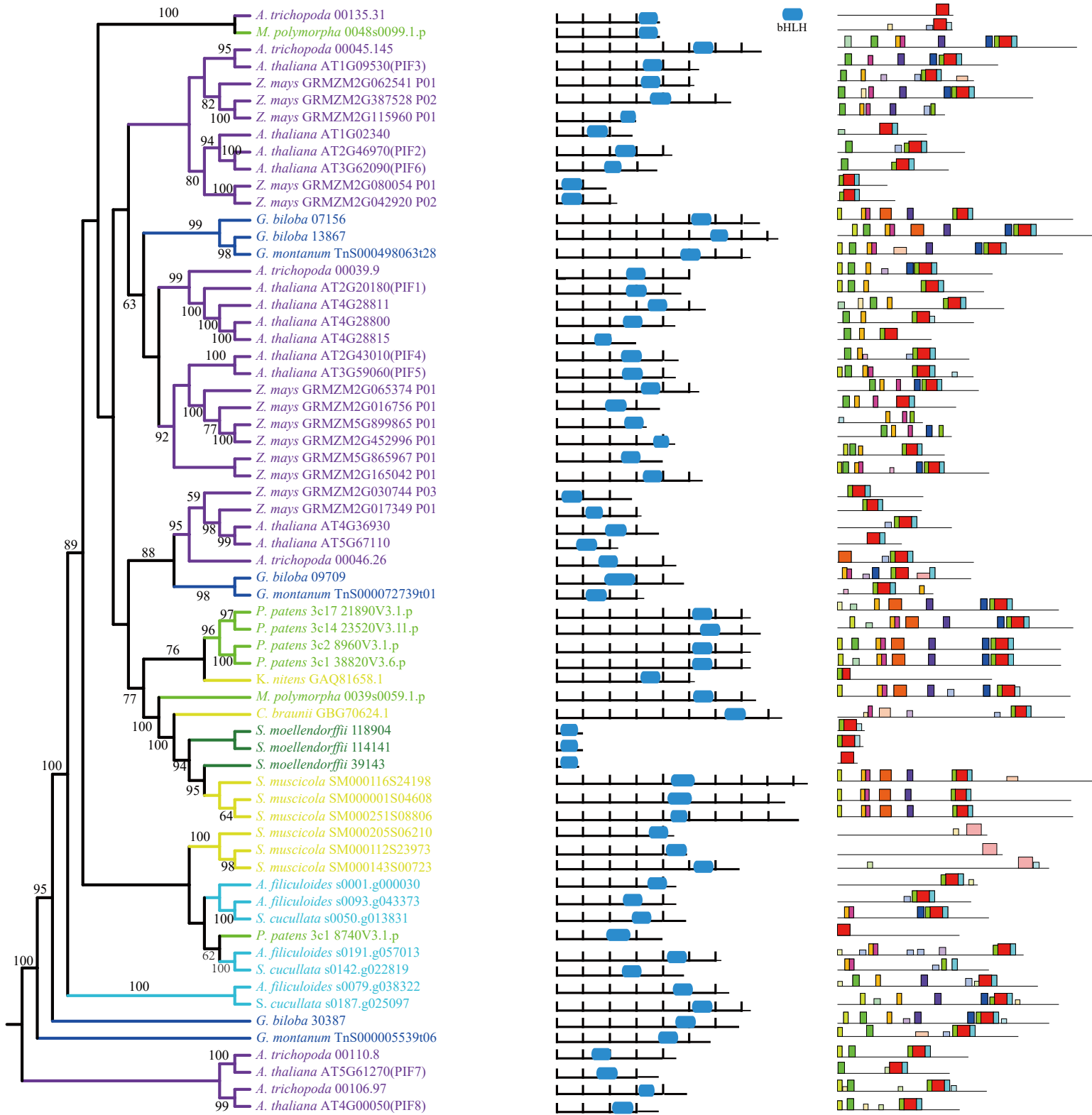
Supplemental Figure S8. Phylogenetic tree of WRKY36. Bootstrap values are labelled at each branch.



Supplemental Figure S9. Phylogenetic tree of MYB73/77. Bootstrap values are labelled at each branch.



Supplemental Figure S11. Phylogenetic tree of PIFs. Bootstrap values are labelled at each branch.



Supplemental Figure S12. Comparisons of protein domain and conserved amino acid motifs among PIFs in representative green plant genomes.