Supplementary Material

Three-dimensional envelope and subunit interactions of the plastid-encoded RNA polymerase from *Sinapis alba*

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Supplemental tables

Table S1: MS-based proteomic characterization of *S. alba* PEP fraction.

Table S2: characterization of proximal proteins in *S. alba* PEP fraction using crosslinking-MS.

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Figure S1: abundance-based ranking of proteins quantified by MS in PEP enriched samples. Distribution of abundances represented as Log2 of normalized and summed iBAQ values of individual proteins detected in three independent PEP samples (Table S1). Identified subunits of individual complexes are color-coded (blue: PAPs; orange: α, β, β´ and β´´ subunits; green: histones). The annotated zoom-in shows the 24 most abundant proteins in the ranking.

Figure S2-5: sequence alignment of the α, β, β´ and β´´ subunits from PEP of angiosperms with those of the RNAPs from *E. coli*, *T. thermophilus* and Nostoc. S3) Sequence alignment of the α subunits, S2) sequence alignment of the β subunits S3) Sequence alignment of the N-terminal part from β´ subunit with β ´ subunit from PEP, S4) Sequence alignment of the C-terminal part from β´ subunit with the β´´ subunit from PEP. The residues conserved more than 50 % are in red, those mutated in similar residues are in blue. The strictly conserved residues described by Lane & Darst (Lane & Darst, 2010) are highlighted in gray. The blue triangles show mutations observed among the strictly conserved residues described (Lane & Darst, 2010). The non-conservative mutations, at least three in a row in the β or β´ domain in *E. coli* and *T. thermophilus*, are high-lighted in green and displayed on the *E. coli* structure (PDB entry: 6GH5). Those colored in orange are nearby to the DNA, those in green are located at the surface of the subunits. The domains described for all-RNA polymerase (a) and the bRNAPs (b) are also given and highlighted in yellow and cyan respectively. The name of the RNAP domains are also given and highlighted in purple and green (Lane & Darst, 2010; Sutherland & Murakami, 2018).

Figure S6: view of the catalytic core from the *E. coli* RNAP (PDB entry: 3LU0 (Opalka *et al*., 2010)) manually fitted into the envelope of PEP using Chimera (Pettersen *et al*., 2004).

Figure S7a and S7b: overall shape of the a) human RNA polymerase II (EMDB entry: EMD-2194; Kassube et al., 2013) and b) yeast RNA polymerase III (EMDB entry: EMD-1753; Vanini et al., 2010) solved at 25 and 21 Å respectively.

Figure S8: FSC curve for the PEP 3D reconstruction calculated between two independent half maps (gold standard FSC). The dotted line represents the FSC=0.143 cutoff used to determine the resolution.

Data source: rpos collection from the green lineage

Figure S1 : abundance-based ranking of proteins quantified by MS in PEP enriched samples. Distribution of abundances represented as Log2 of normalized and summed iBAQ values of individual proteins detected in three independent PEP samples (Table S1). Identified subunits of individual complexes are color-coded (blue: PAPs; orange: α, β, β´ and β´´ subunits; magenta: histones). The annotated zoom-in shows the 24 most abundant proteins in the ranking.

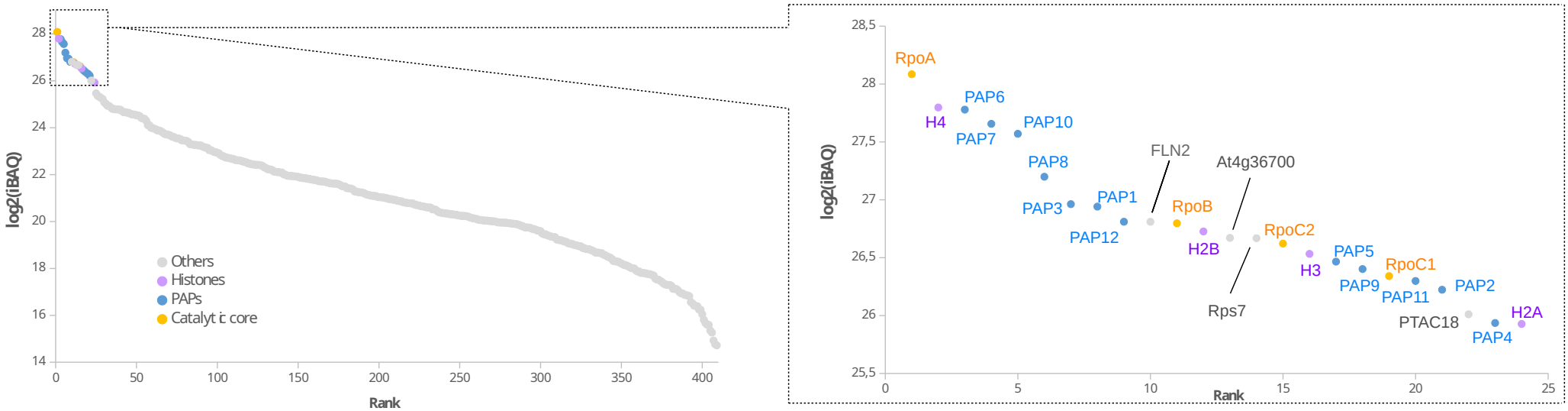

Figure S2: sequence alignment of the α subunits from PEP of angiosperms with those of the RNAPs from *E. coli*, *T. thermophilus* and Nostoc. The residues conserved more than 50 % are in red, those mutated in similar residues are in blue. The strictly conserved residues described by Lane & Darst (Lane & Darst, 2010) are highlighted in gray. The blue triangles show mutations observed among the strictly conserved residues described (Lane & Darst, 2010). The non-conservative mutations, at least three in a row in the β or β' domain in *E. coli* and *T. thermophilus*, are highlighted in green and displayed on the *E. coli* structure (PDB entry: 6GH5). Those colored in orange are nearby to the DNA, those in green are located at the surface of the subunits. The domains described for all-RNA polymerase (a) and the bRNAPs (b) are also given and highlighted in yellow and cyan respectively. The name of the RNAP domains are also given and highlighted in purple and green (Lane & Darst, 2010; Sutherland & Murakami, 2018).

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T. thermophilus     1 --------------------------------------------------------------------------------
E. coli             1 --------------------------------------------------------------------------------
0_Nostoc            1 --------------------------------------------------------------------------------
1_Litchi            1 --------------------------------------------------------------------------------
2_Arabidopsis       1 --------------------------------------------------------------------------------
3_Gossypium         1 --------------------------------------------------------------------------------
5_Ricinus           1 --------------------------------------------------------------------------------
6_Rosa              1 --------------------------------------------------------------------------------
9_Cucumis           1 --------------------------------------------------------------------------------
11_Nicotiana        1 --------------------------------------------------------------------------------
13_Syringa          1 --------------------------------------------------------------------------------
18_Liquidambar      1 --------------------------------------------------------------------------------
19_Papaver          1 --------------------------------------------------------------------------------
20_Ananas           1 --------------------------------------------------------------------------------
28_Liriodendron     1 --------------------------------------------------------------------------------
30_Magnolia         1 --------------------------------------------------------------------------------
32_Nymphaea         1 --------------------------------------------------------------------------------
33_Amborella        1 --------------------------------------------------------------------------------
35_Picea            1 --------------------------------------------------------------------------------
44_Ginkgo           1 --------------------------------------------------------------------------------
51_Physcomitrium    1 MAAVMSAQAMADAVRVVRASISELGKSAKKSDAFSARDLKSRSGFTESVDRLGLVNLQVQARKKRVRGLRLVPTRVVSAI
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                                                    α-NTD
T. thermophilus     1 ------------------------------MLDSK-----------LKAPVFTVRTQGREYGEFVLEPLERGFGVTLGNP
E. coli             1 ---------------------------MQGSVTEF-----------LKPRLVDIEQVSSTHAKVTLEPLERGFGHTLGNA
0_Nostoc            1 -----------------------------------------MAQFQIECVESNTEESRNHYSKFVLEPLERGQGTTVGNA
1_Litchi            1 ------------------------------MVREKVK--VFTRTLQWKCVESRTESKRLYYGRFILSPLMKGQADTIGIA
2_Arabidopsis       1 ------------------------------MVREKVK--VSTRTLQWKCVESKRDSKRLYYGRFILSPLMKGQADTIGIA
3_Gossypium         1 ------------------------------MVREKVKVSTSTRTRQWKCVESRTDSKRLYYGRFILSPLMKGQADTIGIA
5_Ricinus           1 ------------------------------MIREKVT--ISTRTLQWKCVESRTDNKRLFYGRFILSPLMKGQADTIGIA
6_Rosa              1 ------------------------------MVREKVT--VSTRTLQWKCVESRADSKRLYYGRFILAPLMKGQADTIGIA
9_Cucumis           1 ----------------------MILSKNITMVREKIR--VSTRTLKWKCVESRADSKRLYYGRFILSPLMKGQGDTIGIA
11_Nicotiana        1 ------------------------------MVREKVT--VSTRTLQWKCVESRTDSKRLYYGRFILSPLMKGQADTIGIA
13_Syringa          1 ------------------------------MVREKVT--VSTRTLQWKCVESREDSKRLYYGRFILSPLMKGQADTIGIA
18_Liquidambar      1 ------------------------------MVREKVT--VSTRTLQWKCVESRADSKRLYYGRFILSPLMKGQADTIGIA
19_Papaver          1 ------------------------------MLREEVA--VSTRTLQWKCVESRADSKRLYYGRFILSPLLKGQADTIGIA
20_Ananas           1 ------------------------------MVREEVA--GYTRTLQWKCVESRVDSKRLYYGRFILSPLMKGQADTIGIA
28_Liriodendron     1 ------------------------------MVREEVA--VSTRTLQWKCVESRTDSKRLYYGRFILAPLMKGQADTIGIA
30_Magnolia         1 ------------------------------MVREEVA--VSTRTLQWKCVESRTDSKRLYYGRFILAPLMKGQADTIGIA
32_Nymphaea         1 ------------------------------MVREEVP--VSTRTLQWKCVESRADSKRLYYGRFVLSPLMKGQADTIGIA
33_Amborella        1 ------------------------------MVRKEVP--VSNRTLQWKCVESKADSKRLYYGRFVLSPLMKGQADTIGTA
35_Picea            1 ------------------------------MIRDEIS--VSIQTLRWKCIESRAYSERLHYGRFALSPLRKGRADTIGIA
44_Ginkgo           1 ------------------------------MIRDEIS--VSIQTLRWKCIESRVNGKRLHYGRFALSPLQKGQANTIGIA
51_Physcomitrium   81 EGSNSTTADAPVDEDVLAWTKAYRAENSTAITRDETLKSNAQSALQWKCVETQVEGERLHYGRFAVSPFRSGQANTVGVS
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                                                    α-NTD
T. thermophilus    40 LRRILLSSIPGTAVTSVYIEDVLHEFSTIPGVKEDVVEIILNLKELVVRFLNPSLQTVTLLLKAEGPKEVKARDFLPVAD
E. coli            43 LRRILLSSMPGCAVTEVEIDGVLHEYSTKEGVQEDILEILLNLKGLAVRVQGKDEV--ILTLNKSGIGPVTAADITHDGD
0_Nostoc           40 LRRVLLSNLEGTAVTAVRIAGVSHEFATVPGVREDVLEILMRMKEVILKNYSSQPQ--IGRLLVNGPATITAAHFDLPSE
1_Litchi           49 MRRALLGEIEGTCITRAKFEKIPHECSTILGIQESVHEILMNLKEIVLRSNLYGTR--DALLCVKGPGYVTAQDILLPPS
2_Arabidopsis      49 MRRALLGEIEGTCITRAKSENIPHDYSNIAGIQESVHEILMNLNEIVLRSNLYGTR--NALICVQGPGYITARDIILPPA
3_Gossypium        51 MRRALLGELEGTCITRAKSEKIPHEYSTIVGIQESVHEILMNLKEIVLRGNLYGTR--NAFICAKGPGYVTAQDIILPPS
5_Ricinus          49 TRRALLGEIEGTCITRAKSEKIPHEFSTIAGIQESIHEILMNLKEIVLRSNLYGTC--DASICVKGPGYITAQDIILPPF
6_Rosa             49 MRRALLGEIEGTCITRARSEKIPHEYSTIVGIQESVHEILMNLKEIVLRSNLYGTR--NASICVKGPGYVTAQDIILPPS
9_Cucumis          57 MRKALLGEIEGTCITRAKSEKIPHEYSTIVGIQESVHEILMNLKEIVLRSNLYGTR--DASICVKGPGCVTAQDIILPPS
11_Nicotiana       49 MRRALLGEIEGTCITRVKSEKVPHEYSTITGIQESVHEILMNLKEIILRSNLYGTS--DASICVKGPGSVTAQDIILPPY
13_Syringa         49 MRRTLLGEIEGTCITRVKSENVPHEYSTIAGIQESVHEILMNLKEIVLRSNLYGTW--DASICVRGPGYVTAQDIILPPY
18_Liquidambar     49 MRRALLGEIEGTCITRAKSEKIPHEYSTIVGIQESVHEILMNLKEVVLRSNLYGTR--DASICVRGPGYVTAQDIISPPS
19_Papaver         49 MRRALLGEIEGTCITRAKSDKIPHEYSTIVGIEESVHEILMNLKEIVLRSNLYGTR--DASICVRGPGYVTAQDIISPPS
20_Ananas          49 MRRALLGEIEGTCITRAKSEKVPHEYSTIVGIEESVHEILLNLKEIVLRSNLYGVR--DALICVRGPRYVTAQDIISPPS
28_Liriodendron    49 MRRALLGEIEGTCITRVKSEKVPNEYYTIVGIEESVHEILMNLKEIVLRSHLYGTR--DASICVRGPRYVTAQDIIPPPS
30_Magnolia        49 MRRALLGEIEGTCITRAKSEKVPHEYSTIVGIEESVHAILMNLKEIVLGSHLYGTR--DASICVRGPRYVTAQDIIPPPS
32_Nymphaea        49 MRRALLGELEGTCITRAKSDKVPHEYSTIVGIEESVHEILMNLKKIVLRSDLYGTL--NASICVRGPRHVTAQDIISPPS
33_Amborella       49 MRRSLLGEIEGTCITCAKSERVPHEYSTIVGIEESVHEILMNLKEIIVRSDLYGTR--DAFICVRGPKYVTAQDIISPPS
35_Picea           49 MRRVLLGEVEGTCITHVKLENIKHEYSAIIGIEESVHDILMNLKEIVLRSDSYGIR--GASICIVGPRNVTAQDIILPPS
44_Ginkgo          49 MRRALLGEVEGTCITHAKFENMTHEYSAIMGIEESVHDISINLRGIVLQSDPYGIR--EASIYSVGPRDVTAQDIILPPS
51_Physcomitrium  161 MQKALLGEVEGAAVSCATFKNVKSEYAAMKGVEETPMDILVNLKELVIRSDSDEPQ--KAIISAIGPGPVTAGDIVLPPS
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                                  α-NTD
T. thermophilus   120 VEIMNPDLHIATL-EEGGRLNMEVRVDRGVGYVPAEKHGI----KDRINAIPVDAVFSPVRRVAFQVEDTRLGQRTDLDK
E. coli           121 VEIVKPQHVICHLTDENASISMRIKVQRGRGYVPASTRIHSEEDERPIGRLLVDACYSPVERIAYNVEAARVEQRTDLDK
0_Nostoc          118 VEVIDPTQYVATI-AEGGKLEMEFRIERGKGYRTVERGRE---EATSLDFLQIDSVFMPVRKVNYSVEEARGDGSITKDR
1_Litchi          127 VEIIDNTQHIASL-AEPIDFCIGLQIERNRGYNIKAPNNF---QD---RSYSIDAVFMPVRNANYSIHSYGSGN-EKQEI
2_Arabidopsis     127 VEIIDNTQHIATL-TEPIDLCIELKIERNRGYSLKMSNNF---ED---RSYPIDAVFMPVENANHSIHSYGNGN-EKQEI
3_Gossypium       129 VEIVDNTQHVASL-TEPIDLCIGLQIERNRGYGIKTPKNF---HD---GSYPIDAVFMPVRNANHSIHCYGNDN-EKQEI
5_Ricinus         127 VEIIDNTQHIASL-TEPIDLCIGLQIERNRGYRIKPTNNF---HE---GSYPIDAVFMPVRNANHSVHSYGNGN-EKQEI
6_Rosa            127 VEIVDNTQHIANL-TEPINLCIQLQIERNRGYRIKTPNNF---QD---GSYPIDAVFMPVRNANHSIHSYVNGN-EKQEI
9_Cucumis         135 VEIVDNTQHIANL-TEPINFCIELKIERNRGYHIQTPNNF---QD---ASYPMDAIFMPVRNVNHSIHSYVNGN-EKQEI
11_Nicotiana      127 VEIVDNTQHIASL-TEPIDFCIGLQIERNRGYLIKTPHNF---QD---GSYPIDAVFMPVRNANHSIHSYGNGN-EKQEI
13_Syringa        127 VEIVDNTQHIASL-TEPIDLCIGLQIERNRGYLIKMPDNF---QD---GSYPIDAVFMPVRNANHSIHSYGNGN-EKQEI
18_Liquidambar    127 VEIVDNTQHIASL-TEPIDLCIGLKMERNRGYRIKTPNNF---QD---RSYPIDAVFMPVRNANHSIHSYGNEN-EKQEI
19_Papaver        127 VEIVDTTQHIASL-TEPMDLCIGLQIERNRGYRMKTPNNA---QD---GSFTIDAVFMPVRNANHSIHSYGNGN-EKQEI
20_Ananas         127 VEIVDTTQHIANL-TEPIDLCIGLQIKRDRGYRMEPINDS---QD---VSYPIDAVSMPVRNANHSIHSYGNGN-EKQEI
28_Liriodendron   127 VEIVDTTQHIASL-TEPIDLCIELQIERDRGYRMKTPNNY---QD---GSYPIDAVSMPVRNANHSIHSYGNRN-EKQEI
30_Magnolia       127 VEIVDTTQHIASL-TEPIDLCIELQIERDRGYRMKTPNNY---QD---GSYPIDAVSMPVRNANHSIHSYGNGN-EKQEI
32_Nymphaea       127 VEIVDTTQHIAVL-TEPVDLCIELQIERGRGYCTRTPNNY---QD---GSYPIDAVSMPVRNANHSIHSYGNGN-EKQEI
33_Amborella      127 VKIVDTTQHIASI-TEPINFCIGLEIERNRGYRTRTTN-----QD---ASYPIDAVSMPVRNANYSIQCYGNEN-EKQEI
35_Picea          127 VKIIDTTQHIARL-TKSITSDIRLQIEKNRGYIIHSPNNY---QD---GIFPIDAVFMPVRDANYSIHSYGSGN-EIREV
44_Ginkgo         127 VRIIDTTQHIASL-KESITSDIRSQIGKDRGYRIQSPNNS---RD---GIFSTDAVSMPVRNANYSIHSYGNGN-EMQEI
51_Physcomitrium  239 LEVTDPTQHIAYL-TKEVSLDIELDVEKGCGYRMGDHTKS---GD---GRFYIDSVFMPVRNANYSVHSYESEPDVTQEI

                                  α-NTD                                                  α-CTD
T. thermophilus   195 LTLRIWTDGSVTPLEALNQAVEILREHLTYFSNPQAAAVAAPEEAKE-----------------PEAPPEQEEELDLPL
E. coli           201 LVIEMETNGTIDPEEAIRRAATILAEQLEAFVDLRDVRQ--PE---V-----------------KEEKPEFDPILLRPV
0_Nostoc          194 LLLEVWTNGSISPQEALSSAAGILVDLFNPLKDISLEPTD-------T-----------------GSEISEDPTAQIPI
1_Litchi          199 LFLEIWTNGGLTPKEALHEASRNLIDLFIPFLQAAE--ENLHLENNQYKVSLPYLTFRDRVAKLKKKK--KEIAGKSIFI
2_Arabidopsis     199 LFLEIWTNGSLTPKEALHQASRNLINLFIPFLHVEE--ETFYLENNQHQVTLPFFPFHNRLVNLRKKKKTKELAFQYIFI
3_Gossypium       201 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHTEE--ENLHLENNQHDVTLPFFPFHDRLVKLTKKK--KEIALKYIFI
5_Ricinus         199 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHAEE--ENFHLEKNQHKVTLPLFTFYDRLTKLRKNQ--NEITLKYVFI
6_Rosa            199 LFIEIWTNGSLTPKEALHEASRNLIDLFIPFLHAEE--ENFHFENNQHKVTLPLFTFHDKFANPRKSK--TEITLKYIFI
9_Cucumis         207 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHAEEEKENFHFKNNKQKVTLPLFTFHEKLAKLRKKK--KERALKYIFI
11_Nicotiana      199 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHMEE--DNLYLQDNQHTVPLSPFTFHDKLAKLIKNK--KKIALKSIFI
13_Syringa        199 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHKEE--ENLPLEDNQHTVPLSPLTFHEKLDKLRKNK--KKIALKSIFI
18_Liquidambar    199 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHAEE--ENLHLEDNQHKTILPLFTFHDRLAKLKKNK--KKKALKSIFI
19_Papaver        199 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHAEERDTN--LEDNQNIVTIPFFTFQNKLDKL--SKSKKDIALKCIFI
20_Ananas         199 LFLEIWTNGSLTPKEALYEASRNLIDLFIPFLHAEEEDIN--FEENKNRFTLPFLTFQDRLTNL--KKNKKGIPLNCIFI
28_Liriodendron   199 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHAEEQDIV--LEDNPNRFTVPLFTFHDRLANI--RKNKKGIALKCIFI
30_Magnolia       199 LFLEIWTNGSLTPKEALHEASRNLIDLFIPFLHAEEQDIN--LEDNPNRFTVPFFTFHDRLANI--RKNKKGIALKCIFI
32_Nymphaea       199 LFLEIWTNGSLTPKEALYEASRNLIDLFIPFLHAEEQDINRNMEDNLKRASVPFFTFDDGLDNM--K---REIILKRIFI
33_Amborella      197 LFLEIWTNGSLTPKEALYEASRNLIDLFIPFLHAEERDLH--LDDDQNIFTAPFFPFHEGLAYIGIGESKKRIALKRIFI
35_Picea          199 LFLEIWTNGGLTPREALSEASRILIELFIPFLHGEEQNI--DGMNNRKGSNMPPFPLSHVLTDTGET-KEKKIAFQHIFI
44_Ginkgo         199 LFSEIWTNGSLAPGEALYEASRNLIDLFIPFMRAEEQNI--DGIDNWNGYNMSLFPFSHISTDTEK--MEEEIAFKHIFI
51_Physcomitrium  312 LFLEIWTNGSITPEEALHEAARCLIDLFLPFLHPKKKEVTNSATKMHKSFTMSQFNSS-------AEMSAKEVDLRHVYV

                                  α-CTD
T. thermophilus   257 EELGLSTRVLHSLKEEGIESVRALLALNLKDLKNIPGIGERSLEEIKEALEKKGFTLKE----------------
E. coli           258 DDLELTVRSANCLKAEAIHYIGDLVQRTEVELLKTPNLGKKSLTEIKDVLASRGLSLGMRLENW---PPASIADE
0_Nostoc          249 EELQLSVRAYNCLKRAQVNSVADLLDYTQEDLLEIKNFGQKSAEEVVEALQRRL-GITLPQERGSKHP-------
1_Litchi          275 DQPELSPRIYNCLKKSNIHTLFDLLNKSQDDLMKIEHFRIEDVKQILGILEKK----------------------
2_Arabidopsis     277 DQLELPPRIYNCLKKSNIHTLLDLLNNSQEDLIKIEHFHVEDVKKILDILEKK----------------------
3_Gossypium       277 DQSELPPRIYNCLKKSNIHTLLDLLNNSREDLMKIEHFRIEDVKQILGILEKK----------------------
5_Ricinus         275 DQSELTPKIYNCLKRSNIHTLSDLLNKSQEDLMKIEHFRIDDVKHILGILEIEK-NFAI----------------
6_Rosa            275 DQSELPPRVYNCLKRSNIHTLLDLLNNSQEDLIKMKHLRIEDVKHILNILEKKK-HFE-----------------
9_Cucumis         285 DQSELPPRIYNCLKRCNIHTLFDLLNNSPDELMKIKHFRIEDVKHILDILEMEK-NFA-----------------
11_Nicotiana      275 DQSELPSRIYNCLKMSNIYTLLDLLNNSQEDLMKIEHFRSEDVKRILGILEKYF-VIDLAKNKF-----------
13_Syringa        275 DQSEFSPRVYNCLKRSNIYTLLDLLNNSQEDLMKMEHLRLEDIKQILVILEKHF-AIDLPKKNF-----------
18_Liquidambar    275 DQSELPPRIYTCLKRSNIHTLLDLLNNNQEDLMKIEHFRIEDVKKILGILEKHF-AIDLPKNKF-----------
19_Papaver        275 DQSELSPRIYNCLKRSNIYTLLDLLNKSQEDLMKIDHFRIEDVKQILDILQKRF-AIDLPKNKFSFLNPLE----
20_Ananas         275 DQLELPSRTYNCLKRSNIHTLLDLLSNSQEDLMRIEYFRMEDVKQILDTLQKHF-AIDLPKNKFSF---------
28_Liriodendron   275 DQSELPPRTYNCLKRSNIHTLLDLLSNSQEDLMRIEHFRIEDVKQILDILQKHF-TIDLPKNKF-----------
30_Magnolia       275 DQSELPPRTYNCLKRSNIHTLLDLLSNSQEDLMRIEHFRIEDVKQILDILQKHF-TIDLPKNKF-----------
32_Nymphaea       274 DQLELPPRTYNCLKRSNIHTLLDLLSKSQEDLMRIEHFRVEDVKQIFDILQKGF-TIDLLKNFK-NSNQFESR--
33_Amborella      275 DQLELSPRTYNCLKRSNIHTLLDLLSKSQEDLRKIQHFRVEDVKRVLDILKKRF-AMNLFT--------------
35_Picea          276 DQLEFPPRVYNCLRRANIHTLSDLLNYSREDLMRIERFGKESVEQVFEILRKRF-AIDPPRN-------------
44_Ginkgo         275 DQSELPPRVYNCLKRVNIHTLSDLLNYSRDDPTRIENFGNQSVEQILEVLQKRF-AIDLPKKKF-----------
51_Physcomitrium  385 DQLRIPSKAYNSLKRANINTVSDLLDYTQDDLLSIPNFGRKSVDDILEALQAQF-SIDLPENNPLCN--------
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Figure S3: sequence alignment of the β subunits from PEP of angiosperms with those of the RNAPs from *E. coli*, *T. thermophilus* and Nostoc. The residues conserved more than 50 % are in red, those mutated in similar residues are in blue. The strictly conserved residues described by Lane & Darst (Lane & Darst, 2010) are highlighted in gray. The blue triangles show mutations observed among the strictly conserved residues described (Lane & Darst, 2010). The non-conservative mutations, at least three in a row in the β or β' domain in *E. coli* and *T. thermophilus*, are highlighted in green and displayed on the *E. coli* structure (PDB entry: 6GH5). Those colored in orange are nearby to the DNA, those in green are located at the surface of the subunits. The domains described for all-RNA polymerase (a) and the bRNAPs (b) are also given and highlighted in yellow and cyan respectively. The name of the RNAP domains are also given and highlighted in purple and green (Lane & Darst, 2010; Sutherland & Murakami, 2018).

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                                                  β1 domain: Q22-N130 + V336-S392
                                        βa1:P16-L30                βa2:G43-R49
                                        βb1:P16-L30                βb2:G43-G60
T. thermophilus    1 ---------------MEIKRFGRIREVIPLPPLTEIQVESYRRALQADVPPEKRENVGIQAAFRETFPIEEEDKGKGGLV
E. coli            1 ------MVYSYTEKKRIRKDFGKRPQVLDVPYLLSIQLDSFQKFIEQDPEG----QYGLEAAFRSVFPIQSYS---GNSE
0_Nostoc           1 -----------------MTKETYMEPAFLLPDLIEIQRSSFRWFLEEGLIEEL-----------NSFSPITDYTGKLELH
1_Litchi           1 ------------------MRGDVNVRMSTIPGFNQIQFEGFCRFIDQGLTEEL-----------YKFPKIEDTDQEIEFQ
2_Arabidopsis      1 ------------------MLGDEKEGTSAIPGFNQIQFEGFYRFIDQGLIEEL-----------AKFPKIEDIDHEIEFQ
3_Gossypium        1 ------------------MLGDENGEMSTIPGLNQIQFEGFCGFMDRGLTEEL-----------YKFPKIEDTEQEIEFQ
5_Ricinus          1 ------------------MLGDGNEGMSTIPGLNQIQFEGFCRFIDQGLTEEL-----------YKFPKIEDTDQEIEFQ
6_Rosa             1 ------------------MLGGGNEAISTIPGFNQIQFEGFCRFIDQGLTEEL-----------YKFPKIEDTDQEIEFQ
9_Cucumis          1 MMNKQIMGFFFYKWEINKMLGGGNERMSTIPGFNQIQFEGFCRFIDHGLTEEL-----------SKFPKIEDTDQEIEFQ
11_Nicotiana       1 ------------------MLGDGNEGISTIPGFNQIQFEGFCRFIDQGLTEEL-----------YKFPKIEDTDQEIEFQ
13_Syringa         1 ------------------MLGDGNEGMSTIPGFNQIQFEGFCRFIDQGLTEEL-----------YKFPKIEDTDQELEFQ
18_Liquidambar     1 ------------------MLRDGNEGMSTIPGLNQIQFEGFCRFIDQGLTEEL-----------YKFPKIEDTDQEIEFQ
19_Papaver         1 ------------------MLRDGNEGMSTIPGFSQIQFEGFCRFIDQGLMEEL-----------YKFPKIEDIDQEIEFQ
20_Ananas          1 ------------------MLRNGNEGMSTIPGFSQIQFEGFCRFINQGLTEEF-----------HKFPKIEDTDQEIEFK
28_Liriodendron    1 ---------MFSINGKLKMLRDGNEGMSTIPGFSQIQFEGFCRFIDQGLTEEL-----------HKFPKIEDTDQEIEFQ
30_Magnolia        1 ---------MFSINGKLKMLRDGNEGMSTIPGFSQIQFEGFCRFIDQGLTEEL-----------HKFPKIEDTDQEIEFQ
32_Nymphaea        1 -----------------MLRDGGDEEMFTIPGFSQIQFEGFCRFIDQGLMEEL-----------HQFPKIEDTDQEIEFQ
33_Amborella       1 ------------------MLRDGNEGMSTIPGFSQIQFEGFCRFVDQGLAEEL-----------HKFPKIEDTDQEIEFQ
35_Picea           1 ------------------MRLDENEGAFTIPEFGKIQFEGFCRFIDQGLMEEL-----------HNFPKIEDTDKEIESR
44_Ginkgo          1 ------------MDGKLPMLLDENKGTSTIPGFGQIQFEGFCRFIDQGLIEEL-----------SNFPEIEYTDQEIESR
51_Physcomitrium   1 -MKK-IITL---SAPPPSQFSFLSEFQFSLPELRQIQFKSYYYFIYKNLISEL-----------NIFPEIFDLNQEFQFE

                             β1 domain: Q22-N130 + V336-S392
                          βa3:F78-I101                            βa4:E112-F148
                       βb3:L64-I101                               βb4:D111-F148
T. thermophilus   66 LDFLEYRLGEPPFPQDECREKDLTYQAPLYARLQLIHKD-------TGLIKEDEVFLGHIPLMTEDGSFIINGADRVIVS
E. coli           68 LQYVSYRLGEPVFDVQECQIRGVTYSAPLRVKLRLVIYEREAPEGTVKDIKEQEVYMGEIPLMTDNGTFVINGTERVIVS
0_Nostoc          53 FLGQNYKLKEPKYSVEEAKRRDSTYAVQMYVPTRLINKE-------TGEIKEQEVFIGDLPLMTDRGTFIINGAERVIVN
1_Litchi          52 LFVETYQLVEPLIKERDAVYESLTYSSELYVSAGLIWKS-------RGDMQEQTIFIGNIPLMNSLGTSIVNGIYRIVIN
2_Arabidopsis     52 LFVETYQLVEPLIKERDAVYESLTYSSELYVSAGLIWKT-------SRNMQEQRIFIGNIPLMNSLGTSIVNGIYRIVIN
3_Gossypium       52 LFVETYQLVEPLIKERDAVYESLTYSSELYVSAGLIWKT-------SKDMQEQTIFIGNIPLMNSLGTSIVNGIYRIVIN
5_Ricinus         52 LFVETYQLVEPLIKEGDAVYESLTYSSELYISAGLIWKT-------SRDMQEQTIFIGNIPLMNSLGTFIINGIYRIVIN
6_Rosa            52 LFVETYQLVEPLIKERDAVYESLTYSSELYVSAGLIWKN-------SRDMQEQTIFIGNIPLMNSLGTSIVNGIYRIVIN
9_Cucumis         70 LFVETYKLVEPLIKERDAVYESLTYSSELYVSAGLIWKT-------RRDMQEQTIFIGNIPLMNSLGTSIVNGLYRIVIS
11_Nicotiana      52 LFVETYQLVEPLIKERDAVYESLTYSSELYVSAGLIWKN-------SRDMQEQTIFIGNIPLMNSLGTSIVNGIYRIVIN
13_Syringa        52 LFVERYQLVEPLIKERDAVYESLTYSSELYVSGGLIWKT-------SRDMQEQTIFIGNIPLMNSLGTSIVNGIYRIVIN
18_Liquidambar    52 LFVETYQLVEPLIKERDAVYESLTYSSELYVSAGLIWKS-------SGDMQEQTIFIGNIPLMNSLGTSIVNGIYRIVIN
19_Papaver        52 LFVETYQLVEPLIKERDAVYESLTYSSELYVPAGLIWKT-------GRDIQEQTIFIGNIPLMNSLGTFIVNGIYRIVIN
20_Ananas         52 LFAERYQLVEPLIKERDAVYESLTYSSELYVPAGLIWKT-------GRDMQEQTVFIGNIPLMNSLGTSIVNGIYRIVIN
28_Liriodendron   61 LFVETYQLVEPLIKERDAVYESLTYSSELYVPAGLIWKT-------GRDMQEQTVFIGNIPLMNSLGTSIVNGIYRIVIN
30_Magnolia       61 LFVETYQLVEPLIKERDAVYESLTYSSELYVPAGLIWKT-------GRDMQEQTVFIGNIPLMNSLGTSIVNGIYRIVIN
32_Nymphaea       53 LFEESYQLVEPLIKERDAVYESITYSSELYVPAGLIWRT-------GRNMQEQTVLLGNIPLMNSLGTSIVNGIYRIVIN
33_Amborella      52 LLVETYQLAEPLIKERDAVYESLTHSSELYVPAGLIWKV-------GRDMQEQTVFIGNIPLMNSLGTFIVNGIYRIVIN
35_Picea          52 LFGNEYELAEPFIKERDAVYQSLTYYSELYVPARSIRRN-------SSKIQKQTVFLGNIPLMNSHGTFVVNGIYRIVVN
44_Ginkgo         58 LSGKKYKSAEPLIEERNAVYQSLTYSSELYVPARLIQKN-------RRKIQKQTVFLGNIPLMNSRGTFVVNGISRIVVD
51_Physcomitrium  65 LLNKEYKLIKPEKTT--IKFHYNTYSSDLYVTCRLLRRK-----KKIEIQKQTIFIGSIPLIDYQSTFRINSVTRVIIN

                                   β2 domain: R142-D324
                                                                  βa5:F191-G201
                             βb5:Y158-L165      βb6:R168-Y202
T. thermophilus  139 QIHRSPGVYFTPDPARP--GRY-IASIIPLPKRGPWIDLEVEPNGVVSMKVN-KRKFPLVLLLRVLGYDQETLARELGAY
E. coli          148 QLHRSPGVFFDSDKGKTHSSGKVLYNARIIPYRGSWLDFEFDPKDNLFVRIDRRRKLPATIILRALNYTTEQILDLF--F
0_Nostoc         126 QIVRSPGVYYKSEIDKN--GRR-TYSASLIPNRGAWLKFETDRNDLVWVRIDKTRKLSAQVLLKALGLSDNEIFDAL-RH
1_Litchi         125 QILQSPGIYYQSEFDHN--GIL-IYAGTIISDWGGRLELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILENI-CY
2_Arabidopsis    125 QILQSPGIYYQSELDHN--GIS-VYTGTIISDWGGRLELEIDKKARIWARVSRKQKISILVLSSAMGLNLREILENV-CY
3_Gossypium      125 QILQSPGIYYRSELDHN--GIS-VYTGTIISDWGGRLELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILENV-CY
5_Ricinus        125 QILQSPGIYYRSELDHN--GIS-VYTGTIISDWGGRVELEIDRKARIWARVSRKQKISILVLLSAMGLNLREILENV-RY
6_Rosa           125 QILQSPGIYYRSELDHN--GIS-VYTGIIISDWGGRLELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILENA-RY
9_Cucumis        143 QILQSPGIYYRSELDHN--GIS-VYTGTIISDWGGRLELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILENV-CY
11_Nicotiana     125 QILQSPGIYYRSELDHN--GIS-VYTGTIISDWGGRSELEIDRKARIWARVSRKQKISILVLSSAMGLNLREILENV-CY
13_Syringa       125 QILQSPGIYYRSELDHN--GIS-VYTGTIISDWGGRSELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILDNV-CY
18_Liquidambar   125 QILQSPGIYYRSELDHN--GIS-IYTGTIISDWGGRLELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILENV-CY
19_Papaver       125 QILQSPGIYYRSELDHN--GIS-VYTATIISDWGGRSELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILDNV-CY
20_Ananas        125 QILQSPGIYYRSELDHN--GIS-VYTSTIISDWGGRSEFEIDRKARIWARVSRKQKISILVLSSAMGSNLREILDNV-CY
28_Liriodendron  134 QILQSPGIYYRSELDHN--GIS-VYTGTIISDWGGRSELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILDNV-CY
30_Magnolia      134 QILQSPGIYYRSELDHN--GIS-VYTGTIISDWGGRSELEIDRKARIWARVSRKQKISILVLSSAMGSNLREILDNV-CY
32_Nymphaea      126 QILQSPGIYYSTGLDHN--GIS-VYTGTIISDWGGRSELEIDRKERIWARVSRKQKISILVLSSAMGSSLREILDNV-CY
33_Amborella     125 QILQSPGIYYSSELDHN--GIS-VYTGTIISDRGGRSELEIDRKARIWARVSRKQKISILVLPSAMGSNLREILDNV-CY
35_Picea         125 QILISPGIYYRSELDHN--RINYIYTGTLISDWGRRSKLEIDVGERIWARVSRKRKISIPVLLSAMGLNLEEILDNT-RY
44_Ginkgo        131 QILRSPGIYYSSEPGHN--GIA-IYTGTIISDWGGRPKLEIDGKTRIWARVSRKQKVSIPVLLSAMGSNFEEILDNV-CY
51_Physcomitrium 137 QILRSPGIYYNSELDHN--GIS-IYTGTIISDWGGRLKLEIDSKTRIWARISKKRKVSILVLLLAMGLTIKQILDSV-CS
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T. thermophilus  215 GELVQGLM------------------------------------------------------------------------
E. coli          226 EKVIFEIRDNKLQMELVPERLRGETASFDIEANGKVYVEKGRRITARHIRQLEKDDVKLIEVPVEYIAGKVVAKDYIDES
0_Nostoc         202 PEYFQKTIE-----------------------------------------------------------------------
1_Litchi         201 PEIFLSFLTD----------------------------KE----------------------------------------
2_Arabidopsis    201 PEIFLSFLTD----------------------------KE----------------------------------------
3_Gossypium      201 PEIFLSFLTD----------------------------KE----------------------------------------
5_Ricinus        201 PEIFLSFLND----------------------------KE----------------------------------------
6_Rosa           201 PEIFLSFLND----------------------------KE----------------------------------------
9_Cucumis        219 PEIFLSFLND----------------------------KE----------------------------------------
11_Nicotiana     201 PEIFLSFLSD----------------------------KE----------------------------------------
13_Syringa       201 PEIFLSFLND----------------------------KE----------------------------------------
18_Liquidambar   201 PEIFLSFLND----------------------------KE----------------------------------------
19_Papaver       201 PEIFLSFPND----------------------------KE----------------------------------------
20_Ananas        201 PEIFLSFPND----------------------------KE----------------------------------------
28_Liriodendron  210 PEIFLSFPND----------------------------KE----------------------------------------
30_Magnolia      210 PEIFLSFPND----------------------------KE----------------------------------------
32_Nymphaea      202 PEIFLSFPNE----------------------------KE----------------------------------------
33_Amborella     201 PEILLYFPNE----------------------------KE----------------------------------------
35_Picea         202 PEKIFFLLKK----------------------------KKGRW-------------------------------------
44_Ginkgo        207 PEIFLSFL-------------------------------NGRQ-------------------------------------
51_Physcomitrium 213 SKIFLDFLKE----------------------------KK----------------------------------------
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β2 domain: R142-D324

βb7:A234-K280

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T. thermophilus  223 -------------------------DE--------------------SVFAMRPEEALIRLFTLLRPGDPPKR--DKAVA
E. coli          306 TGELICAANMELSLDLLAKLSQSGHKRIETLFTNDLDHGPYISETLRVDPTNDRLSALVEIYRMMRPGEPPTR--EAAES
0_Nostoc         211 -----------------------------------------------KEGQFSEEEALMELYRKLRPGEPPTVLG--GQQ
1_Litchi         213 -----------------------------------------------KKKIGSKENAILEFYQQFACVGGDPIFSESLCK
2_Arabidopsis    213 -----------------------------------------------KKKIGSKENAILEFYQQFSCVGGDPIFSESLCK
3_Gossypium      213 -----------------------------------------------KKKIGSKENAILEFYQQFSCVGGDPVFSESLCK
5_Ricinus        213 -----------------------------------------------KKKIGSKENAILEFYQQFTCVGGDPVFSESLCK
6_Rosa           213 -----------------------------------------------KKKIGSKENAILEFYQQFACVGGDPVVSESLCK
9_Cucumis        231 -----------------------------------------------KKKIGSKENAILEFYQQFSCVGGDPVFSESLCK
11_Nicotiana     213 -----------------------------------------------RKKIGSKENAILEFYQQFACVGGDPVFSESLCK
13_Syringa       213 -----------------------------------------------RKKIGSKENAILEFYQQFACVGGDPVFSESLCK
18_Liquidambar   213 -----------------------------------------------KKKIGSKENAILEFYQQFACVGGDPVFSESLCK
19_Papaver       213 -----------------------------------------------KKKIGSKENAILEFYQQFACVGGDPVFSESLCK
20_Ananas        213 -----------------------------------------------KKKIGSKENAILEFYQQFACVGGDPVFSESLCK
28_Liriodendron  222 -----------------------------------------------KKKIGSRENAILEFYQQFACVGGDPVFSESLCK
30_Magnolia      222 -----------------------------------------------KKKIGSRENAILEFYQQFACVGGDPVFSESLCK
32_Nymphaea      214 -----------------------------------------------KKKISSKENAILEFYQKFACVGGDPVFSESLCK
33_Amborella     213 -----------------------------------------------KKKIGSKENAILEFYQQFSCVGGDPVFSESLCK
35_Picea         217 -------------------------ER--------------------EEYIWSKEKAILEFYKKLYCVSGDLVFSESLCK
44_Ginkgo        219 -------------------------KR--------------------KKYLRSEENAILEFHKKLYCVGGDLVFSESLCK
51_Physcomitrium 225 -------------------------KK--------------------KEHLQSTEDAMVELYKQLYYIGGDLLFSESIRK
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β2 domain: R142-D324

βa6:D323-V355

βb7:A234-K280 βb8:V302-G316 βb9:D323-M359

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T. thermophilus  256 YVYGLIADPRRYDLGEAGRYKAEEKLGIRLSGRTLARFEDGEFKDEVFLPTLRYLFALTAGVPGHEVDDIDHLGNRRIRT
E. coli          384 LFENLFFSEDRYDLSAVGRMKFNRSLLREEIEGS------GILSKDDIIDVMKKLIDIRNGK--GEVDDIDHLGNRRIRS
0_Nostoc         242 LLDSRFFDPKRYDLGRVGRYKLNKKLRLSVPDTMRVLTSS------DILAAVDYLINLEYDI--GNIDDIDHLGNRRVRS
1_Litchi         246 ELQKKF-FHQRCELGRIGRRNMNRRLNLNIPQNNTFLLPR------DVLAAADHLIELKFGM--GTLDDMNHLKNKRIRS
2_Arabidopsis    246 ELQKKF-FHQRCELGRIGRRNINWRLNLNIPQNNIFLLPR------DVLAAADHLIGMKFGM--GTLDDMNHLKNKRIRS
3_Gossypium      246 ELQKKF-FQQRCELGRIGRRNMNQRLNLNIPQNNTFLLPR------DILAAADRLIGMKFGM--GPLDDMNHLKNKRIRS
5_Ricinus        246 ELQKKF-FQQRCELGRIGRLNMNRRLNLDIPHNNTFLLPR------DILAAADHLIGMKFGM--GTLDDMNHLKNKRIRS
6_Rosa           246 ELQKKF-FQQRCELGRIGRRNMNRRLNLDIPQNNTFLLPR------DILAAADHLIGMKFGM--GTLDDMNHLKNKRIRS
9_Cucumis        264 ELQKKF-FQQRCELGRIGRRNLNQRLNLDIPENNTFLLPR------DILAAADHLIGLKFGM--GTLDDMNHLKNKRIRS
11_Nicotiana     246 ELQKKF-FQQRCELGRIGRRNMNRRLNLDIPQNNTFLLPR------DILAAADHLIGLKFGM--GALDDMNHLKNKRIRS
13_Syringa       246 ELQKKF-FQQRCELGRIGRRNMNRRLNLDIPQNNTFLLPR------DILAAADHLIELKFGM--GTLDDMNHLKNKRIRS
18_Liquidambar   246 ELQKKF-FQQRCELGRIGRRNMNRRLDLNIPQNNTFLLPR------DILAAADHLIGMKFGM--GTLDDMNHLKNKRIRS
19_Papaver       246 ELQKKF-FQQRCELGRIGRRNMNRRLNLDIPQNNTFLLPR------DVLAAADHLIGMKFGM--GTLDDMNHLKNKRIRS
20_Ananas        246 ELQKKF-FQQRCELGRIGRRNMNRRLNLDIPQNNTFLLPR------DVLAAADHLIGMKFGM--GTFDDMNHLKNKRIRS
28_Liriodendron  255 ELQKKF-FQQRCELGRIGRRNMNRRLNLDIPQNNTFLLPR------DVLAAADHLIGMKFGM--GTLDDMNHLKNKRIRS
30_Magnolia      255 ELQKKF-FQQRCELGRIGRRNMNRRLNLDIPQNNTFLLPR------DVLSAADHLIRMKFGM--GTLDDMNHLKNKRIRS
32_Nymphaea      247 ELQKKF-FQQRCELGRIGRRNMNQRLNLDIPQNNTFLLPR------DVLAAADHLIGMKFGM--GTLDDMNHLKNKRIRS
33_Amborella     246 ELQKRF-FQQRCELGRIGRQNMNQRLNIDIPQNNTFLLPR------DVLAATDHLIGLKFGM--GTLDDMNHLKNKRIRS
35_Picea         252 ELQEKF-FRQRCELGKIGRRNPNQKLNLDIPENEIFSLPQ------DVLAAVDYLIGVKFGM--GTLDDIDHLRNRRIRS
44_Ginkgo        254 ELQKKS-LQQRCELGRIGRRNPNQKLNLDIPENEIFSLPQ------DVLAAADYSIRVKFGM--GTLDDMDHLKNKRIRS
51_Physcomitrium 260 ELQKKF-FQQRCELGKIGRLNVNKKLSLDIPENEFFLLPQ------DILAAIDYLIKIKFGI--GTLDDIDHLKNRRIRS
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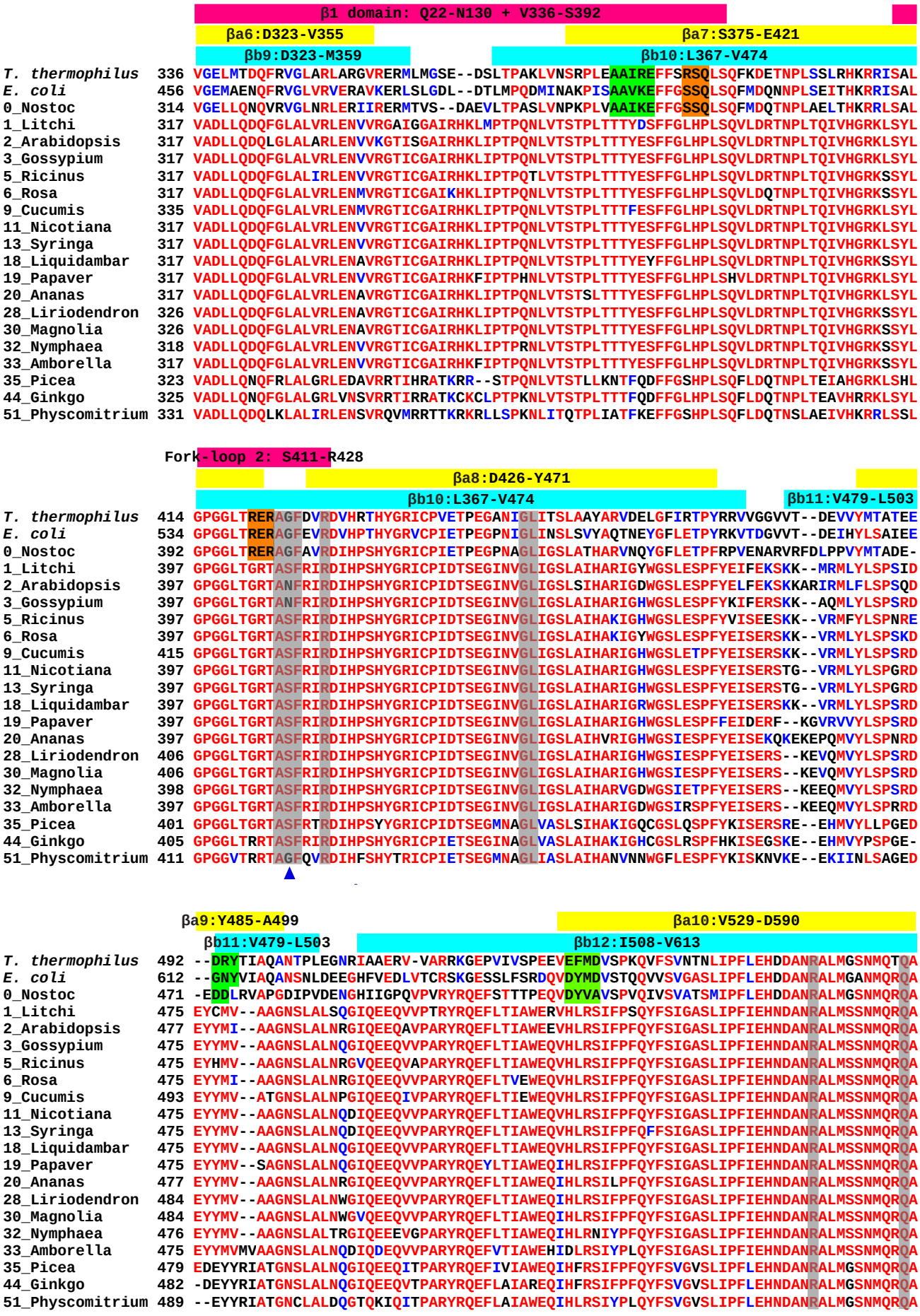
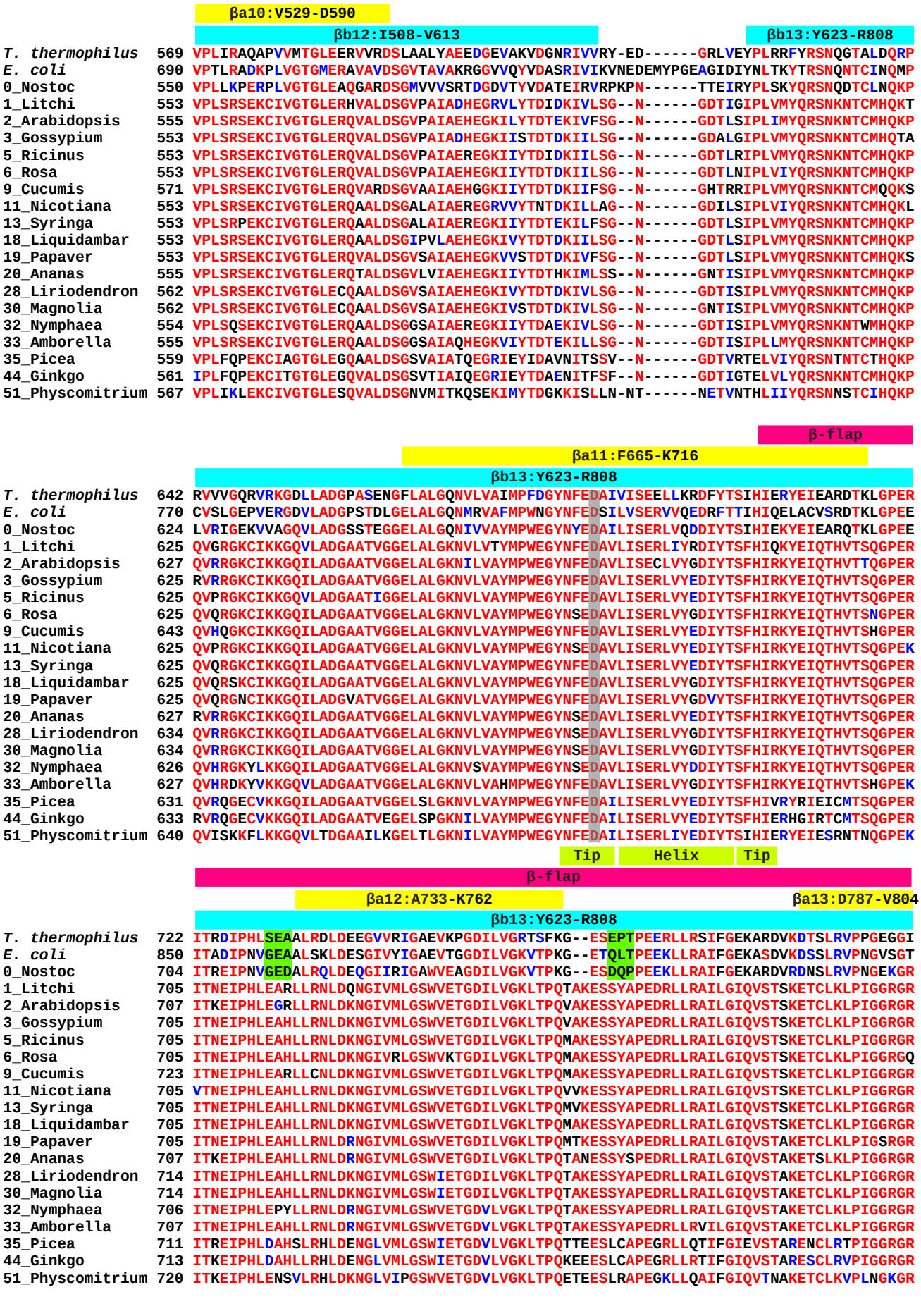
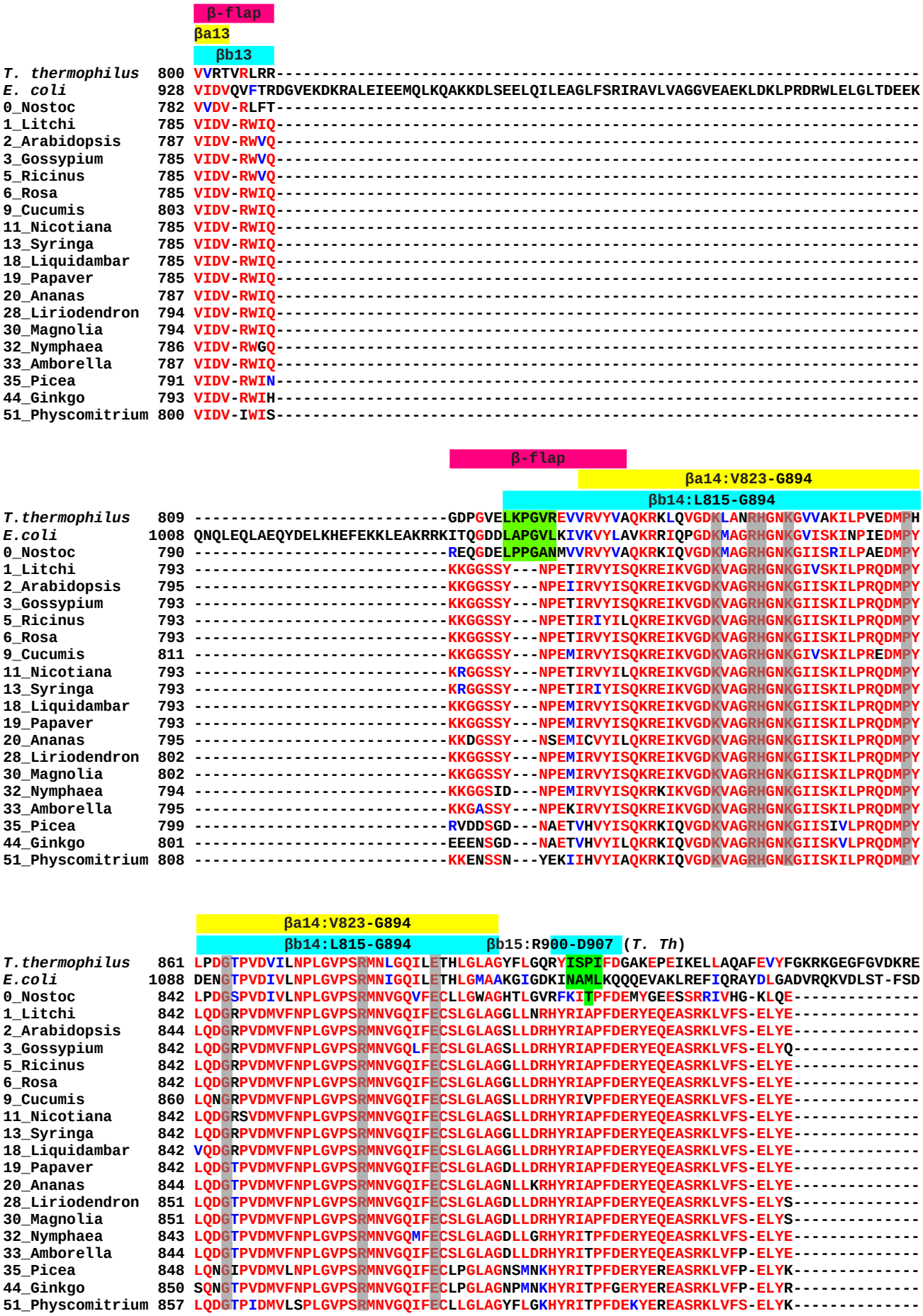

β1 domain: Q22-N130 + V336-S392
βa6:D323-V355
βa7:S375-E421
βb9:D323-M359
βb10:L367-V474
T. thermophilus 336 VGELMTDQFRVGLARLARGVRERMLMGSE--DSLTPAKLVNSRPLEAAIREFFSRSQLSQFKDETNPLSSLRHKRRISAL
E. coli 456 VGEMAENQFRVGLVRVERAVKERLSLGDL--DTLMPQDMINAKPISAAVKEFFGSSQLSQFMDQNNPLSEITHKRRISAL
0_Nostoc 314 VGELLQNQVRVGLNRLERIIRERMTVS--DAEVLTPASLVNPKPLVAAIKEFFGSSQLSQFMDQTNPLAELTHKRRLSAL
1_Litchi 317 VADLLQDQFGLALVRLENVVRGAIGGAIRHKLMPTPQNLVTSTPLTTTYDSFFGLHPLSQVLDRTNPLTQIVHGRKLSYL
2_Arabidopsis 317 VADLLQDQLGLALARLENVVKGTISGAIRHKLIPTPQNLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKLSYL
3_Gossypium 317 VADLLQDQFGLALVRLENVVRGTICGAIRHKLIPTPQNLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKLSYL
5_Ricinus 317 VADLLQDQFGLALIRLENVVRGTICGAIRHKLIPTPQTLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKSSYL
6_Rosa 317 VADLLQDQFGLALVRLENMVRGTICGAIKHKLIPTPQNLVTSTPLTTTYESFFGLHPLSQVLDQTNPLTQIVHGRKSSYL
9_Cucumis 335 VADLLQDQFGLALVRLENMVRGTICGAIRHKLIPTPQNLVTSTPLTTTFESFFGLHPLSQVLDRTNPLTQIVHGRKLSYL
11_Nicotiana 317 VADLLQDQFGLALVRLENVVRGTICGAIRHKLIPTPQNLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKLSYL
13_Syringa 317 VADLLQDQFGLALVRLENVVRGTICGAIRHKLIPTPQNLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKLSYL
18_Liquidambar 317 VADLLQDQFGLALVRLENAVRGTICGAIRHKLIPTPQNLVTSTPLTTTYEYFFGLHPLSQVLDRTNPLTQIVHGRKSSYL
19_Papaver 317 VADLLQDQFGLALVRLENVVRGTICGAIRHKFIPTPHNLVTSTPLTTTYESFFGLHPLSHVLDRTNPLTQIVHGRKLSYL
20_Ananas 317 VADLLQDQFGLALVRLENAVRGTICGAIRHKLIPTPQNLVTSTSLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKLSYL
28_Liriodendron 326 VADLLQDQFGLALVRLENAVRGTICGAIRHKLIPTPQNLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKSSYL
30_Magnolia 326 VADLLQDQFGLALVRLENAVRGTICGAIRHKLIPTPQNLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKSSYL
32_Nymphaea 318 VADLLQDQFGLALVRLENVVRGTICGAIRHKLIPTPRNLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKSSYL
33_Amborella 317 VADLLQDQFGLALVRLENVVRGTICGAIRHKFIPTPQNLVTSTPLTTTYESFFGLHPLSQVLDRTNPLTQIVHGRKSSYL
35_Picea 323 VADLLQNQFRLALGRLEDAVRRTIHRATKRR--STPQNLVTSTLLKNTFQDFFGSHPLSQFLDQTNPLTEIAHGRKLSHL
44_Ginkgo 325 VADLLQNQFGLALGRLVNSVRRTIRRATKCKCLPTPKNLVTSTPLTTTFQDFFGLHPLSQFLDQTNPLTEAVHRRKLSYL
51_Physcomitrium 331 VADLLQDQLKLALIRLENSVRQVMRRTTKRKRLLSPKNLITQTPLIATFKEFFGSHPLSQFLDQTNSLAEIVHKRRLSSL
Fork-loop 2: S411-R428
βa8:D426-Y471
βb10:L367-V474
βb11:V479-L503
T. thermophilus 414 GPGGLTRERAGFDVRDVHRTHYGRICPVETPEGANIGLITSLAAYARVDELGFIRTPYRRVVGGVVT--DEVVYMTATEE
E. coli 534 GPGGLTRERAGFEVRDVHPTHYGRVCPIETPEGPNIGLINSLSVYAQTNEYGFLETPYRKVTDGVVT--DEIHYLSAIEE
0_Nostoc 392 GPGGLTRERAGFAVRDIHPSHYGRICPIETPEGPNAGLIGSLATHARVNQYGFLETPFRPVENARVRFDLPPVYMTADE-
1_Litchi 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGYWGSLESPFYEIFEKSKK--MRMLYLSPSID
2_Arabidopsis 397 GPGGLTGRTANFRIRDIHPSHYGRICPIDTSEGINVGLIGSLSIHARIGDWGSLESPFYELFEKSKKARIRMLFLSPSQD
3_Gossypium 397 GPGGLTGRTANFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGHWGSLESPFYKIFERSKK--AQMLYLSPSRD
5_Ricinus 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHAKIGHWGSLESPFYVISEESKK--VRMFYLSPNRE
6_Rosa 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHAKIGYWGSLESPFYEISERSKK--VRMLYLSPSKD
9_Cucumis 415 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGHWGSLETPFYEISERSKK--VRMLYLSPSRD
11_Nicotiana 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGHWGSLESPFYEISERSTG--VRMLYLSPGRD
13_Syringa 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGHWGSLESPFYEISERSTG--VRMLYLSPGRD
18_Liquidambar 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGRWGSLESPFYEISERSKK--VRMLYLSPSRD
19_Papaver 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGHWGSLESPFFEIDERF--KGVRVVYLSPSRD
20_Ananas 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHVRIGHWGSIESPFYEISEKQKEKEPQMVYLSPNRD
28_Liriodendron 406 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGHWGSIESPFYEISERS--KEVQMVYLSPSRD
30_Magnolia 406 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGHWGSIESPFYEISERS--KEVQMVYLSPSRD
32_Nymphaea 398 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARVGDWGSIETPFYEISERS--KEEQMVYLSPSRD
33_Amborella 397 GPGGLTGRTASFRIRDIHPSHYGRICPIDTSEGINVGLIGSLAIHARIGDWGSIRSPFYEISERS--KEEQMVYLSPRRD
35_Picea 401 GPGGLTGRTASFRTRDIHPSYYGRICPIDTSEGMNAGLVASLSIHAKIGQCGSLQSPFYKISERSRE--EHMVYLLPGED
44_Ginkgo 405 GPGGLTRRTASFRIRDIHPSHYGRICPIETSEGINAGLVASLAIHAKIGHCGSLRSPFHKISEGSKE--EHMVYPSPGE-
51_Physcomitrium 411 GPGGVTRRTAGFQVRDIHFSHYTRICPIETSEGMNAGLIASLAIHANVNNWGFLESPFYKISKNVKE--EKIINLSAGED
βa9:Y485-A499
βa10:V529-D590
βb11:V479-L503
βb12:I508-V613
T. thermophilus 492 --DRYTIAQANTPLEGNRIAAERV-VARRKGEPVIVSPEEVEFMDVSPKQVFSVNTNLIPFLEHDDANRALMGSNMQTQA
E. coli 612 --GNYVIAQANSNLDEEGHFVEDLVTCRSKGESSLFSRDQVDYMDVSTQQVVSVGASLIPFLEHDDANRALMGANMQRQA
0_Nostoc 471 -EDDLRVAPGDIPVDENGHIIGPQVPVRYRQEFSTTTPEQVDYVAVSPVQIVSVATSMIPFLEHDDANRALMGSNMQRQA
1_Litchi 475 EYCMV--AAGNSLALSQGIQEEQVVPTRYRQEFLTIAWERVHLRSIFPSQYFSIGASLIPFIEHNDANRALMSSNMQRQA
2_Arabidopsis 477 EYYMI--AAGNSLALNRGIQEEQAVPARYRQEFLTIAWEEVHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
3_Gossypium 475 EYYMV--AAGNSLALNQGIQEEQVVPARYRQEFLTIAWEQVHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
5_Ricinus 475 EYHMV--AAGNSLALNRGVQEEQVAPARYRQEFLTIAWEQVHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
6_Rosa 475 EYYMI--AAGNSLALNRGIQEEQVVPARYRQEFLTVEWEQVHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
9_Cucumis 493 EYYMV--ATGNSLALNPGIQEEQIVPARYRQEFLTIEWEQVHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
11_Nicotiana 475 EYYMV--AAGNSLALNQDIQEEQVVPARYRQEFLTIAWEQVHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
13_Syringa 475 EYYMV--AAGNSLALNQDIQEEQVVPARYRQEFLTIAWEQVHLRSIFPFQFFSIGASLIPFIEHNDANRALMSSNMQRQA
18_Liquidambar 475 EYYMV--AAGNSLALNQGIQEEQVVPARYRQEFLTIAWEQVHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
19_Papaver 475 EYYMV--SAGNSLALNQGIQEEQVVPARYRQEYLTIAWEQIHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
20_Ananas 477 EYYMV--AAGNSLALNRGIQEEQVVPARYRQEFLTIAWEQIHLRSILPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
28_Liriodendron 484 EYYMV--AAGNSLALNWGIQEEQVVPARYRQEFLTIAWEQIHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
30_Magnolia 484 EYYMV--AAGNSLALNWGVQEEQVVPARYRQEFLTIAWEQIHLRSIFPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
32_Nymphaea 476 EYYMV--AAGNSLALTRGIQEEEVGPARYRQEFLTIAWEQIHLRNIYPFQYFSIGASLIPFIEHNDANRALMSSNMQRQA
33_Amborella 475 EYYMVMVAAGNSLALNQDIQDEQVVPARYRQEFVTIAWEHIDLRSIYPLQYFSIGASLIPFIEHNDANRALMSSNMQRQA
35_Picea 479 EDEYYRIATGNSLALNQGIQEEQITPARYRQEFIVIAWEQIHFRSIFPFQYFSVGVSLIPFLEHNDANRALMGSNMQRQA
44_Ginkgo 482 -DEYYRIATGNSLALNQGIQEEQVTPARYRQEFLAIAREQIHFRSIFPFQYFSVGVSLIPFLEHNDANRALMGSNMQRQA
51_Physcomitrium 489 --EYYRIATGNCLALDQGTQKIQITPARYRQEFLAIAWEQIHLRSIYPLQYFSVGVSLIPFLEHNDANRALMGSNMQRQA


βa10:V529-D590
βb12:I508-V613
βb13:Y623-R808
T. thermophilus 569 VPLIRAQAPVVMTGLEERVVRDSLAALYAEEDGEVAKVDGNRIVVRY-ED------GRLVEYPLRRFYRSNQGTALDQRP
E. coli 690 VPTLRADKPLVGTGMERAVAVDSGVTAVAKRGGVVQYVDASRIVIKVNEDEMYPGEAGIDIYNLTKYTRSNQNTCINQMP
0_Nostoc 550 VPLLKPERPLVGTGLEAQGARDSGMVVVSRTDGDVTYVDATEIRVRPKPN------TTEIRYPLSKYQRSNQDTCLNQKP
1_Litchi 553 VPLSRSEKCIVGTGLERHVALDSGVPAIADHEGRVLYTDIDKIVLSG--N------GDTIGIPLVMYQRSNKNTCMHQKT
2_Arabidopsis 555 VPLSRSEKCIVGTGLERQVALDSGVPAIAEHEGKILYTDTEKIVFSG--N------GDTLSIPLIMYQRSNKNTCMHQKP
3_Gossypium 553 VPLSRSEKCIVGTGLERQVALDSGVPAIADHEGKIISTDTDKIILSG--N------GDALGIPLVMYQRSNKNTCMHQTA
5_Ricinus 553 VPLSRSEKCIVGTGLERQVALDSGVPAIAEREGKIIYTDIDKIILSG--N------GDTLRIPLVMYQRSNKNTCMHQKP
6_Rosa 553 VPLSRSEKCIVGTGLERQVALDSGVPAIAEHEGKIIYTDTDKIILSG--N------GDTLNIPLVIYQRSNKNTCMHQKP
9_Cucumis 571 VPLSRSEKCIVGTGLERQVARDSGVAAIAEHGGKIIYTDTDKIIFSG--N------GHTRRIPLVMYQRSNKNTCMQQKS
11_Nicotiana 553 VPLSRSEKCIVGTGLERQAALDSGALAIAERGERVVYTNTDKILLAG--N------GDILSIPLVIYQRSNKNTCMHQKL
13_Syringa 553 VPLSRPEKCIVGTGLERQAALDSGALAIAERGEKIIYTDTEKILFSG--N------GDTLSIPLVMYQRSNKNTCMHQKP
18_Liquidambar 553 VPLSRSEKCIVGTGLERQAALDSGIPVLAEHEGKIVYTDTDKIILSG--N------GDTLSIPLVMYQRSNKNTCMHQKP
19_Papaver 553 VPLSRSEKCIVGTGLERQVALDSGVSAIAEHEGKVVSTDTDKIVFSG--N------GDTLSIPLVMYQRSNKNTCMHQKS
20_Ananas 555 VPLSRSEKCIVGTGLERQTALDSGVLVIAEHEGKIIYTDTHKIMLSS--N------GNTISIPLVMYQRSNKNTCMHQKP
28_Liriodendron 562 VPLSRSEKCIVGTGLECQAALDSGVSAIAEHEGKIVYTDTDKIVLSG--N------GDTISIPLVMYQRSNKNTCMHQKP
30_Magnolia 562 VPLSRSEKCIVGTGLECQAALDSGVSAIAEHEGKIVSTDTDKIVLSG--N------GNTISIPLVMYQRSNKNTCMHQKP
32_Nymphaea 554 VPLSQSEKCIVGTGLERQAALDSGGSAIAERGEKIIYTDAEKIVLSG--N------GDTISIPLVMYQRSNKNTWMHQKP
33_Amborella 555 VPLSRSEKCIVGTGLERQAALDSGGSAIAQHEGKVIYTDTEKILLSG--N------GDTISIPLLMYQRSNKNTCMHQKP
35_Picea 559 VPLFQPEKCIAGTGLEGQAALDSGSVAIATQEGRIEYIDAVNITSSV--N------GDTVRTELVIYQRSNTNTCTHQKP
44_Ginkgo 561 IPLFQPEKCITGTGLEGQVALDSGSVTIAIQEGRIEYTDAENITFSF--N------GDTIGTELVLYQRSNKNTCMHQKP
51_Physcomitrium 567 VPLIKLEKCIVGTGLESQVALDSGNVMITKQSEKIMYTDGKKISLLN-NT------NETVNTHLIIYQRSNNSTCIHQKP
β-flap
βa11:F665-K716
βb13:Y623-R808
T. thermophilus 642 RVVVGQRVRKGDLLADGPASENGFLALGQNVLVAIMPFDGYNFEDAIVISEELLKRDFYTSIHIERYEIEARDTKLGPER
E. coli 770 CVSLGEPVERGDVLADGPSTDLGELALGQNMRVAFMPWNGYNFEDSILVSERVVQEDRFTTIHIQELACVSRDTKLGPEE
0_Nostoc 624 LVRIGEKVVAGQVLADGSSTEGGELALGQNIVVAYMPWEGYNYEDAILISERLVQDDIYTSIHIEKYEIEARQTKLGPEE
1_Litchi 625 QVGRGKCIKKGQVLADGAATVGGELALGKNVLVTYMPWEGYNFEDAVLISERLIYRDIYTSFHIQKYEIQTHVTSQGPER
2_Arabidopsis 627 QVRRGKCIKKGQILADGAATVGGELALGKNILVAYMPWEGYNFEDAVLISECLVYGDIYTSFHIRKYEIQTHVTTQGPER
3_Gossypium 625 RVRRGKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNFEDAVLISERLVYEDIYTSFHIRKYEIQTHVTSQGPER
5_Ricinus 625 QVPRGKCIKKGQVLADGAATIGGELALGKNVLVAYMPWEGYNFEDAVLISERLVYEDIYTSFHIRKYEIQTHVTSQGPER
6_Rosa 625 QVQRGKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNSEDAVLISERLVYGDIYTSFHIRKYEIQTHVTSNGPER
9_Cucumis 643 QVHQGKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNFEDAVLISERLVYEDIYTSFHIRKYEIQTHVTSHGPER
11_Nicotiana 625 QVPRGKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNSEDAVLISERLVYEDIYTSFHIRKYEIQTHVTSQGPEK
13_Syringa 625 QVQRGKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNFEDAVLISERLVYEDIYTSFHIRKYEIQTHVTSQGPER
18_Liquidambar 625 QVQRSKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNFEDAVLISERLVYGDIYTSFHIRKYEIQTHVTSQGPER
19_Papaver 625 QVQRGNCIKKGQILADGVATVGGELALGKNVLVAYMPWEGYNFEDAVLISERLVYGDVYTSFHIRKYEIQTHVTSQGPER
20_Ananas 627 RVRRGKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNSEDAVLISERLVYEDIYTSFHIRKYEIQTHVTSQGPER
28_Liriodendron 634 QVRRGKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNSEDAVLISERLVYGDIYTSFHIRKYEIQTHVTSQGPER
30_Magnolia 634 QVRRGKCIKKGQILADGAATVGGELALGKNVLVAYMPWEGYNSEDAVLISERLVYGDIYTSFHIRKYEIQTHVTSQGPER
32_Nymphaea 626 QVHRGKYLKKGQILADGAATVGGELALGKNVSVAYMPWEGYNSEDAVLISERLVYDDIYTSFHIRKYEIQTHVTSQGPER
33_Amborella 627 QVHRDKYVKKGQVLADGAATVGGELALGKNVLVAHMPWEGYNFEDAVLISERLVYGDIYTSFHIRKYEIQTHVTSHGPEK
35_Picea 631 QVRQGECVKKGQILADGAATVGGELSLGKNVLVAYMPWEGYNFEDAILISERLVYEDIYTSFHIVRYRIEICMTSQGPER
44_Ginkgo 633 RVRQGECVKKGQILADGAATVEGELSPGKNILVAYMPWEGYNFEDAILISERLVYEDIYTSFHIERHGIRTCMTSQGPER
51_Physcomitrium 640 QVISKKFLKKGQVLTDGAAILKGELTLGKNILVAYMPWEGYNFEDAILISERLIYEDIYTSIHIERYEIESRNTNQGPEK
Tip
Helix
Tip
β-flap
βa12:A733-K762
βa13:D787-V804
βb13:Y623-R808
T. thermophilus 722 ITRDIPHLSEAALRDLDEEGVVRIGAEVKPGDILVGRTSFKG--ESEPTPEERLLRSIFGEKARDVKDTSLRVPPGEGGI
E. coli 850 ITADIPNVGEAALSKLDESGIVYIGAEVTGGDILVGKVTPKG--ETQLTPEEKLLRAIFGEKASDVKDSSLRVPNGVSGT
0_Nostoc 704 ITREIPNVGEDALRQLDEQGIIRIGAWVEAGDILVGKVTPKG--ESDQPPEEKLLRAIFGEKARDVRDNSLRVPNGEKGR
1_Litchi 705 ITNEIPHLEARLLRNLDQNGIVMLGSWVETGDILVGKLTPQTAKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGR
2_Arabidopsis 707 ITKEIPHLEGRLLRNLDKNGIVMLGSWVETGDILVGKLTPQVAKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGR
3_Gossypium 705 ITNEIPHLEAHLLRNLDKNGIVMLGSWVETGDILVGKLTPQVAKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGR
5_Ricinus 705 ITNEIPHLEAHLLRNLDKNGIVMLGSWVETGDILVGKLTPQMAKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGR
6_Rosa 705 ITNEIPHLEAHLLRNLDKNGIVRLGSWVKTGDILVGKLTPQMAKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGQ
9_Cucumis 723 ITNEIPHLEARLLCNLDKNGIVMLGSWVETGDILVGKLTPQMAKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGR
11_Nicotiana 705 VTNEIPHLEAHLLRNLDKNGIVMLGSWVETGDILVGKLTPQVVKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGR
13_Syringa 705 ITNEIPHLEAHLLRNLDKNGIVMLGSWVETGDILVGKLTPQMVKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGR
18_Liquidambar 705 ITNEIPHLEAHLLRNLDKNGIVMLGSWVETGDILVGKLTPQMAKESSYAPEDRLLRAILGIQVSTSKETCLKLPIGGRGR
19_Papaver 705 ITNEIPHLEAHLLRNLDRNGIVMLGSWVETGDILVGKLTPQMTKESSYAPEDRLLRAILGIQVSTAKETCLKLPIGSRGR
20_Ananas 707 ITKEIPHLEAHLLRNLDRNGIVMLGSWVETGDILVGKLTPQTANESSYSPEDRLLRAILGIQVSTAKETSLKLPIGGRGR
28_Liriodendron 714 ITNEIPHLEAHLLRNLDKNGIVMLGSWIETGDILVGKLTPQTAKESSYAPEDRLLRAILGIQVSTAKETCLKLPIGGRGR
30_Magnolia 714 ITNEIPHLEAHLLRNLDKNGIVMLGSWIETGDILVGKLTPQTAKESSYAPEDRLLRAILGIQVSTAKETCLKLPIGGRGR
32_Nymphaea 706 ITNEIPHLEPYLLRNLDRNGIVMLGSWVETGDVLVGKLTPQTAKESSYAPEDRLLRAILGIQVSTAKETCLKLPIGGRGR
33_Amborella 707 ITNEIPHLEAHLLRNLDRNGIVMLGSWVETGDVLVGKLTPQTAKESSYAPEDRLLRVILGIQVSTAKETCLKLPIGGRGR
35_Picea 711 ITREIPHLDAHSLRHLDENGLVMLGSWIETGDVLVGKLTPQTTEESLCAPEGRLLQTIFGIEVSTARENCLRTPIGGRGR
44_Ginkgo 713 ITKEIPHLDAHLLRHLDENGLVMLGSWIETGDVLVGKLTPQKEEESLCAPEGRLLRTIFGIQVSTARESCLRVPIGGRGR
51_Physcomitrium 720 ITKEIPHLENSVLRHLDKNGLVIPGSWVETGDVLVGKLTPQETEESLRAPEGKLLQAIFGIQVTNAKETCLKVPLNGKGR


β-flap
βa13
βb13
T. thermophilus 800 VVRTVRLRR
E. coli 928 VIDVQVFTRDGVEKDKRALEIEEMQLKQAKKDLSEELQILEAGLFSRIRAVLVAGGVEAEKLDKLPRDRWLELGLTDEEK
0_Nostoc 782 VVDV-RLFT
1_Litchi 785 VIDV-RWIQ
2_Arabidopsis 787 VIDV-RWVQ
3_Gossypium 785 VIDV-RWVQ
5_Ricinus 785 VIDV-RWVQ
6_Rosa 785 VIDV-RWIQ
9_Cucumis 803 VIDV-RWIQ
11_Nicotiana 785 VIDV-RWIQ
13_Syringa 785 VIDV-RWIQ
18_Liquidambar 785 VIDV-RWIQ
19_Papaver 785 VIDV-RWIQ
20_Ananas 787 VIDV-RWIQ
28_Liriodendron 794 VIDV-RWIQ
30_Magnolia 794 VIDV-RWIQ
32_Nymphaea 786 VIDV-RWGQ
33_Amborella 787 VIDV-RWIQ
35_Picea 791 VIDV-RWIN
44_Ginkgo 793 VIDV-RWIH
51_Physcomitrium 800 VIDV-IWIS
β-flap
βa14:V823-G894
βb14:L815-G894
T.thermophilus 809 GDPGVELKPGVREVVRVYVAQKRKLQVGDKLANRHGNKGVVAKILPVEDMPH
E.coli 1008 QNQLEQLAEQYDELKHEFEKKLEAKRRKITQGDDLAPGVLKIVKVYLAVKRRIQPGDKMAGRHGNKGVISKINPIEDMPY
0_Nostoc 790 REQGDELPPGANMVVRVYVAQKRKIQVGDKMAGRHGNKGIISRILPAEDMPY
1_Litchi 793 KKGGSSY---NPETIRVYISQKREIKVGDKVAGRHGNKGIVSKILPRQDMPY
2_Arabidopsis 795 KKGGSSY---NPEIIRVYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
3_Gossypium 793 KKGGSSY---NPETIRVYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
5_Ricinus 793 KKGGSSY---NPETIRIYILQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
6_Rosa 793 KKGGSSY---NPETIRVYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
9_Cucumis 811 KKGGSSY---NPEMIRVYISQKREIKVGDKVAGRHGNKGIVSKILPREDMPY
11_Nicotiana 793 KRGGSSY---NPETIRVYILQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
13_Syringa 793 KRGGSSY---NPETIRIYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
18_Liquidambar 793 KKGGSSY---NPEMIRVYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
19_Papaver 793 KKGGSSY---NPEMIRVYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
20_Ananas 795 KKDGSSY---NSEMICVYILQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
28_Liriodendron 802 KKGGSSY---NPEMIRVYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
30_Magnolia 802 KKGGSSY---NPEMIRVYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
32_Nymphaea 794 KKGGSID---NPEMIRVYISQKRKIKVGDKVAGRHGNKGIISKILPRQDMPY
33_Amborella 795 KKGASSY---NPEKIRVYISQKREIKVGDKVAGRHGNKGIISKILPRQDMPY
35_Picea 799 RVDDSGD---NAETVHVYISQKRKIQVGDKVAGRHGNKGIISIVLPRQDMPY
44_Ginkgo 801 EEENSGD---NAETVHVYILQKRKIQVGDKVAGRHGNKGIISKVLPRQDMPY
51_Physcomitrium 808 KKENSSN---YEKIIHVYIAQKRKIQVGDKVAGRHGNKGIISKILPRQDMPY
βa14:V823-G894
βb14:L815-G894
βb15:R900-D907 (T. Th)
T.thermophilus 861 LPDGTPVDVILNPLGVPSRMNLGQILETHLGLAGYFLGQRYISPIFDGAKEPEIKELLAQAFEVYFGKRKGEGFGVDKRE
E.coli 1088 DENGTPVDIVLNPLGVPSRMNIGQILETHLGMAAKGIGDKINAMLKQQQEVAKLREFIQRAYDLGADVRQKVDLST-FSD
0_Nostoc 842 LPDGSPVDIVLNPLGVPSRMNVGQVFECLLGWAGHTLGVRFKITPFDEMYGEESSRRIVHG-KLQE
1_Litchi 842 LQDGRPVDMVFNPLGVPSRMNVGQIFECSLGLAGGLLNRHYRIAPFDERYEQEASRKLVFS-ELYE
2_Arabidopsis 844 LQDGRPVDMVFNPLGVPSRMNVGQIFECSLGLAGSLLDRHYRIAPFDERYEQEASRKLVFS-ELYE
3_Gossypium 842 LQDGRPVDMVFNPLGVPSRMNVGQLFECSLGLAGSLLDRHYRIAPFDERYEQEASRKLVFS-ELYQ
5_Ricinus 842 LQDGRPVDMVFNPLGVPSRMNVGQIFECSLGLAGGLLDRHYRIAPFDERYEQEASRKLVFS-ELYE
6_Rosa 842 LQDGRPVDMVFNPLGVPSRMNVGQIFECSLGLAGGLLDRHYRIAPFDERYEQEASRKLVFS-ELYE
9_Cucumis 860 LQNGRPVDMVFNPLGVPSRMNVGQIFECSLGLAGSLLDRHYRIVPFDERYEQEASRKLVFS-ELYE
11_Nicotiana 842 LQDGRSVDMVFNPLGVPSRMNVGQIFECSLGLAGSLLDRHYRIAPFDERYEQEASRKLVFS-ELYE
13_Syringa 842 LQDGRPVDMVFNPLGVPSRMNVGQIFECSLGLAGGLLDRHYRIAPFDERYEQEASRKLVFS-ELYE
18_Liquidambar 842 VQDGRPVDMVFNPLGVPSRMNVGQIFECSLGLAGGLLDRHYRIAPFDERYEQEASRKLVFS-ELYE
19_Papaver 842 LQDGTPVDMVFNPLGVPSRMNVGQIFECSLGLAGDLLDRHYRIAPFDERYEQEASRKLVFS-ELYE
20_Ananas 844 LQDGTPVDMVFNPLGVPSRMNVGQIFECSLGLAGNLLKRHYRIAPFDERYEQEASRKLVFS-ELYE
28_Liriodendron 851 LQDGTPVDMVFNPLGVPSRMNVGQIFECSLGLAGDLLDRHYRIAPFDERYEQEASRKLVFS-ELYS
30_Magnolia 851 LQDGTPVDMVFNPLGVPSRMNVGQIFECSLGLAGDLLDRHYRIAPFDERYEQEASRKLVFS-ELYS
32_Nymphaea 843 LQDGTPVDMVFNPLGVPSRMNVGQMFECSLGLAGDLLGRHYRITPFDERYEQEASRKLVFS-ELYE
33_Amborella 844 LQDGTPVDMVFNPLGVPSRMNVGQIFECSLGLAGDLLDRHYRITPFDERYEQEASRKLVFP-ELYE
35_Picea 848 LQNGIPVDMVLNPLGVPSRMNVGQIFECLPGLAGNSMNKHYRITPFDERYERAASRKLVFP-ELYK
44_Ginkgo 850 SQNGTPVDMVFNPLGVPSRMNVGQIFECLPGLAGNPMNKHYRITPFGERYERAASRKLVFP-ELYR
51_Physcomitrium 857 LQDGTPIDMVLSPLGVPSRMNVGQIFECLLGLAGYFLGKHYRITPFDEKYERAASRKLVFS-ELYK

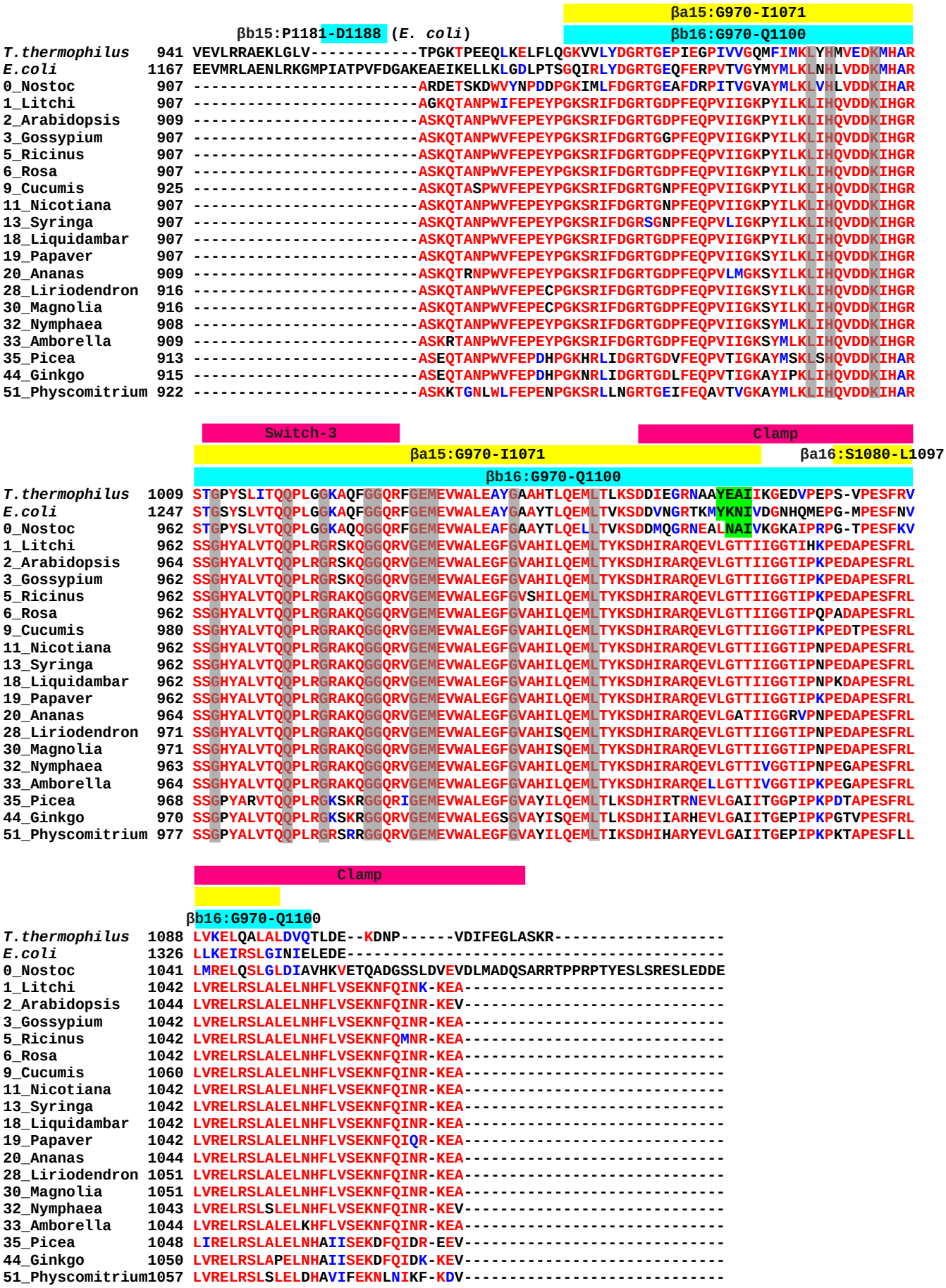
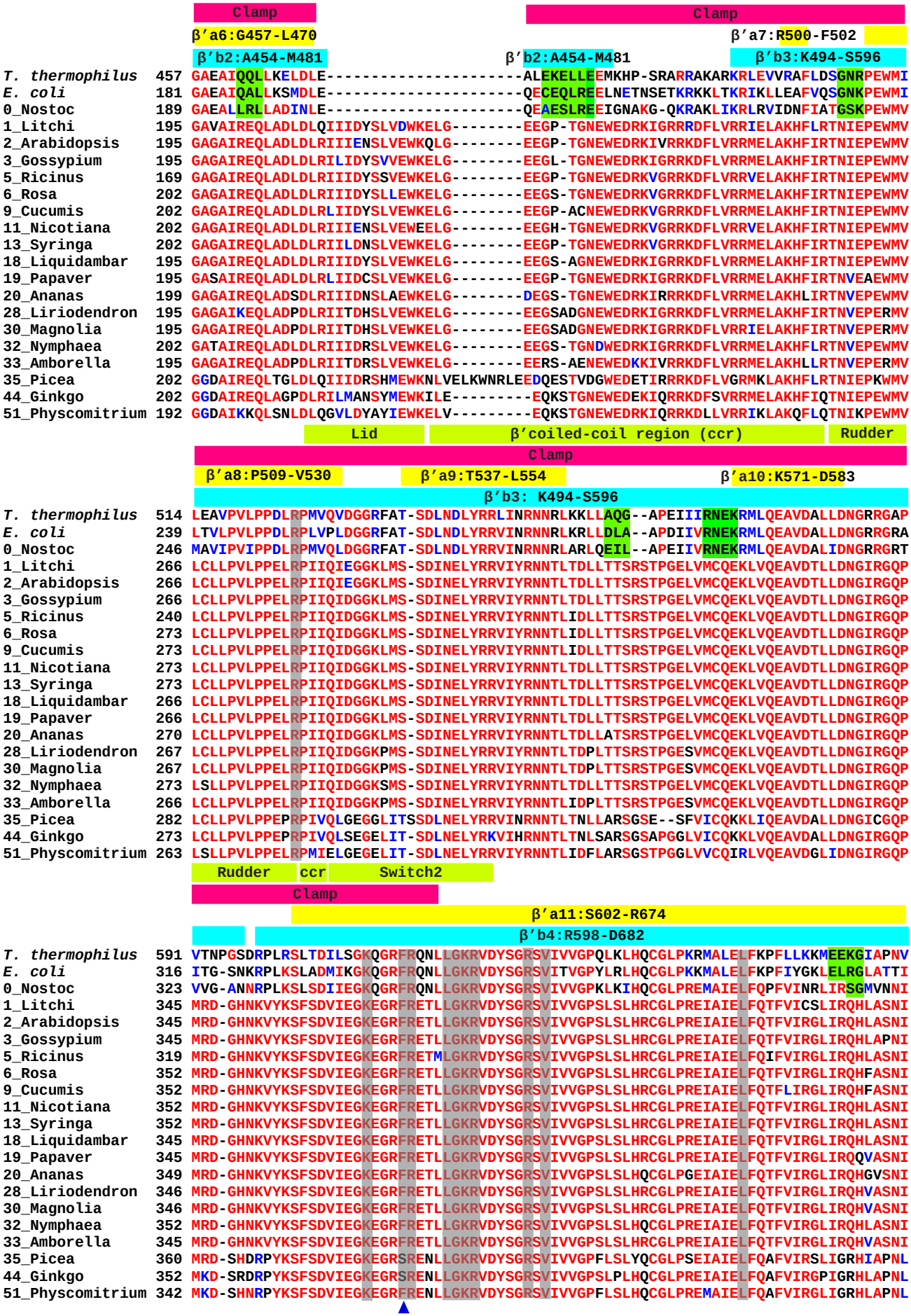

βa15:G970-I1071
βb15:P1181-D1188 (E. coli)
βb16:G970-Q1100
T.thermophilus 941 VEVLRRAEKLGLV----------TPGKTPEEQLKELFLQGKVVLYDGRTGEPIEGPIVVGQMFIMKLYHMVEDKMHAR
E.coli 1167 EEVMRLAENLRKGMPIATPVFDGAKEAEIKELLKLGDLPTSGQIRLYDGRTGEQFERPVTVGYMYMLKLNHLVDDKMHAR
0_Nostoc 907 ----------ARDETSKDWVYNPDDPGKIMLFDGRTGEAFDRPITVGVAYMLKLVHLVDDKIHAR
1_Litchi 907 ----------AGKQTANPWIFEPEYPGKSRIFDGRTGDPFEQPVIIGKPYILKLIHQVDDKIHGR
2_Arabidopsis 909 ----------ASKQTANPWVFEPEYPGKSRIFDGRTGDPFEQPVIIGKPYILKLIHQVDDKIHGR
3_Gossypium 907 ----------ASKQTANPWVFEPEYPGKSRIFDGRTGGPFEQPVIIGKPYILKLIHQVDDKIHGR
5_Ricinus 907 ----------ASKQTANPWVFEPEYPGKSRIFDGRTGDPFEQPVIIGKPYILKLIHQVDDKIHGR
6_Rosa 907 ----------ASKQTANPWVFEPEYPGKSRIFDGRTGDPFEQPVIIGKPYILKLIHQVDDKIHGR
9_Cucumis 925 ----------ASKQTASPWVFEPEYPGKSRIFDGRTGNPFEQPVIIGKPYILKLIHQVDDKIHGR
11_Nicotiana 907 ----------ASKQTANPWVFEPEYPGKSRIFDGRTGNPFEQPVIIGKPYILKLIHQVDDKIHGR
13_Syringa 907 ----------ASKQTANPWVFEPEYPGKSRIFDGRSGNPFEQPVLIGKPYILKLIHQVDDKIHGR
18_Liquidambar 907 ----------ASKQTANPWVFEPEYPGKSRIFDGRTGDPFEQPVIIGKPYILKLIHQVDDKIHGR
19_Papaver 907 ----------ASKQTANPWVFEPEYPGKSRIFDGRTGDPFEQPVIIGKSYILKLIHQVDDKIHGR
20_Ananas 909 ----------ASKQTRNPWVFEPEYPGKSRIFDGRTGDPFEQPVLMGKSYILKLIHQVDDKIHGR
28_Liriodendron 916 ----------ASKQTANPWVFEPECPGKSRIFDGRTGDPFEQPVIIGKSYILKLIHQVDDKIHGR
30_Magnolia 916 ----------ASKQTANPWVFEPECPGKSRIFDGRTGDPFEQPVIIGKSYILKLIHQVDDKIHGR
32_Nymphaea 908 ----------ASKQTANPWVFEPEYPGKSRIFDGRTGDPFEQPVIIGKSYMLKLIHQVDDKIHGR
33_Amborella 909 ----------ASKRTANPWVFEPEYPGKSRIFDGRTGDPFEQPVIIGKSYMLKLIHQVDDKIHGR
35_Picea 913 ----------ASEQTANPWVFEPDHPGKHRLIDGRTGDVFEQPVTIGKAYMSKLSHQVDDKIHAR
44_Ginkgo 915 ----------ASEQTANPWVFEPDHPGKNRLIDGRTGDLFEQPVTIGKAYIPKLIHQVDDKIHAR
51_Physcomitrium 922 ----------ASKKTGNLWLFEPENPGKSRLLNGRTGEIFEQAVTVGKAYMLKLIHQVDDKIHAR
Switch-3
Clamp
βa15:G970-I1071
βa16:S1080-L1097
βb16:G970-Q1100
T.thermophilus 1009 STGPYSLITQQPLGGKAQFGGQRFGEMEVWALEAYGAAHTLQEMLTLKSDDIEGRNAAYEAIIKGEDVPEPS-VPESFRV
E.coli 1247 STGSYSLVTQQPLGGKAQFGGQRFGEMEVWALEAYGAAYTLQEMLTVKSDDVNGRTKMYKNIVDGNHQMEPG-MPESFNV
0_Nostoc 962 STGPYSLVTQQPLGGKAQQGGQRFGEMEVWALEAFGAAYTLQELLTVKSDDMQGRNEALNAIVKGKAIPRPG-TPESFKV
1_Litchi 962 SSGHYALVTQQPLRGRSKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIHKPEDAPESFRL
2_Arabidopsis 964 SSGHYALVTQQPLRGRSKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIPKPEDAPESFRL
3_Gossypium 962 SSGHYALVTQQPLRGRSKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIPKPEDAPESFRL
5_Ricinus 962 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVSHILQEMLTYKSDHIRARQEVLGTTIIGGTIPKPEDAPESFRL
6_Rosa 962 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIPQPADAPESFRL
9_Cucumis 980 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIPKPEDTPESFRL
11_Nicotiana 962 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIPNPEDAPESFRL
13_Syringa 962 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIPNPEDAPESFRL
18_Liquidambar 962 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIPNPKDAPESFRL
19_Papaver 962 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIIGGTIPKPEDAPESFRL
20_Ananas 964 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGATIIGGRVPNPEDAPESFRL
28_Liriodendron 971 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHISQEMLTYKSDHIRARQEVLGTTIIGGTIPNPEDAPESFRL
30_Magnolia 971 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHISQEMLTYKSDHIRARQEVLGTTIIGGTIPNPEDAPESFRL
32_Nymphaea 963 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQEVLGTTIVGGTIPNPEGAPESFRL
33_Amborella 964 SSGHYALVTQQPLRGRAKQGGQRVGEMEVWALEGFGVAHILQEMLTYKSDHIRARQELLGTTIVGGTIPKPEGAPESFRL
35_Picea 968 SSGPYARVTQQPLRGKSKRGGQRIGEMEVWALEGFGVAYILQEMLTLKSDHIRTRNEVLGAIITGGPIPKPDTAPESFRL
44_Ginkgo 970 SSGPYALVTQQPLRGKSKRGGQRVGEMEVWALEGSGVAYISQEMLTLKSDHIIARHEVLGAIITGEPIPKPGTVPESFRL
51_Physcomitrium 977 SSGPYALVTQQPLRGRSRRGGQRVGEMEVWALEGFGVAYILQEMLTIKSDHIHARYEVLGAIITGEPIPKPKTAPESFLL
Clamp
βb16:G970-Q1100
T.thermophilus 1088 LVKELQALALDVQTLDE--KDNP------VDIFEGLASKR----------
E.coli 1326 LLKEIRSLGINIELEDE----------
0_Nostoc 1041 LMRELQSLGLDIAVHKVETQADGSSLDVEVDLMADQSARRTPPRPTYESLSRESLEDDE
1_Litchi 1042 LVRELRSLALELNHFLVSEKNFQINK-KEA----------
2_Arabidopsis 1044 LVRELRSLALELNHFLVSEKNFQINR-KEV----------
3_Gossypium 1042 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
5_Ricinus 1042 LVRELRSLALELNHFLVSEKNFQMNR-KEA----------
6_Rosa 1042 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
9_Cucumis 1060 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
11_Nicotiana 1042 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
13_Syringa 1042 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
18_Liquidambar 1042 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
19_Papaver 1042 LVRELRSLALELNHFLVSEKNFQIQR-KEA----------
20_Ananas 1044 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
28_Liriodendron 1051 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
30_Magnolia 1051 LVRELRSLALELNHFLVSEKNFQINR-KEA----------
32_Nymphaea 1043 LVRELRSLSLELNHFLVSEKNFQINR-KEV----------
33_Amborella 1044 LVRELRSLALELKHFLVSEKNFQINR-KEA----------
35_Picea 1048 LIRELRSLALELNHAIISEKDFQIDR-EEV----------
44_Ginkgo 1050 LVRELRSLAPELNHAIISEKDFQIDK-KEV----------
51_Physcomitrium 1057 LVRELRSLSLELDHAVIFEKNLNIKF-KDV----------

Figure S4: sequence alignment of the β' subunits from PEP of angiosperms with those of the RNAPs from *E. coli*, *T. thermophilus* and Nostoc. The residues conserved more than 50 % are in red, those mutated in similar residues are in blue. The strictly conserved residues described by Lane & Darst (Lane & Darst, 2010) are highlighted in gray. The blue triangles show mutations observed among the strictly conserved residues described (Lane & Darst, 2010). The non-conservative mutations, at least three in a row in the β or β' domain in *E. coli* and *T. thermophilus*, are highlighted in green and displayed on the *E. coli* structure (PDB entry: 6GH5). Those colored in orange are nearby to the DNA, those in green are located at the surface of the subunits. The domains described for all-RNA polymerase (a) and the bRNAPs (b) are also given and highlighted in yellow and cyan respectively. The name of the RNAP domains are also given and highlighted in purple and green (Lane & Darst, 2010; Sutherland & Murakami, 2018).

```
                                        Clamp                         Zipper          Clamp
                              β'a1:S14-S22                       β'a2:D42-G51
                                           β'b1:A13-L135
T. thermophilus    1 ------------MKKEVRKVRIALASPEKIRSWS---------YGEVEKPETINYRTLKPERDGLFDERIFGPIKDYECA
E. coli            1 MKDLLKFLKAQTKTEEFDAIKIALASPDMIRSWS---------FGEVKKPETINYRTFKPERDGLFCARIFGPVKDYECL
0_Nostoc           1 --------MRPAQTNQFDYVKIGLASPERIRQWGERTLPNGQVVGEVTKPETINYRTLKPEMDGLFCERIFGPAKDWECH
1_Litchi           1 -------MI---DRYKHQQLRIGSVSPQQISAWTKKILPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
2_Arabidopsis      1 -------MI---DRYKHQQLRIGLVSPQQISAWATKIIPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
3_Gossypium        1 -------MI---DRYKHQQLRIGSVSPQQISAWAKKILPNGETVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
5_Ricinus          1 -------MI---DRYKHQQLRIGSVSPQQISAWAKKILPNGEIVGEVTKPYTFHYKTNKPEKGGLFCERIFGPIKSGICA
6_Rosa             1 MNQNFSSMI---DRYKHQQLRIGLVSPQQISAWAQKILPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
9_Cucumis          1 MNQKIFSMI---DRYKHQQLRIGLVSPQQISAWANKTLPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
11_Nicotiana       1 MNNNFSSMI---DRYKHQQLRIGSVSPQQISAWATKILPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
13_Syringa         1 MNQNFSSMI---DRYKHQQLRIGLVSPQQISAWATKILPNGEIVGEVIKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
18_Liquidambar     1 -------MI---DRYKHQQLRIGSVSPQQISAWANKILPNGEIVGEVTKPYTFHYKTNKPEKGGLFCERIFGPIKSGICA
19_Papaver         1 -------MI---DQYKHQHLRIGSVSPEQISAWAKKILPNGEVVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
20_Ananas          1 -------MI---DQYKHQQLRIGPVSPQQIKAWANKILPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERISGPIKSGICA
28_Liriodendron    1 -------MI---DRYKHQQLRIGSVSPQQISAWANKILPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
30_Magnolia        1 -------MI---DRYKHQQLRIGSVSPQQISAWANKILPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
32_Nymphaea        1 MNQNFSSMI---DQYKHQQLRIGLVSPKQIRAWANKILPNGEIVGEVTKPYTFHYKTNKPEKDGLFCERIFGPIKSGICA
33_Amborella       1 -------MI---DRYKHQQLRIGLVSPQQITAWANKILPNGEMVGEVTKPYTFHYKSNKPEKDGLFCERIFGPIKSGICA
35_Picea           1 -------MI---DQNKHQQLRIGLASPEQICAWSEKILPNGEIVGQVTKPYTLHYETNKPERDGSFCERIFGPIKSRVCS
44_Ginkgo          1 MNRNLSFTI---ARDKHQQLRIGLASPEKICAWSEKILPNGEIVGQVTKPHTSHYKTNEPEKDGLFCERIFGPIKSGVCA
51_Physcomitrium   1 -------MI---HREKYHHLRIRLASPEQIRSWAERVLPNGEIVGQVTKPYTLHYKTHKPEKDGLFCERIFGPIKSGICA

                                        β'a1-a6; clamp
β'a3:C58-G61                          β'a4:R89-V105       β'a5:S110-Y128
                                           β'b1:A13-L135
T. thermophilus   60 CGKYKRQR---FEGKVCERCGVEVTKSIVRRYRMGHIELATPAAHIWFVKDVPSKIGTLLDLSATELEQVLYFSKYIVLD
E. coli           72 CGKYKRLK---HRGVICEKCGVEVTQTKVRRERMGHIELASPTAHIWFLKSLPSRIGLLLDMPLRDIERVLYFESYVVIE
0_Nostoc          73 CGKYKRVR---HRGIVCERCGVEVTESRVRRHRMGYIKLAAPVAHVWYLKGIPSYISILLDMPLRDVEQIVYFNSYVVLS
1_Litchi          71 CGNYRVIGDEKEDPQFCEQCGVEFVNSRIRRYQMGYIKLGCPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
2_Arabidopsis     71 CGNYRVIGDEKEDPKFCEQCGVEFVDSRIRRYQMGYIKLTCPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
3_Gossypium       71 CGNYRVIGNQKEGPKFCEQCGVEFVDSRIRRYQMGYIRLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
5_Ricinus         71 CGNYRVIRNEKEDQKFCEQCGVEFVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----V-
6_Rosa            78 CGNYRVIGDEKKDPRFCEQCGVEFVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
9_Cucumis         78 CGNYRVIGDKKEDSKFCEQCGVEFVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
11_Nicotiana      78 CGNYRVIGDEKEDPKFCEQCGVEFVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
13_Syringa        78 CGNYRVIGDEKEDPKFCEQCGVEFVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
18_Liquidambar    71 CGNYRVIGDEKEDPKFCEQCGVEFVDSRVRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
19_Papaver        71 CGNYRVIGDEKEDPKFCEQCGVEFVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----VS
20_Ananas         71 CGNYRVIRAEKEDPKFCEQCGVEFVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKQLEGLVYCDVYLDFS
28_Liriodendron   71 CGNYRVIGNEKEDPKFCEQCGVEFVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIASLLDKPLKELEGLVYCD----FS
30_Magnolia       71 CGNYRVIGNEKEDPKFCEQCGVEFVDSRIRRYQMGYTKLACPVTHVWYLKRLPSYIASLLDKPLKELEGLVYCD----FS
32_Nymphaea       78 CGNYRVIGGEKEEPKFCEQCGVESVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLLDKPLKELEGLVYCD----FS
33_Amborella      71 CGNYRVIGDEKEDPKFCEQCGVESVDSRIRRYQMGYIKLACPVTHVWYLKRLPSYIANLSDRPLKELEGLVYCD----FS
35_Picea          71 CGNSPGIGNEKIDSKFCTQCGVEFVDSRIRRYRMGYIKLACPVAHIWYLKRLPSYIANLLAKTRKELEGPVYCDLF----
44_Ginkgo         78 CGNSRVIRNEKEDSKFCEQCGVEFVDSRSRRYRMGYIKLACPVVHVWYSKRLPSYIANLLAKPLKELEGPVYCDLF----
51_Physcomitrium  71 CGKYQIIE---KYSKFCEQCGVEFVESRVRRYRMGYIKLACPVTHVWYLKRLPSYIANLLAKPLKELESLVYCDLF----

                        Clamp
T. thermophilus  137 PKGAILNGVPVEKRQLLTDEEYRELRYGKQETYPLPPGVDALVKDGEEVVKGQELAPGVVSRLDGVALYRFPRRVRVEYV
E. coli          149 GGMT-----NLERQQILTEEQYLDAL------------------------------------------------------
0_Nostoc         150 AGNAE----TLTYKQLLSEDQWLEIE------------------------------------------------------
1_Litchi         147 FARPIAKKPTFLRLRGLF-------EY-----------------------------------------------------
2_Arabidopsis    147 FARPITKKPTFLRLRGSF-------EY-----------------------------------------------------
3_Gossypium      147 FARPIAKKPTFLRLRGSF-------EY-----------------------------------------------------
5_Ricinus        146 --------------------------------------------------------------------------------
6_Rosa           154 FARPIAKKPTFLRLRGSF-------EY-----------------------------------------------------
9_Cucumis        154 FARPIAKKPTFLRLRGSF-------EY-----------------------------------------------------
11_Nicotiana     154 FARPITKKPTFLRLRGLF-------EY-----------------------------------------------------
13_Syringa       154 FARPITKKPTFLRLRGLF-------EY-----------------------------------------------------
18_Liquidambar   147 FARPIAKKPTFLRLRGSF-------EY-----------------------------------------------------
19_Papaver       147 FARTVAKKPTFLRLRGSF-------EY-----------------------------------------------------
20_Ananas        151 FARPIAKKPTFLRLRGSF-------EY-----------------------------------------------------
28_Liriodendron  147 FARPIAKKPTFLRLRGSF-------ES-----------------------------------------------------
30_Magnolia      147 FARPIAKKPTFLRLRGSF-------ES-----------------------------------------------------
32_Nymphaea      154 FARPIAKKPTFLRLRGSF-------EY-----------------------------------------------------
33_Amborella     147 FARPIAKKPTFLRLRGSF-------EY-----------------------------------------------------
35_Picea         147 IARPIANKPTLLRSRGTF-------NY-----------------------------------------------------
44_Ginkgo        154 IARPIANKPTSLRSRGTF-------KY-----------------------------------------------------
51_Physcomitrium 144 LARPISKKPILLKLRGLF-------KY-----------------------------------------------------
```

```
T. thermophilus   217 KKERAGLRLPLAAWVEKEAYKPGEILAELPEPYLFRAEEEGVVELKELEEGAFLVLRREDEPVATYFLPVGMTPLVVHGE
E. coli           170 ------------------------------------------------------------------------------
0_Nostoc          172 ------------------------------------------------------------------------------
1_Litchi          167 ---------EIQSWKYSI-------------PLFFTT--------------------------------QGFD-------
2_Arabidopsis     167 ---------EIQSWKYSI-------------PLFFTT--------------------------------QGFD-------
3_Gossypium       167 ---------EIQSWKYSI-------------PLFFTT--------------------------------QGFD-------
5_Ricinus         146 -------------KYSI-------------PLFFTA--------------------------------QGFD-------
6_Rosa            174 ---------EIQSWKYSI-------------PLFFTT--------------------------------PGFD-------
9_Cucumis         174 ---------EIQSWKYSI-------------PLFFTT--------------------------------QGFD-------
11_Nicotiana      174 ---------EIQSWKYSI-------------PLFFTT--------------------------------QGFD-------
13_Syringa        174 ---------EIQSWKYSI-------------PLFFTT--------------------------------QGFD-------
18_Liquidambar    167 ---------EIQSWKYSI-------------PLFFTT--------------------------------QGFD-------
19_Papaver        167 ---------EIQSWKYSI-------------PLFFTT--------------------------------QGFD-------
20_Ananas         171 ---------EIQSRNYSI-------------PLFFTT--------------------------------SGFE-------
28_Liriodendron   167 ---------EIQSRKYSI-------------PLFFTT--------------------------------QDFD-------
30_Magnolia       167 ---------EIQSRKYSI-------------PLFFTT--------------------------------QGFD-------
32_Nymphaea       174 ---------EIQSRKYSI-------------PLFFTT--------------------------------QGFD-------
33_Amborella      167 ---------EIQSRKYSI-------------PLFFTT--------------------------------QCFN-------
35_Picea          167 ---------EIQSWRDII-------------PHYLSAR------------------------SHYLFARGSG-------
44_Ginkgo         174 ---------DIQSWGDIL-------------PHYLSA--------------------------------QGFG-------
51_Physcomitrium  164 ---------EDQSWREIF-------------PRYFSS--------------------------------RGFE-------

T. thermophilus   297 IVEKGQPLAEAKGLLRMPRQVRAAQVEAEEEGETVYLTLFLEWTEPKDYRVQPHMNVVVPEGARVEAGDKIVAAIDPEEE
E. coli           170 ----------------------------------------------------------------------------EE
0_Nostoc          172 ----------------------------------------------------------------------------DQ
1_Litchi          186 ------------------------------------------------------------------------------
2_Arabidopsis     186 ------------------------------------------------------------------------------
3_Gossypium       186 ------------------------------------------------------------------------------
5_Ricinus         160 ------------------------------------------------------------------------------
6_Rosa            193 ------------------------------------------------------------------------------
9_Cucumis         193 ------------------------------------------------------------------------------
11_Nicotiana      193 ------------------------------------------------------------------------------
13_Syringa        193 ------------------------------------------------------------------------------
18_Liquidambar    186 ------------------------------------------------------------------------------
19_Papaver        186 ------------------------------------------------------------------------------
20_Ananas         190 ------------------------------------------------------------------------------
28_Liriodendron   186 ------------------------------------------------------------------------------
30_Magnolia       186 ------------------------------------------------------------------------------
32_Nymphaea       193 ------------------------------------------------------------------------------
33_Amborella      186 ------------------------------------------------------------------------------
35_Picea          193 ------------------------------------------------------------------------------
44_Ginkgo         193 ------------------------------------------------------------------------------
51_Physcomitrium  183 ------------------------------------------------------------------------------

T. thermophilus   377 VIAEAEGVVHLHEPASILVVKARVYPFEDDVEVSTGDRVAPGDVLADGGKVKSDVYGRVEVDLVRNVVRVVESYDIDARM
E. coli           172 ----------------------F-----------------------------------------------GDEFDAKM
0_Nostoc          174 ----------------------IYS-E---------------------------------------DSVLQGVEVGI
1_Litchi          186 ------------------------TFR-----------------------------------------------NREIST
2_Arabidopsis     186 ------------------------IFR-----------------------------------------------NREIST
3_Gossypium       186 ------------------------TFR-----------------------------------------------SREIST
5_Ricinus         160 ------------------------TFR-----------------------------------------------NREIST
6_Rosa            193 ------------------------TFR-----------------------------------------------NREIST
9_Cucumis         193 ------------------------TFR-----------------------------------------------NREIST
11_Nicotiana      193 ------------------------TFR-----------------------------------------------NREIST
13_Syringa        193 ------------------------TFR-----------------------------------------------NREIST
18_Liquidambar    186 ------------------------TFR-----------------------------------------------NREIST
19_Papaver        186 ------------------------TFR-----------------------------------------------NREIST
20_Ananas         190 ------------------------TFR-----------------------------------------------NREIST
28_Liriodendron   186 ------------------------TFR-----------------------------------------------NREIST
30_Magnolia       186 ------------------------TFR-----------------------------------------------NREIST
32_Nymphaea       193 ------------------------TFR-----------------------------------------------NREIST
33_Amborella      186 ------------------------LFR-----------------------------------------------NREIST
35_Picea          193 ------------------------TFQ-----------------------------------------------EREIAT
44_Ginkgo         193 ------------------------AFQ-----------------------------------------------NREIAT
51_Physcomitrium  183 ------------------------AFQ-----------------------------------------------NKEIAT
```


Clamp
Clamp
β'a6:G457-L470
β'a7:R500-F502
β'b2:A454-M481
β'b2:A454-M481
β'b3:K494-S596
T. thermophilus 457 GAEAIQQLLKELDLE----------ALEKELLEEMKHP-SRARRAKARKRLEVVRAFLDSGNRPEWMI
E. coli 181 GAEAIQALLKSMDLE----------QECEQLREELNETNSETKRKKLTKRIKLLEAFVQSGNKPEWMI
0_Nostoc 189 GAEALLRLLADINLE----------QEAESLREEIGNAKG-QKRAKLIKRLRVIDNFIATGSKPEWMV
1_Litchi 195 GAVAIREQLADLDLQIIIDYSLVDWKELG--------EEGP-TGNEWEDRKIGRRRDFLVRRIELAKHFLRTNIEPEWMV
2_Arabidopsis 195 GAGAIREQLADLDLRIIIENSLVEWKQLG--------EEGP-TGNEWEDRKIVRRKDFLVRRMELAKHFIRTNIEPEWMV
3_Gossypium 195 GAGAIREQLADLDLRILIDYSVVEWKELG--------EEGL-TGNEWEDRKIGRRKDFLVRRMELAKHFIRTNIEPEWMV
5_Ricinus 169 GAGAIREQLADLDLRIIIDYSSVEWKELG--------EEGP-TGNEWEDRKVGRRKDFLVRRVELAKHFIRTNIEPEWMV
6_Rosa 202 GAGAIREQLADLDLRIIIDYSLLEWKELG--------EEGS-TGNEWEDRKVGRRKDFLVRRMELAKHFIRTNIEPEWMV
9_Cucumis 202 GAGAIREQLADLDLRLIIDYSLVEWKELG--------EEGP-ACNEWEDRKVGRRKDFLVRRMELAKHFIRTNIEPEWMV
11_Nicotiana 202 GAGAIREQLADLDLRIIIENSLVEWEELG--------EEGH-TGNEWEDRKVGRRKDFLVRRVELAKHFIRTNIEPEWMV
13_Syringa 202 GAGAIREQLADLDLRIILDNSLVEWKELG--------EEGP-TGNEWEDRKVGRRKDFLVRRMELAKHFIRTNIEPEWMV
18_Liquidambar 195 GAGAIREQLADLDLRIIIDYSLVEWKELG--------EEGS-AGNEWEDRKIGRRKDFLVRRMELAKHFIRTNIEPEWMV
19_Papaver 195 GASAIREQLADLDLRLIIDCSLVEWKELG--------EEGP-TGNEWEDRKIGRRKDFLVRRMELAKHFIRTNVEAEWMV
20_Ananas 199 GAGAIREQLADSDLRIIIDNSLAEWKELG--------DEGS-TGNEWEDRKIRRKDFLVRRMELAKHLIRTNVEPEWMV
28_Liriodendron 195 GAGAIKEQLADPDLRIITDHSLVEWKELG--------EEGSADGNEWEDRKIGRRKDFLVRRMELAKHFIRTNVEPERMV
30_Magnolia 195 GAGAIREQLADPDLRIITDHSLVEWKELG--------EEGSADGNEWEDRKIGRRKDFLVRRIELAKHFIRTNVEPERMV
32_Nymphaea 202 GATAIREQLADLDLRIIIDRSLVEWKELG--------EEGS-TGNDWEDRKIGRRKDFLVRRMELAKHFLRTNVEPEWMV
33_Amborella 195 GAGAIREQLADPDLRIITDRSLVEWKELG--------EERS-AENEWEDKKIVRRKDFLVRRMELAKHLLRTNVEPERMV
35_Picea 202 GGDAIREQLTGLDLQIIIDRSHMEWKNLVELKWNRLEEDQESTVDGWEDETIRRRKDFLVGRMKLAKHFLRTNIEPKWMV
44_Ginkgo 202 GGDAIREQLAGPDLRILMANSYMEWKILE---------EQKSTGNEWEDEKIQRRKDFSVRRMELAKHFIQTNIEPEWMV
51_Physcomitrium 192 GGDAIKKQLSNLDLQGVLDYAYIEWKELV---------EQKSTGNEWEDRKIQRRKDLLVRRIKLAKQFLQTNIKPEWMV
Lid
β'coiled-coil region (ccr)
Rudder
Clamp
β'a8:P509-V530
β'a9:T537-L554
β'a10:K571-D583
β'b3: K494-S596
T. thermophilus 514 LEAVPVLPPDLRPMVQVDGGRFAT-SDLNDLYRRLINRNNRLKKLLAQG--APEIIIRNEKRMLQEAVDALLDNGRRGAP
E. coli 239 LTVLPVLPPDLRPLVPLDGGRFAT-SDLNDLYRRVINRNNRLKRLLDLA--APDIIVRNEKRMLQEAVDALLDNGRRGRA
0_Nostoc 246 MAVIPVIPPDLRPMVQLDGGRFAT-SDLNDLYRRVINRNNRLARLQEIL--APEIIVRNEKRMLQEAVDALIDNGRRGRT
1_Litchi 266 LCLLPVLPPELRPIIQIEGGKLMS-SDINELYRRVIYRNNTLTDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
2_Arabidopsis 266 LCLLPVLPPELRPIIQIEGGKLMS-SDINELYRRVIYRNNTLTDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
3_Gossypium 266 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLTDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
5_Ricinus 240 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLIDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
6_Rosa 273 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLIDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
9_Cucumis 273 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLIDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
11_Nicotiana 273 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLTDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
13_Syringa 273 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLTDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
18_Liquidambar 266 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLTDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
19_Papaver 266 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLTDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
20_Ananas 270 LCLLPVLPPELRPIIQIDGGKLMS-SDINELYRRVIYRNNTLTDLLATSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
28_Liriodendron 267 LCLLPVLPPELRPIIQIDGGKPMS-SDINELYRRVIYRNNTLTDPLTTSRSTPGESVMCQEKLVQEAVDTLLDNGIRGQP
30_Magnolia 267 LCLLPVLPPELRPIIQIDGGKPMS-SDINELYRRVIYRNNTLTDPLTTSRSTPGESVMCQEKLVQEAVDTLLDNGIRGQP
32_Nymphaea 273 LSLLPVLPPELRPIIQIDGGKSMS-SDINELYRRVIYRNNTLTDLLTTSRSTPGELVMCQEKLVQEAVDTLLDNGIRGQP
33_Amborella 266 LCLLPVLPPELRPIIQIDGGKPMS-SDINELYRRVIYRNNTLIDPLTTSRSTPGESVMCQEKLVQEAVDTLLDNGIRGQP
35_Picea 282 LCLLPVLPPEPRPIVQLGEGGLITSSDLNELYRRVINRNNTLTNLLARSGSE--SFVICQKKLIQEAVDALLDNGICGQP
44_Ginkgo 273 LCLLPVLPPEPRPIVQLSEGELIT-SDLNELYRKVIHRNNTLTNLSARSGSAPGGLVICQKKLVQEAVDALLDNGIRGQP
51_Physcomitrium 263 LSLLPVLPPELRPMIELGEGELIT-SDLNELYRRVIYRNNTLIDFLARSGSTPGGLVVCQIRLVQEAVDGLIDNGIRGQP
Rudder
ccr
Switch2
Clamp
β'a11:S602-R674
β'b4:R598-D682
T. thermophilus 591 VTNPGSDRPLRSLTDILSGKQGRFRQNLLGKRVDYSGRSVIVVGPQLKLHQCGLPKRMALELFKPFLLKKMEEKGIAPNV
E. coli 316 ITG-SNKRPLKSLADMIKGKQGRFRQNLLGKRVDYSGRSVITVGPYLRLHQCGLPKKMALELFKPFIYGKLELRGLATTI
0_Nostoc 323 VVG-ANNRPLKSLSDIIEGKQGRFRQNLLGKRVDYSGRSVIVVGPKLKIHQCGLPREMAIELFQPFVINRLIRSGMVNNI
1_Litchi 345 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVICSLIRQHLASNI
2_Arabidopsis 345 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHLASNI
3_Gossypium 345 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHLAPNI
5_Ricinus 319 MRD-GHNKVYKSFSDVIEGKEGRFRETMLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQIFVIRGLIRQHLASNI
6_Rosa 352 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHFASNI
9_Cucumis 352 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFLIRGLIRQHFASNI
11_Nicotiana 352 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHLASNI
13_Syringa 352 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHLASNI
18_Liquidambar 345 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHLASNI
19_Papaver 345 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQQVASNI
20_Ananas 349 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHQCGLPGEIAIELFQTFVIRGLIRQHGVSNI
28_Liriodendron 346 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHVASNI
30_Magnolia 346 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHVASNI
32_Nymphaea 352 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHQCGLPREIAIELFQTFVIRGLIRQHLASNI
33_Amborella 345 MRD-GHNKVYKSFSDVIEGKEGRFRETLLGKRVDYSGRSVIVVGPSLSLHRCGLPREIAIELFQTFVIRGLIRQHVASNI
35_Picea 360 MRD-SHDRPYKSFSDVIEGKEGRSRENLLGKRVDYSGRSVIVVGPFLSLYQCGLPSEIAIELFQAFVIRSLIGRHIAPNL
44_Ginkgo 352 MKD-SRDRPYKSFSDVIEGKEGRSRENLLGKRVDYSGRSVIVVGPSLPLHQCGLPREIAIELFQAFVIRGPIGRHLAPNL
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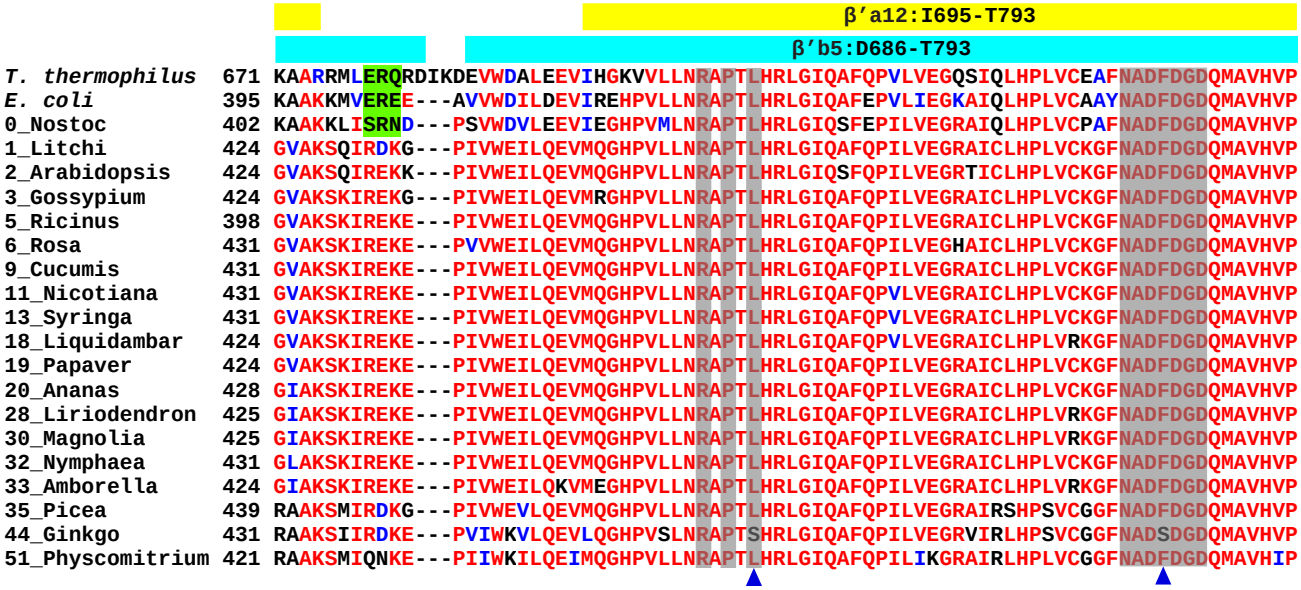
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β’b5:D686-T793
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E. coli 395 KAAKKMVEREE---AVVWDILDEVIREHPVLLNRAPTLHRLGIQAFEPVLIEGKAIQLHPLVCAAYNADFDGDQMAVHVP
0_Nostoc 402 KAAKKLISRND---PSVWDVLEEVIEGHPVMLNRAPTLHRLGIQSFEPILVEGRAIQLHPLVCPAFNADFDGDQMAVHVP
1_Litchi 424 GVAKSQIRDKG---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVCKGFNADFDGDQMAVHVP
2_Arabidopsis 424 GVAKSQIREKK---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQSFQPILVEGRTICLHPLVCKGFNADFDGDQMAVHVP
3_Gossypium 424 GVAKSKIREKG---PIVWEILQEVMRGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVCKGFNADFDGDQMAVHVP
5_Ricinus 398 GVAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVCKGFNADFDGDQMAVHVP
6_Rosa 431 GVAKSKIREKE---PVVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGHAICLHPLVCKGFNADFDGDQMAVHVP
9_Cucumis 431 GVAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVCKGFNADFDGDQMAVHVP
11_Nicotiana 431 GVAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPVLVEGRAICLHPLVCKGFNADFDGDQMAVHVP
13_Syringa 431 GVAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPVLVEGRAICLHPLVCKGFNADFDGDQMAVHVP
18_Liquidambar 424 GVAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPVLVEGRAICLHPLVRKGFNADFDGDQMAVHVP
19_Papaver 424 GVAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVCKGFNADFDGDQMAVHVP
20_Ananas 428 GIAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVCKGFNADFDGDQMAVHVP
28_Liriodendron 425 GIAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVRKGFNADFDGDQMAVHVP
30_Magnolia 425 GIAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVRKGFNADFDGDQMAVHVP
32_Nymphaea 431 GLAKSKIREKE---PIVWEILQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVCKGFNADFDGDQMAVHVP
33_Amborella 424 GIAKSKIREKE---PIVWEILQKVMEGHPVLLNRAPTLHRLGIQAFQPILVEGRAICLHPLVRKGFNADFDGDQMAVHVP
35_Picea 439 RAAKSMIRDKG---PIVWEVLQEVMQGHPVLLNRAPTLHRLGIQAFQPILVEGRAIRSHPSVCGGFNADFDGDQMAVHVP
44_Ginkgo 431 RAAKSIIRDKE---PVIWKVLQEVLQGHPVSLNRAPTSHRLGIQAFQPILVEGRVIRLHPSVCGGFNADSDGDQMAVHVP
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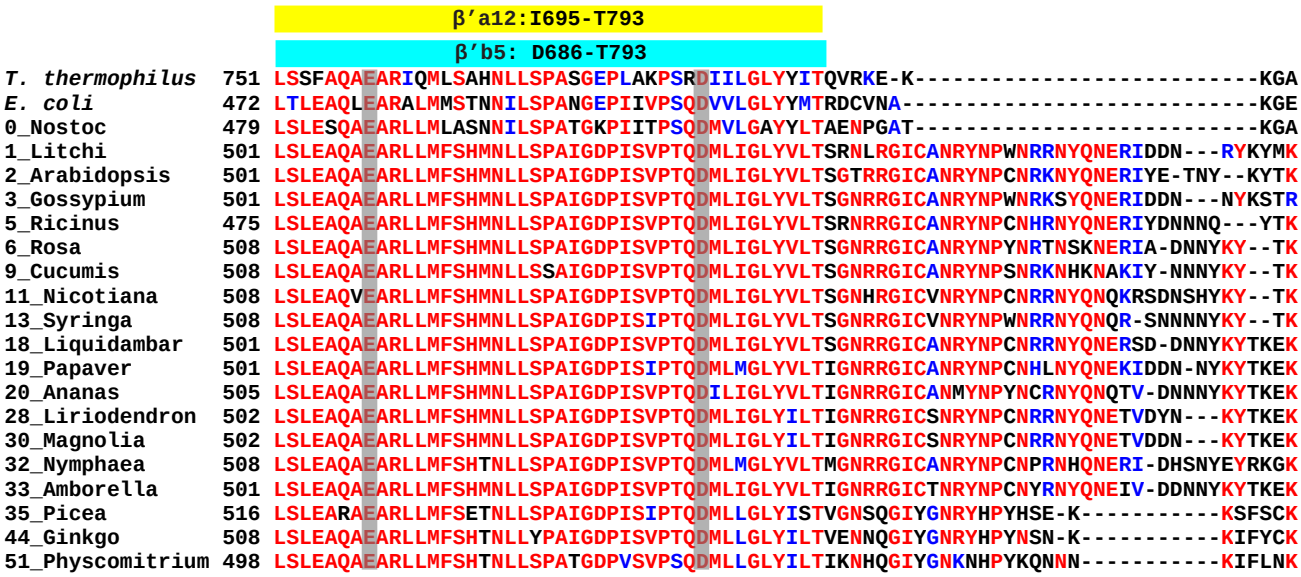
β’a12:I695-T793
β’b5: D686-T793
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E. coli 472 LTLEAQLEARALMMSTNNILSPANGEPIIVPSQDVVLGLYYMTRDCVNA----------KGE
0_Nostoc 479 LSLESQAEARLLMLASNNILSPATGKPIITPSQDMVLGAYYLTAENPGAT----------KGA
1_Litchi 501 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYVLTSRNLRGICANRYNPWNRRNYQNERIDDN---RYKYMK
2_Arabidopsis 501 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYVLTSGTRRGICANRYNPCNRKNYQNERIYE-TNY--KYTK
3_Gossypium 501 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYVLTSGNRRGICANRYNPWNRKSYQNERIDDN---NYKSTR
5_Ricinus 475 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYVLTSRNRRGICANRYNPCNHRNYQNERIYDNNNQ---YTK
6_Rosa 508 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYVLTSGNRRGICANRYNPYNRTNSKNERIA-DNNYKY--TK
9_Cucumis 508 LSLEAQAEARLLMFSHMNLLSSAIGDPISVPTQDMLIGLYVLTSGNRRGICANRYNPSNRKNHKNAKIY-NNNYKY--TK
11_Nicotiana 508 LSLEAQVEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYVLTSGNHRGICVNRYNPCNRRNYQNQKRSDNSHYKY--TK
13_Syringa 508 LSLEAQAEARLLMFSHMNLLSPAIGDPISIPTQDMLIGLYVLTSGNRRGICVNRYNPWNRRNYQNQR-SNNNNYKY--TK
18_Liquidambar 501 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYVLTSGNRRGICANRYNPCNRRNYQNERSD-DNNYKYTKEK
19_Papaver 501 LSLEAQAEARLLMFSHMNLLSPAIGDPISIPTQDMLMGLYVLTIGNRRGICANRYNPCNHLNYQNEKIDDN-NYKYTKEK
20_Ananas 505 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDILIGLYVLTIGNRRGICANMYNPYNCRNYQNQTV-DNNNYKYTKEK
28_Liriodendron 502 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYILTIGNRRGICSNRYNPCNRRNYQNETVDYN---KYTKEK
30_Magnolia 502 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYILTIGNRRGICSNRYNPCNRRNYQNETVDDN---KYTKEK
32_Nymphaea 508 LSLEAQAEARLLMFSHTNLLSPAIGDPISVPTQDMLMGLYVLTMGNRRGICANRYNPCNPRNHQNERI-DHSNYEYRKGK
33_Amborella 501 LSLEAQAEARLLMFSHMNLLSPAIGDPISVPTQDMLIGLYVLTIGNRRGICTNRYNPCNYRNYQNEIV-DDNNYKYTKEK
35_Picea 516 LSLEARAEARLLMFSETNLLSPAIGDPISIPTQDMLLGLYISTVGNSQGIYGNRYHPYHSE-K----------KSFSCK
44_Ginkgo 508 LSLEAQAEARLLMFSHTNLLYPAIGDPISVPTQDMLLGLYILTVENNQGIYGNRYHPYNSN-K----------KIFYCK
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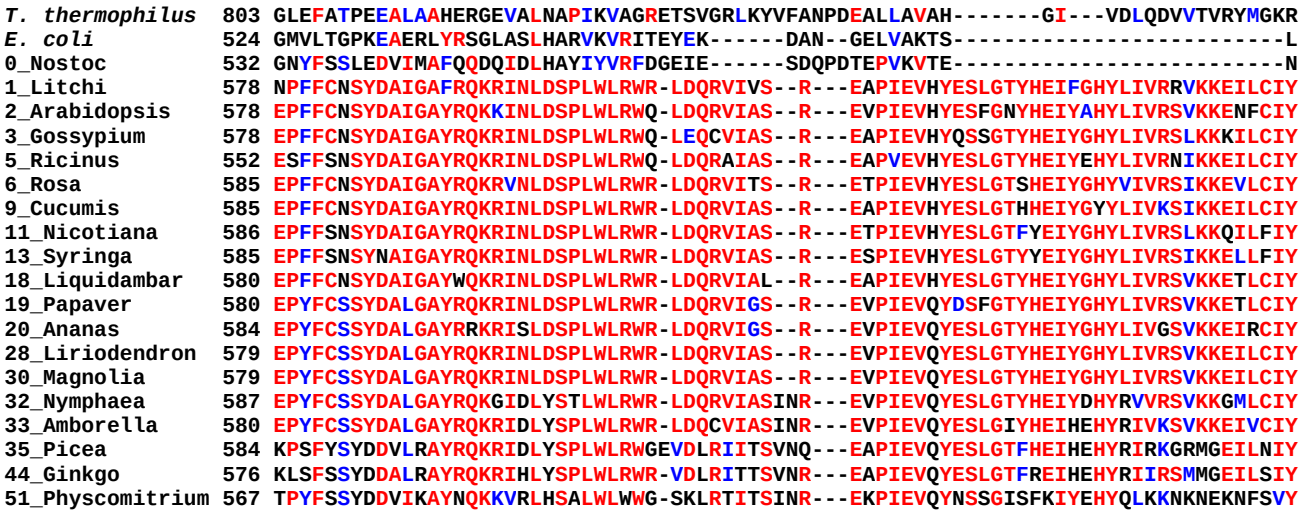
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E. coli 524 GMVLTGPKEAERLYRSGLASLHARVKVRITEYEK------DAN--GELVAKTS----------L
0_Nostoc 532 GNYFSSLEDVIMAFQQDQIDLHAYIYVRFDGEIE------SDQPDTEPVKVTE----------N
1_Litchi 578 NPFFCNSYDAIGAFRQKRINLDSPLWLRWR-LDQRVIVS--R---EAPIEVHYESLGTYHEIFGHYLIVRRVKKEILCIY
2_Arabidopsis 578 EPFFCNSYDAIGAYRQKKINLDSPLWLRWQ-LDQRVIAS--R---EVPIEVHYESFGNYHEIYAHYLIVRSVKKENFCIY
3_Gossypium 578 EPFFCNSYDAIGAYRQKRINLDSPLWLRWQ-LEQCVIAS--R---EAPIEVHYQSSGTYHEIYGHYLIVRSLKKKILCIY
5_Ricinus 552 ESFFSNSYDAIGAYRQKRINLDSPLWLRWQ-LDQRAIAS--R---EAPVEVHYESLGTYHEIYEHYLIVRNIKKEILCIY
6_Rosa 585 EPFFCNSYDAIGAYRQKRVNLDSPLWLRWR-LDQRVITS--R---ETPIEVHYESLGTSHEIYGHYVIVRSIKKEVLCIY
9_Cucumis 585 EPFFCNSYDAIGAYRQKRINLDSPLWLRWR-LDQRVIAS--R---EAPIEVHYESLGTHHEIYGYYLIVKSIKKEILCIY
11_Nicotiana 586 EPFFSNSYDAIGAYRQKRINLDSPLWLRWR-LDQRVIAS--R---ETPIEVHYESLGTFYEIYGHYLIVRSLKKQILFIY
13_Syringa 585 EPFFSNSYNAIGAYRQKRINLDSPLWLRWR-LDQRVIAS--R---ESPIEVHYESLGTYYEIYGHYLIVRSIKKELLFIY
18_Liquidambar 580 EPFFCNSYDAIGAYWQKRINLDSPLWLRWR-LDQRVIAL--R---EAPIEVHYESLGTYHEIYGHYLIVRSVKKETLCIY
19_Papaver 580 EPYFCSSYDALGAYRQKRINLDSPLWLRWR-LDQRVIGS--R---EVPIEVQYDSFGTYHEIYGHYLIVRSVKKETLCIY
20_Ananas 584 EPYFCSSYDALGAYRRKRISLDSPLWLRWR-LDQRVIGS--R---EVPIEVQYESLGTYHEIYGHYLIVGSVKKEIRCIY
28_Liriodendron 579 EPYFCSSYDALGAYRQKRINLDSPLWLRWR-LDQRVIAS--R---EVPIEVQYESLGTYHEIYGHYLIVRSVKKEILCIY
30_Magnolia 579 EPYFCSSYDALGAYRQKRINLDSPLWLRWR-LDQRVIAS--R---EVPIEVQYESLGTYHEIYGHYLIVRSVKKEILCIY
32_Nymphaea 587 EPYFCSSYDALGAYRQKGIDLYSTLWLRWR-LDQRVIASINR---EVPIEVQYESLGTYHEIYDHYRVVRSVKKGMLCIY
33_Amborella 580 EPYFCSSYDALGAYRQKRIDLYSPLWLRWR-LDQCVIASINR---EVPIEVQYESLGIYHEIHEHYRIVKSVKKEIVCIY
35_Picea 584 KPSFYSYDDVLRAYRQKRIDLYSPLWLRWGEVDLRIITSVNQ---EAPIEVQYESLGTFHEIHEHYRIRKGRMGEILNIY
44_Ginkgo 576 KLSFSSYDDALRAYRQKRIHLYSPLWLRWR-VDLRITTSVNR---EAPIEVQYESLGTFREIHEHYRIIRSMMGEILSIY
51_Physcomitrium 567 TPYFSSYDDVIKAYNQKKVRLHSALWLWWG-SKLRTITSINR---EKPIEVQYNSSGISFKIYEHYQLKKNKNEKNFSVY

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T. thermophilus   873 LETSPGRILFARIVAEAVEDEKVAWELIQL-------DVPQEKNSLKDLVYQAFLRLGMEKTARLLDALKYYGFTFSTTS
E. coli           570 KDTTVGR-------------AILWMIVPKGLPYSIVNQALGKKAISKMLNTCYRILGLKPTVIFADQIMYTGFAYAARS
0_Nostoc          580 --EDGTR-------------TLLYKFR-------RVRQDAKGNVLSQYI---YT---TPGRVIYNNAIQ-EALAS----
1_Litchi          652 IRTTVGHISLYREIEEAIQGFCRACSYGT-------------------------------------------------
2_Arabidopsis     652 IRTTVGHISFYREIEEAIQGFSQACSYDT-------------------------------------------------
3_Gossypium       652 IRTTVGHISLYREIEEAIQGFFRAYSYDTQSYGI-------------------------------------------
5_Ricinus         626 IRTTVGHISLYREIEEAIQGFCQAGSDGI-----------------------------------------------
6_Rosa            659 VRTTVGHISLYREIEEAIQGFCRAYSYGT-------------------------------------------------
9_Cucumis         659 IRTTVGHISLYREIEEAIQGFCRACSYGT-------------------------------------------------
11_Nicotiana      660 IRTTVGHIALYREIEEAIQGFSRAYSSGT-------------------------------------------------
13_Syringa        659 IRTTVGHISLYREIEEAVQGFSQACSYGTELS----------------------------------------------
18_Liquidambar    654 IRTTVGHISLYREIEEALQGFYRACSYRT-------------------------------------------------
19_Papaver        654 IRTTVGHISFYREIEEAIQGFSQACSYDT-------------------------------------------------
20_Ananas         658 IRTTLGHISFYREIEEAIQGFCRAYSYTI-------------------------------------------------
28_Liriodendron   653 IRTTVGHISFYREIEEAIQGFCRAYLYDT-------------------------------------------------
30_Magnolia       653 IRTTVGHISFYREIEEAIQGFCRAYSYDT-------------------------------------------------
32_Nymphaea       663 IRTTVGHISFYREIEEAVQGFCRSYSYGT-------------------------------------------------
33_Amborella      656 IRTTVGHISFYREIEEAIQGFCRTY-----------------------------------------------------
35_Picea          661 IRTTVGRTRFNREMEEAIQGFAR-SEHPKKSLPALRI-----------------------------------------
44_Ginkgo         652 IRTTVGRIRFNREIEEAIQGFSRASEHPNKSLKAIRI-----------------------------------------
51_Physcomitrium  643 ICTTVGRIIFNQQIEEAIQGTLKASLFRNQSLPAITI-----------------------------------------
```

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T. thermophilus   946 GITIGIDDAVIPEEKKQYLEEADRKLLQIEQAYEMGFLTD
E. coli           636 GASVGIDDMVIPEKKHEIISEAEAEVAEIQEQFQSGLVTA
0_Nostoc              ----------------------------------------
1_Litchi              ----------------------------------------
2_Arabidopsis         ----------------------------------------
3_Gossypium           ----------------------------------------
5_Ricinus             ----------------------------------------
6_Rosa                ----------------------------------------
9_Cucumis             ----------------------------------------
11_Nicotiana          ----------------------------------------
13_Syringa            ----------------------------------------
18_Liquidambar        ----------------------------------------
19_Papaver            ----------------------------------------
20_Ananas             ----------------------------------------
28_Liriodendron       ----------------------------------------
30_Magnolia           ----------------------------------------
32_Nymphaea           ----------------------------------------
33_Amborella          ----------------------------------------
35_Picea              ----------------------------------------
44_Ginkgo             ----------------------------------------
51_Physcomitrium      ----------------------------------------
```
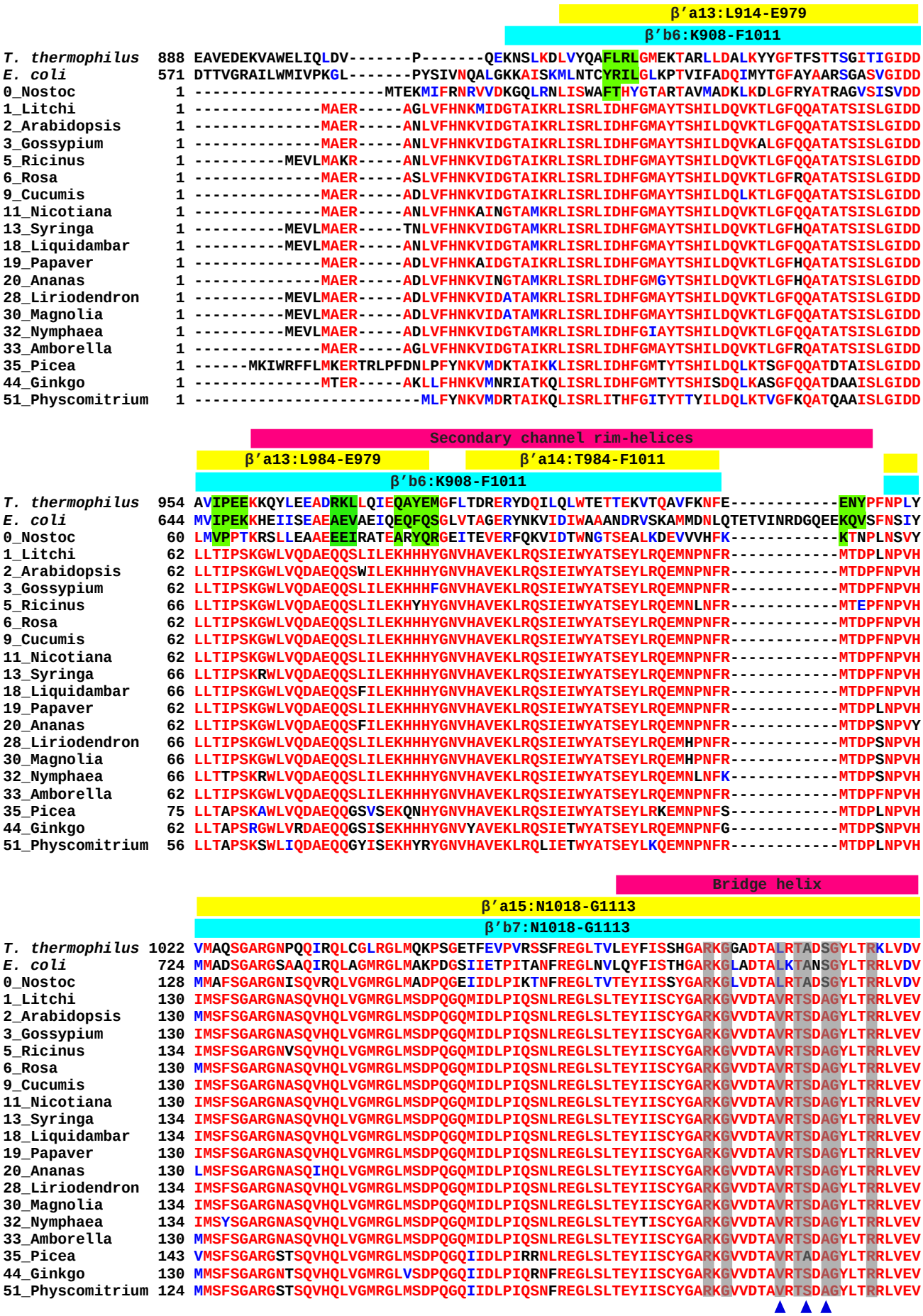

Figure S5 : sequence alignment of the β" subunits from PEP of angiosperms with those of the RNAPs from *E. coli*, *T. thermophilus* and Nostoc. The residues conserved more than 50 % are in red, those mutated in similar residues are in blue. The strictly conserved residues described by Lane & Darst (Lane & Darst, 2010) are highlighted in gray. The blue triangles show mutations observed among the strictly conserved residues described (Lane & Darst, 2010). The non-conservative mutations, at least three in a row in the β or β' domain in *E. coli* and *T. thermophilus*, are highlighted in green and displayed on the *E. coli* structure (PDB entry: 6GH5). Those colored in orange are nearby to the DNA, those in green are located at the surface of the subunits. The domains described for all-RNA polymerase (a) and the bRNAPs (b) are also given and highlighted in yellow and cyan respectively. The name of the RNAP domains are also given and highlighted in purple and green (Lane & Darst, 2010; Sutherland & Murakami, 2018).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β'b6:K908-F1011
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E. coli 571 DTTVGRAILWMIVPKGL-------PYSIVNQALGKKAISKMLNTCYRILGLKPTVIFADQIMYTGFAYAARSGASVGIDD
0_Nostoc 1 ----------MTEKMIFRNRVVDKGQLRNLISWAFTHYGTARTAVMADKLKDLGFRYATRAGVSISVDD
1_Litchi 1 ----------MAER-----AGLVFHNKMIDGTAIKRLISRLIDHFGMAYTSHILDQVKTLGFQQATATSISLGIDD
2_Arabidopsis 1 ----------MAER-----ANLVFHNKVIDGTAIKRLISRLIDHFGMAYTSHILDQVKTLGFQQATATSISLGIDD
3_Gossypium 1 ----------MAER-----ANLVFHNKVIDGTAIKRLISRLIDHFGMAYTSHILDQVKALGFQQATATSISLGIDD
5_Ricinus 1 ----------MEVLMAKR-----ANLVFHNKVIDGTAIKRLISRLIDHFGMAYTSHILDQVKTLGFQQATATSISLGIDD
6_Rosa 1 ----------MAER-----ASLVFHNKVIDGTAIKRLISRLIDHFGMAYTSHILDQVKTLGFRQATATSISLGIDD
9_Cucumis 1 ----------MAER-----ADLVFHNKVIDGTAIKRLISRLIDHFGMAYTSHILDQLKTLGFQQATATSISLGIDD
11_Nicotiana 1 ----------MAER-----ANLVFHNKAINGTAMKRLISRLIDHFGMAYTSHILDQVKTLGFQQATATSISLGIDD
13_Syringa 1 ----------MEVLMAER-----TNLVFHNKVIDGTAMKRLISRLIDHFGMAYTSHILDQVKTLGFHQATATSISLGIDD
18_Liquidambar 1 ----------MEVLMAER-----ANLVFHNKVIDGTAMKRLISRLIDHFGMAYTSHILDQVKTLGFQQATATSISLGIDD
19_Papaver 1 ----------MAER-----ADLVFHNKAIDGTAIKRLISRLIDHFGMAYTSHILDQVKTLGFHQATATSISLGIDD
20_Ananas 1 ----------MAER-----ADLVFHNKVINGTAMKRLISRLIDHFGMGYTSHILDQVKTLGFHQATATSISLGIDD
28_Liriodendron 1 ----------MEVLMAER-----ADLVFHNKVIDATAMKRLISRLIDHFGMAYTSHILDQVKTLGFQQATATSISLGIDD
30_Magnolia 1 ----------MEVLMAER-----ADLVFHNKVIDATAMKRLISRLIDHFGMAYTSHILDQVKTLGFQQATATSISLGIDD
32_Nymphaea 1 ----------MEVLMAER-----ADLVFHNKVIDGTAMKRLISRLIDHFGIAYTSHILDQVKTLGFQQATATSISLGIDD
33_Amborella 1 ----------MAER-----AGLVFHNKVIDGTAIKRLISRLIDHFGMAYTSHILDQVKTLGFRQATATSISLGIDD
35_Picea 1 ------MKIWRFFLMKERTRLPFDNLPFYNKVMDKTAIKKLISRLIDHFGMTYTSHILDQLKTSGFQQATDTAISLGIDD
44_Ginkgo 1 ----------MTER-----AKLLFHNKVMNRIATKQLISRLIDHFGMTYTSHISDQLKASGFQQATDAAISLGIDD
51_Physcomitrium 1 ----------MLFYNKVMDRTAIKQLISRLITHFGITYTTYILDQLKTVGFKQATQAAISLGIDD
Secondary channel rim-helices
β'a13:L984-E979
β'a14:T984-F1011
β'b6:K908-F1011
T. thermophilus 954 AVIPEEKKQYLEEADRKLLQIEQAYEMGFLTDRERYDQILQLWTETTEKVTQAVFKNFE----------ENYPFNPLY
E. coli 644 MVIPEKKHEIISEAEAEVAEIQEQFQSGLVTAGERYNKVIDIWAAANDRVSKAMMDNLQTETVINRDGQEEKQVSFNSIY
0_Nostoc 60 LMVPPTKRSLLEAAEEEIRATEARYQRGEITEVERFQKVIDTWNGTSEALKDEVVVHFK----------KTNPLNSVY
1_Litchi 62 LLTIPSKGWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPLNPVH
2_Arabidopsis 62 LLTIPSKGWLVQDAEQQSWILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPFNPVH
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5_Ricinus 66 LLTIPSKGWLVQDAEQQSLILEKHYHYGNVHAVEKLRQSIEIWYATSEYLRQEMNLNFR----------MTEPFNPVH
6_Rosa 62 LLTIPSKGWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPFNPVH
9_Cucumis 62 LLTIPSKGWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPFNPVH
11_Nicotiana 62 LLTIPSKGWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPFNPVH
13_Syringa 66 LLTIPSKRWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPFNPVH
18_Liquidambar 66 LLTIPSKGWLVQDAEQQSFILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPFNPVH
19_Papaver 62 LLTIPSKGWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPLNPVH
20_Ananas 62 LLTIPSKGWLVQDAEQQSFILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPSNPVY
28_Liriodendron 66 LLTIPSKGWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMHPNFR----------MTDPSNPVH
30_Magnolia 66 LLTIPSKGWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMHPNFR----------MTDPSNPVH
32_Nymphaea 66 LLTTPSKRWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNLNFK----------MTDPSNPVH
33_Amborella 62 LLTIPSKGWLVQDAEQQSLILEKHHHYGNVHAVEKLRQSIEIWYATSEYLRQEMNPNFR----------MTDPFNPVH
35_Picea 75 LLTAPSKAWLVQDAEQQGSVSEKQNHYGNVHAVEKLRQSIEIWYATSEYLRKEMNPNFS----------MTDPLNPVH
44_Ginkgo 62 LLTAPSRGWLVRDAEQQGSISEKHHHYGNVYAVEKLRQSIETWYATSEYLRQEMNPNFG----------MTDPSNPVH
51_Physcomitrium 56 LLTAPSKSWLIQDAEQQGYISEKHYRYGNVHAVEKLRQLIETWYATSEYLKQEMNPNFR----------MTDPLNPVH
Bridge helix
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β'b7:N1018-G1113
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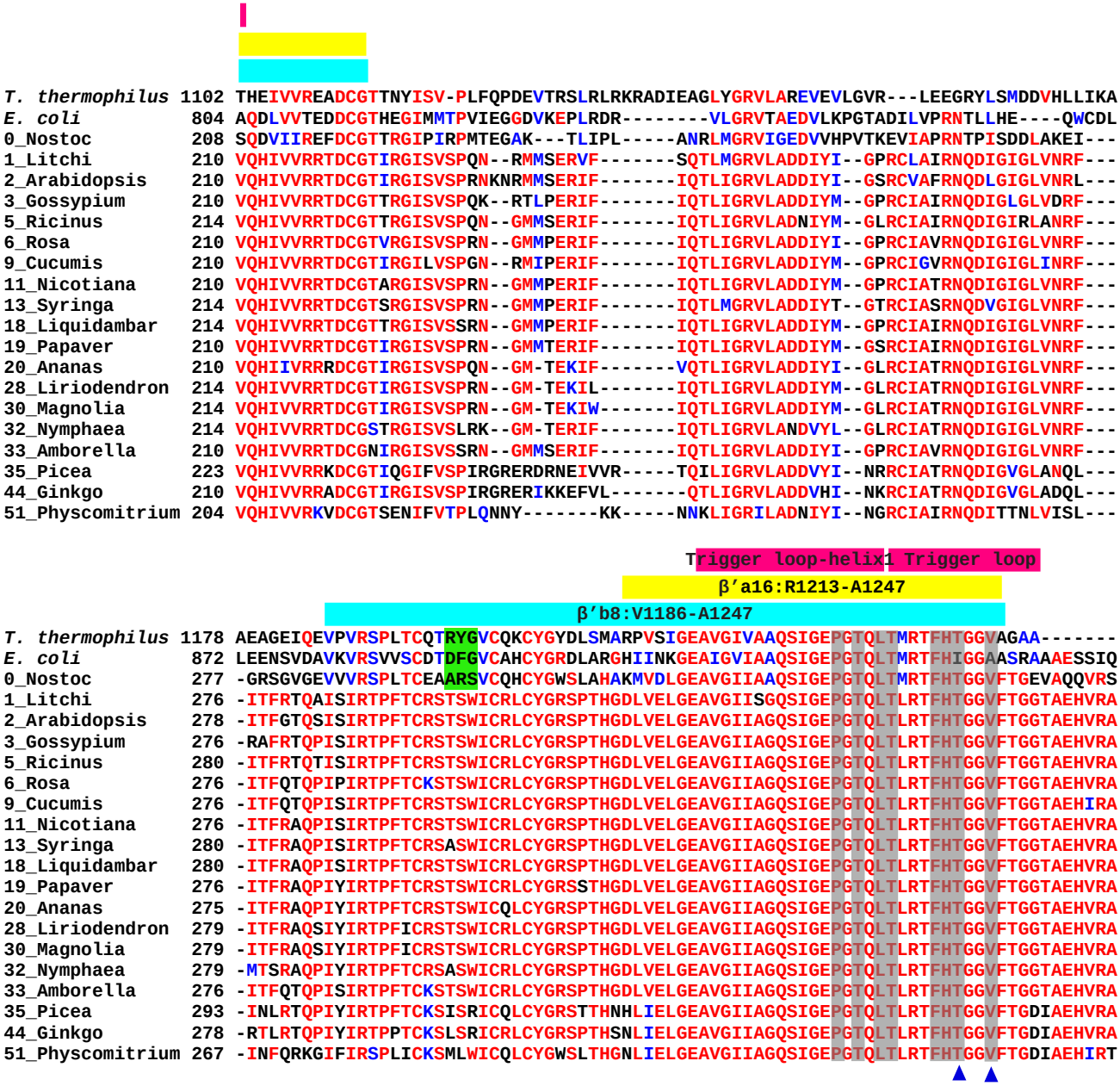
E. coli 724 MMADSGARGSAAQIRQLAGMRGLMAKPDGSIIETPITANFREGLNVLQYFISTHGARKGLADTALKTANSGYLTRRLVDV
0_Nostoc 128 MMAFSGARGNISQVRQLVGMRGLMADPQGEIIDLPIKTNFREGLTVTEYIISSYGARKGLVDTALRTADSGYLTRRLVDV
1_Litchi 130 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
2_Arabidopsis 130 MMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
3_Gossypium 130 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
5_Ricinus 134 IMSFSGARGNVSQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
6_Rosa 130 MMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
9_Cucumis 130 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
11_Nicotiana 130 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
13_Syringa 134 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
18_Liquidambar 134 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
19_Papaver 130 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
20_Ananas 130 LMSFSGARGNASQIHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
28_Liriodendron 134 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
30_Magnolia 134 IMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
32_Nymphaea 134 IMSYSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYTISCYGARKGVVDTAVRTSDAGYLTRRLVEV
33_Amborella 130 MMSFSGARGNASQVHQLVGMRGLMSDPQGQMIDLPIQSNLREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
35_Picea 143 VMSFSGARGSTSQVHQLVGMRGLMSDPQGQIIDLPIRRNLREGLSLTEYIISCYGARKGVVDTAVRTADAGYLTRRLVEV
44_Ginkgo 130 MMSFSGARGNTSQVHQLVGMRGLVSDPQGQIIDLPIQRNFREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV
51_Physcomitrium 124 MMSFSGARGSTSQVHQLVGMRGLMSDPQGQIIDLPIQSNFREGLSLTEYIISCYGARKGVVDTAVRTSDAGYLTRRLVEV


Trigger loop-helix
Trigger loop
β'a16:R1213-A1247
β'b8:V1186-A1247

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T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli          961 ------------------------------------SNVKSVVNSSGKLVITS-------------------------
0_Nostoc         435 GRTTRTNTEKAVKDVASDLAGEVQFAEVVPEQKTDRQGNTTTTAARGGLIWILSGEVYNLPPGAELVVKNGDAIASNGVL
1_Litchi         427 TY-TLNFKERVRKHIYSDSEGEMHWSTDVYHAPEFTYSNVH-LLPKTSHLWILSGGSCGSGVVSFSLYKDQDQLSIHYRS
2_Arabidopsis    429 TY-TFHFKERVRKYIYSDSEGEMHWSTDVSHAPEFTYSNVH-LLPKTSHLWILSGGSCGSSLIRFSIHKDQDQMNIPFLS
3_Gossypium      427 TY-TLNLKERVRKHIYSDSEGEMHWSTDVYHSPEFTYSNVH-LLPKTSHLWILSGGSYKFSVVPFSLHKDQDQINIHYLS
5_Ricinus        431 TY-TLNFKEKVRKHIYSDSEGEMHWSTDVYHAPEFTYSNVH-LLPKTSHLWILSGNSCRSSIVPFSLHKDQDQMNVHSLS
6_Rosa           427 AY-TFNFKERVRKHIYSDSEGEMHWSTDVYHAPEFTYSNVH-LLPKTSHLWILSGGSCRFSAVPPSLHKDQDQTNVHSLS
9_Cucumis        427 TY-TLNLKERVRKHIYSDSEGEMHWSTDVYHAPEFTYSNVH-LLPKTSHLWILSGGSCGCSVVPFSLYKDQDQINVHSLC
11_Nicotiana     427 IS-TLNFKEKVRKHIYSDSDGEMHWSTDVYHAPEFTYGNVH-LLPKTSHLWILLGRPCRSSLVYLSIHKDQDQMNAHFLS
13_Syringa       431 TS-TLNFKEKVRKHIYSDSDGEMHWSTDVYHAPEFTYGNVH-LLPKTSHLWILLGGPCRSSLVSLSLHKDQDQINAHSRS
18_Liquidambar   431 TY-TFNFKERVRKHIYSDSEGEMHWSTDVYHAPEFTYGNVH-LLPKTSHLWILSGGSCRSSVVPFSLHKDQDQMNVHSLS
19_Papaver       427 TS-TFNFKERVRKHIYSDLEGEMHWSTDVYHAPEYTYGNVH-LLPKTSHLWILSGGLCRSSIVPFSLGKDQDQTNVHSLF
20_Ananas        426 TS-TFHFKERVRKHIYSESEGEMHWSTDVYHAPEYTYGNVH-LLPKTSHLWILAGGPCRSSIVSFSLHKDQDQMNVYSLS
28_Liriodendron  430 TS-TFNFKERVRKHIYSDSEGEMHWSTDVYHAPEYRYGNVH-LLPKTSHLWILSGGPCRSSIVPFSLHKDQDQMNVHSLS
30_Magnolia      430 TS-TFNFKERARKHIYSDSEGEMHWSTDVYHAPEYRYGNVH-LLPKTSHLWILSGGPCRSSIVTFSLHKDQDQMNVHSLS
32_Nymphaea      430 TS-TFHFKERVRKHIYSDSEGEMHWSTGVYHAPEYTHGNVH-FLPKTSHLWILSGGPCKSSLVPFSLHKDQDQMNVQSLS
33_Amborella     427 TS-TFNFKEKVRKHIYSDSEGEMHWSTDVYHAPDFTYSNVH-LLPKTSHLWILSGSSYRSSVVPFSIHKDQDQTNVYFLS
35_Picea         444 TS---SFKEKVRKNIYSDLEGEMHWSTNVCHAPEYVHGNVH-PILRTGYLWILSGGIYGSGVVPFPFHKHQDQVDVQPFV
44_Ginkgo        429 TS---PSKEKVMKHIYSDLEGEMHWSTNVCHAPENVHGNVH-LILRTSYLWVLSGGLYESGVVPFPLYKDQDQVNIQFPL
51_Physcomitrium 418 TS---PFKEKVQKYIYSNLSGEMHWSSKVQHSSEYIHSNVH-LLRKTGHIWILAGNFDKDNKFSFIFYQNQDKLDNKLPI


T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli          978 ------------------------------------------------------------RNTELKLIDEFGRTKES
0_Nostoc         515 AETKLTT------LHGGVVRL-------------PEATPGK--------STREIEIITASVVLDQATVTVQSS--QGRNN
1_Litchi         505 VERRYISSLS---VNNDQVRHQLVSSDFSDNK--EDGISDY-SGFNRIIGIGHCNLIHAAILHENSD--LLAK--RRRNR
2_Arabidopsis    507 AERKSISSLS---VNNDQVSQKFFSSDFADPK--KLGIYDY-SELNGNLGTSHYNLIYSAIFHENSD--LLAK--RRRNR
3_Gossypium      505 AERRYISRFS---VNNDQVRHNLFSSDFSDKK--EERIYDY-SELNRIIGTGHCDFIYSAILHENAD--LLAK--RRRNR
5_Ricinus        509 IKRRYISSPSVNSVNNDQVKPKFFSSDFSGKK--PSRIPYY-SELNRIVCTGHCNLIYPAILYENSD--LLAK--RRRNK
6_Rosa           505 VEGRYFSSLS---VNNDQVKHKFFGLNLSGKK--ESCIPDY-SELNRIIYTSHCNLIFPPIRHDN-F--LLTK--RRRNR
9_Cucumis        505 VERRYISSLS---VNNDKVGQKFYGPDLSGKN--ESGIPDY-SELNPILCTGQSNLTYPAIFHGNSD--LLAK--RRRNG
11_Nicotiana     505 GKRRYTSNLS---VTNDQARQKLFSSDFSGKK--EDRIPDY-SDLNRIICAGQYNLVYSPILHENSD--LLSK--RRRNK
13_Syringa       509 VKRRYTSNLS---GTNDPERQKLFSSYFYGKKKXEDRISDY-SDLNRIICNGRCNLIYPTILHQNSD--LFSK--RRRNR
18_Liquidambar   509 VERRYISNLS---VTNDQVRHKLFSSDISGKK--EGRIPDY-SELNRIICSGHCNLIYPAILRENSD--LLAK--RRRNR
19_Papaver       505 AKQRYTPSLS---VTNDQVKQKFCSSESSGTG--GRGVLDY-SGPDRIICNGHCNFIYPPILHESSD--LLAK--RRRNR
20_Ananas        504 VEGRYISNPS---MTNDQVRHKLLDT--SGKK--DRKILDY-SRLDRIISNGHWNFIYPSILQENPD--FLAK--KRRNR
28_Liriodendron  508 VERRYISDLS---VTNDRVRHKLFSSDPSGKK--KERILDY-SGPDRIVSNGHWNFLYPAILHENSD--LLAK--RRRNR
30_Magnolia      508 VERRYISDLS---VTNDRVRHKLFSSDPSSKK--GKGILDY-SGPDRIISNGHWNFLYPATLHENSD--LLAK--RRRNR
32_Nymphaea      508 VQERSISDFS---VNNNRVKHKLFGSDPLARK--GRRISDYAAGLERVISNGDGDFIYPAILRENSY--LLAK--RRRNR
33_Amborella     505 AEGKNISSRSVNTVNNDQGKGKFFSSDFSGKK--ESTIPDY-SEFNRIIDRDHWNLIFPSILHKNYDLFLLAK--RRRNR
35_Picea         520 AKHQSLFDSY---V--DQVEHRSGDSNCYGKE---EQIFSY-SETDRTISNEHRDSIYVTLSPKNYN--MKGK--RQMNR
44_Ginkgo        505 AKHKSLSDSS---VNQDRVKHKSVDSNFSGKE---EKISGY-SGIDRIMSNEHWDSIYSTIPFDNCK--ILGK--KQRNR
51_Physcomitrium 494 AKQ----------------------------------TLNY-FQLKEHFLNNFWNSIYSSIILYNYR--FLEK--K-NNK


T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli          995 YKVPYG------------------------AV----------------------------------------------
0_Nostoc         566 YLVSTGNNQVFN-----------LRATPGTKVQNGQVVAELIDDRYRTTTGGFLKFAGVEVQKKGKA-----------
1_Litchi         575 FLIPFQSIQEQEKELMPH--SGISIEIPIKGVFRKNSIFAYFDDPRYRRKNSGITKYGTIGAHSIVKKEDLIEYRGRGGK
2_Arabidopsis    577 FLIPFQSIQEQEKEFIPQ--SGISVEIPINGIFRRNSIFAFFDDPRYRRKSSGILKYGTLKADSIIQKEDMIEYRG--VQ
3_Gossypium      575 FIIPFQLIQDQEKELMLHSHSGISMEIPINGIFRRKSILAFFDDPRYRRKSSGITKYGTLGAHSIVKREDVIEYRG--VK
5_Ricinus        582 FIIPFQSIQEQEKKLMTRS-SAISIEIPLNGIFRRNSVFAYFDDPQYRRKSSGITKYGAIGVHSIVKKEDLIEYRG--VK
6_Rosa           574 FIIPFQSIQEQEKERMPR--PDISIEIPINGIFRRNSILAYFDDPQYRRKSSGITKYGTVGLHSILKKEDLIEYRG--VK
9_Cucumis        575 FIIQFESLQERKELRPP--SGISIEIPINGLFRRNSILAFFDDPQYRRNSSGITKYGTIGVHSILKKEDLIEYRG--VK
11_Nicotiana     575 FIIPLHSIQELENELMPC--SGISIEIPVNGIFRRNSILAYFDDPRYRRKSSGIIKYGTVETHSVIKKEDLLEYRG--VK
13_Syringa       581 FIIPLQSIQERENELMPR--SGISIEIPPNGIFRRNSILAYFDDPRYRRKSSGITKYGTIEMHSIVKKEDLIEYRG--VK
18_Liquidambar   579 FIIPFQSIQERKEQMPHSNSGISIEIPINGIFRRNSILAYFDDPRYRRKSSGITKYGTIEVHSIVKKEDLIECRG--VK
19_Papaver       575 LIIPFQSNQERDKERIPR--SGISIEIPINGIFRRNSILAYFDDPRYRRNSSGITKYETLEMHSIVKKEDFIEYRR--AK
20_Ananas        572 FIIPLQYDQEREKELIPC--FGISIEIPINGILRRNSILAYFDDPRYRRSSSGITKYGTIEVDSIIKKEDLIEYRG--AK
28_Liriodendron  578 FIIPFQYDQEREKELMPR--SGISIEIPINGILRRDTILAYFDDPRYRRSSSGITKYGTIEVDSIVKKEDLIEYRG--AK
30_Magnolia      578 FIIPFQYDQEREKELMPR--SGISIEIPINGILRRNSILAYFDDPRYRRSSSGITKYGTIEVDSIVKKEDLIEYRG--AK
32_Nymphaea      579 FIIPFQYDPEREKELTPHSSTSITVEIPANGILRRNSILAYFDDPRYRRSSSGITKYGIIEVDSIVKKEGLIEYRR--PK
33_Amborella     580 FIIPFQWIQERENELMLR--SSISIEIPINGVFRKNSILAYFDDPQYRRKSSGITKYGAIGLHSIFKKEDLIEYVG--IK
35_Picea         587 FIVPLQCDKEWGKRIISF--PDAILRIPKSGVLQRNSIFGY-----------------------------------------
44_Ginkgo        574 LIVPLRYDKERKKRRIPC--PNSILRIPRNFLFQRNHILAVLDDPQYRVDSSGILKYGNIRIDSIEKKDDFLEDQG--SR
51_Physcomitrium 534 ----------YEKKL----LFQFMLKLPKNGILKQNDIFAIFNDPKYRIKNSGIIKYGNIKVDLINKKNDIFEDQK--TK
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T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli         1003 ------------------------------------------------------------------------------
0_Nostoc         622 --KLGYEV-VQGGTLLWIPEETHEVNKD-ISLLLVEDGQFVEAGTEVVK--DIFCQNSGVIEVTQKNDILREVVVKPGEL
1_Litchi         653 KIKPKYQ--MKFDRFFFIPEEVHTLPES--SYVMVRNNSLIGVDTRITL--NRRSQVGGLVRVERKKKR-IELKIFSGDI
2_Arabidopsis    653 KIKTKYE--MKVDRFFFIPEEVHILPES--SAIMVQNYSIIGVDTRLTL--NIRSQVGGLIRVEKKKKR-IELKIFSGDI
3_Gossypium      653 KVKPKYQ--MKVDRFFFIPEEVHILSES--SSIMVRNNSIIGVDTPITL--NTRSQVGGLVRVERKKKR-IELKIFSGNI
5_Ricinus        659 EFKPKYQ--MKVDRFFFIPEEVYILPES--SSLMVRNNSIIGVDTPITL--NTRSRVGGLVRVERKKKK-IELKIFSGDI
6_Rosa           650 EFKPKYQ--TKVDRFFFIPEEVHILPES--SSIMVRNNSIIGIDTRITL--NTRSRVGGLVRIERKKKR-IELKIFSGDI
9_Cucumis        651 DFKPKYQMQMKVDRFFFIPEEVHILPES--SSIMVRNNSIIGVATRLTL--SIRSRVGGLVRVEKKKKR-IELKIFSGDI
11_Nicotiana     651 EFRPKYQ--MKVDRFFFIPEEVHILPGS--SSIMVRNNSIVGVDTQITL--NLRSRVGGLVRVERKKKR-IELKIFSGDI
13_Syringa       657 AFRPKYQ--MKVDRFFFIPEEVHILPGS--SSIMVRNNSLIGVDTQITL--NIRSRVGGFVRVERKKKR-IELQIFSGDI
18_Liquidambar   657 EFKPRYQ--MKVDRFFFIPEEAHILPGS--SSIMVRNNSIIGVDTQITL--NTRSRVGGLVRVERKKKR-IELKIFSGDI
19_Papaver       651 EFRQKYQ--KKVDRFFFIPEEVHILSGS--SSIMVRNNSIIGIDTRITL--NIRSRVGGLVRVERKKKR-IELKIFSGDI
20_Ananas        648 EFSPKYQ--TEVDQFFFILEEVHILPGS--SLIMVRNNSIIGVDTRLALNINTRSRVRGLVRVERKKKY-IELKIFSGDI
28_Liriodendron  654 EFRPKYQ--MKVDRFFFIPEEVHILPGS--SPIMVRNNSIIGVDTRIAL--NTRSRVGGLVRVERKKKK-IELKIFSGDI
30_Magnolia      654 EFRPKYQ--MKVDRFFFIPEEVHILPGS--SSIMVRNNSIIGVDTRIAL--NTRSRVGGLVRVERKKKR-IELKIFSGDI
32_Nymphaea      657 ESRPKYQ--MKVDRFFVIPEEVHILPGS--SSIMVRNNSIIGVDTRITF--NTRSQIGGLVRIEKKKKK-IELKIFSGGI
33_Amborella     656 ELKPKYQTKYYWNKYT-----NHF-------------------------KYKKPSRRIGPSGEKKKR-IELKIFSGEI
35_Picea         626 ------------------------------------------------------------------------------
44_Ginkgo        650 GSRPKYE--IEGGRFLFIPEEVHILHES--SSIMVRNGSIIRTGTQITF--NIESQVGGLVRIERMRKK-IEVRILPGDI
51_Physcomitrium 598 TVRPRYKI-LKEGNFFLLPEEVYILDQSSFSSILVKNNSFIKAGTKITF--NISSKITGFVKIKKKFNN-FKIKILPGSI

T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli         1003 ------------------------------------------------------------------------------
0_Nostoc         696 LMVDDPEAVMGRDNTFVQPGEEFQGT--------VATELRYIQYVE-TPEGPALLSRPVVEFAVPNNPDVPSTTS----V
1_Litchi         726 HFPGEADKISRHSGILIPPETGKKKLKESTGESKKLKKWIYVQRITLTKKKYFVLVRPVVTYEIAD---GINLATLFPQD
2_Arabidopsis    726 HFPDKTDKISRHSGILIPPGRGKKNSK----ESKKFKNWIYVQRITPTKKKFFVLVRPVATYEIAD---SINLATLFPQD
3_Gossypium      726 YFPGERDKISRHSGILIPPGTGKTNSK----ESKKLKNWIYVQRITPTKKKYFVLVRPVTPYEIPD---GLNLATLFPQD
5_Ricinus        732 HFPGETDKISRHSGILIPPGMVKTNSK----ESKKQKNWIYIQRIAPTRKKYFVLVRLVIIYEIAN---GINLETLFPRD
6_Rosa           723 HFPGEMDKIFRHNGILIPPGT---NSK----ESKKRNNWIYVQWITPTKKKYFVLVRPVIIYEIAD---GINLATLFPQD
9_Cucumis        726 HFPGEMDKISRHNGILIPPERVKKNSK----KSKKSKNWIYVQWITPTKKKYFVFVRPVIIYELAD---GINLVKLFPQD
11_Nicotiana     724 HFPGETDKISRHTGVLIPPGTGKRNSK----ESKKVKNWIYVQRITPSKKKFFVLVRPVVTYEITD---GINLATLFPPD
13_Syringa       730 HFPGETDKISRHSGVLIPPGTGNSNSK----ESKKLKNWIYVQRITPSKKKYFVLVRPVVTYEITD---GINLVTLFPPD
18_Liquidambar   730 HFPGETNKIARHSGILIPPGTGKTNSK----ESKKLKNWIYVQRITPTKKKHFVLVRPVVTYEIAD---GINLATLFPQD
19_Papaver       724 HFPGETDKISWHSGILIPPGTGKKNAG----DSKKLKNWIYVQRITPIKKKFFVLVRPVVTYEIAD---GINLATLFPHD
20_Ananas        723 HFPGETDKISRHSGIFIPPETEKKNSK----ESKKWKNWIYVQRITPTKKKYFVSVRPVVTYEISD---GINLATLFPRD
28_Liriodendron  727 HFPGETDKISRHSGILIPPGTGKKNSK----ESKKWKNWIYVQRITPTKKKYFVSVRPVVTYEIAD---GINLGTLFPQD
30_Magnolia      727 HFTGETDKISRHSGILIPPGTGKRNSK----ESKKWKNWIYVQRITPTKKKYFVSVRPVVTYEIAD---GINLGTLFPQD
32_Nymphaea      730 HFPGETDKISRHIGILIPPGARKKMDKGSQGKNWEGKNWVYVQRITPIKKKYFVSVRPVVTYEIAD---GINLVTLFPGD
33_Amborella     703 QFPVEMDKIFRHSGILIPPGRVKKKIK----ESKKLKNWIYVQWITPTKKKYFVLVRPVIIYEIAD---GINLETLFPQD
35_Picea         626 ------------------------------------------------------SNVEYGIPD---GPIMATSFSLD
44_Ginkgo        723 YFPGEIHEISRHNGTLIPPGKIIFD-------EFQSVNWIYFQWITPHKEKPFVPVRSAAEYGIHD---GSNRTAPFYLD
51_Physcomitrium 674 YYPKEKQKNFKQNGILIPPGEKIF-------EQFRAKNWIYLEWIVLSKDNSFFLIRPAIEYKIIFNDNPLTLPIPFYLD

T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli         1003 --------------LAKGDGEQVA----------GGETVANWDPHTMPVIT---------------EVSGFVRFTDMID
0_Nostoc         763 SQQTGRSIQLRAVQRLPYKDSERVKSVE--GVELLRTQLVLEIEQEGEQQDHNASPLAADIELVQDTEDPEVQRLQLVIL
1_Litchi         803 PLREKDNMQLRVVNYILYGKGKPTRGISDTSIQLVRTCLVLNWGQDKKS-SSAEEVRTSFVEVSTNGMIRDFLRIDLVQS
2_Arabidopsis    799 LFREKDNIQLRVFNYILYGNGKPTRGISDTSIQLVRTCLVLNWDKN----SSLEEVRAFFVEVSTKGLIQDFIRIGLVKS
3_Gossypium      799 PFQEKDNMQLRAVNYILYGNGKPTRRISDTSIQLVRTCLVLSWDQDNKS-SFAEEVCASFVEVRTNGLIRDFLRIDLVKS
5_Ricinus        805 LLQEKDNLKLRVVNYILSGNGKPIRGISDTSIQLVRTCLVLNWDQEKKS-SSIEEARASFVEVNTNGLIRDFLRINLVKS
6_Rosa           793 PLRERDNLELRVVNYILYGNGKPIRGISGTSIQLVRTCLILNWDKNKKS-SSIEEAHASFVEVSANGLIQDFLRINLVKS
9_Cucumis        799 LLQERDNLELRVVNYILYGNGKPIRGISGTSIQLVRTCLLLNWDRDKKS-SSIEDARASFVEVSTNGLVRNFLRIDLGKS
11_Nicotiana     797 PLQERDNVQLRIVNYILYGNGKPIRGISDTSIQLVRTCLVLNWNQDKKS-SSCEEARASFVEIRTNGLIRHFLRINLVKS
13_Syringa       803 LLQERDNVQLRVVNYILYGNGKPIRGISDTDIQLVRTCLVLNWDQDKKSSSSEEARASFVEIRTNGLIRHFLRIDLVKS
18_Liquidambar   803 LLQERDNMKLRVVNYILYGNGKPIRGISDTSIQLVRTCLVLNWDQDKKSA-SSGEAHASFVEVRTNGLIRNFLRINLVES
19_Papaver       797 LLQERDNVQLRVVNYILYGNGKPIRGIYHTSIQLVRTCLVLNWNQEKKG-SSIEEVQASFVEVRVNNLIRYFIRMDLVKS
20_Ananas        796 ILQEKDNVQLRVVNYILYGNGKSIRGIYHTSIQLVRTCLVLNWDQEQNG--FIEEVHASFVEVRANDLIRDFIRIELVKS
28_Liriodendron  800 LLQERDNVQLRVVNYILYGNGKPIRGIYHTSIQLVRTCLVLNWDQDRNG--SIEEVHASFVEVGTNDLIRDFIRIDLVKS
30_Magnolia      800 LLQERDNVQLRVVNYILYGNGKPIRGIYHTSIQLVRTCLVLNWDQDRNG--SIEEVHASFVEVGANDLIRDFIRIDLVKS
32_Nymphaea      807 MLQEKDNLRLQVVNYILYGDGKPIRGISHTSIQLVRTCLVLNWDQDKKG--SIEKVQASSAEVRANDLIRYFIRIDLVKS
33_Amborella     776 LLQEKDNLELRVVNYILYGNGKPILGISGTSIQLVRTCLMLNWDQDNKS-SSSEEAHVYFVEVSTTGLIRDFLRINLAKS
35_Picea         646 LSREGDNLQIQVSNSSSYEDGERIQVMSDTSIPLVQTCLGFDWEQIDS---IESEAYASLTSVRTNKIVSNMIQISLIKY
44_Ginkgo        793 LLGEEDNLQVQVGNYILYGDGEQIQVISDTSIQLVRTCSVLNWEQKDS---ME-EAYAFLTEVRINEVVRNFLQISLMKY
51_Physcomitrium 747 LLKEQKKIKIQTVKYILYEDSEEVEINPDTDIQLIQTCLILNWETK----VFIKEAHISFIKIRINKIIKNFFQINLIEN
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T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli         1043 GQTITR-QTDE--LTG-----------------------------------------------------LSSLVVLDSAERT-
0_Nostoc         841 ESLVIRRDITADATQG--------STQTTLEVQDGLTIAPGSVVARTQILSKEGGIVRGVQKGTENVRRCLVLRET----
1_Litchi         882 HISYMR-KRNDPSSSG--LISDNGSDRTNINP--FYSLYF--KARVQQSLSQNQRTLHTLLNRNKKCQSLIILSSSNCFR
2_Arabidopsis    875 HISYIR-KRNNSPDSGLI-------SADHMNP--FYSISPK-SGILQQSLRQNHGTIRMFLNRNKESQSLLILSSSNCFR
3_Gossypium      878 HIFYIR-KRNDPSGSE--LISDNRSDRTNKNP--FYSIYS--NARIQQSFSQNHGTIHTLLNRNKESQSLIILSASNCFR
5_Ricinus        884 HISYISRKRNDPSGSG--PISNNGANHTNINP--FYPIYF--KTRIQQSLKQNQGTISTLLNRNKECQSLIILSSSNCFR
6_Rosa           872 HTSYIR-KRNDPLGSG--LISDNRSDRTNINP--FYSIYS--KERIQQSLRQNQGTFRTLLNRNKESQSLIILSSYNCFQ
9_Cucumis        878 DTAYMR-KRKDPSGSG--LIFNNESDRTNINP--FFSIYS--KTRVPQSPSQNQGTIRTLFNRNKERQSLIILSASNCLQ
11_Nicotiana     876 PISYIG-KRNDPSGSG--LLSDNGSDCTNINP--FSSIYSYSKAKIQQSINQPQGTIHTLLNRNKECQSLIILSAANCSR
13_Syringa       883 PISYIG-KRNNPSGSG--LLSDNGSDCTNINP--FSSIYS--KARIQHSLNQNQGTIHTLLNRNTGFQSLIILSSSNCFR
18_Liquidambar   882 PISYTG-KRNDPSGSG--WISDNGSDRTNINP--FYSTYS--KERIQQSLSQNQGTIRTLLNRNKECQSLRILSSSNCSR
19_Papaver       876 PILYTR-KRNDRGGAGLIWIPDNGSDRTNLNP--FSF---SSKARIQQTFTQHQGTIRALVNRNKESQPLIILSSSNCFQ
20_Ananas        874 TISYTG-KRYDRASSG--LIPDNGLDRTNINP--FYSKAK------IQSLSQHQGTIGTLLNRNKECQSLIILSSSNCSR
28_Liriodendron  878 PISYIG-KRDDTTGSG--LIPDNESDRTNINT--FYSKT-----R-IQSLTQHQGTIRTFLNRNKECQSFLILSSSDCSR
30_Magnolia      878 PISYIG-KRNDTAGSG--LIPDNESDRTNINT--FYSKT-----R-IQSLTQHQGTICTFLNRNKECQSFLILSSSDCSR
32_Nymphaea      885 PILYTG-KRNDGSGS---VIPDTGSYCANTNL--FSSKVK------MKSLSQHQGTVRTFLNRNKEGQSLIVFSSSNCSR
33_Amborella     855 NICYIR-KRNDPLGSG--LISDNRSDCT--NP--FYSIYS--KEKIQQSLRQNQGTIHTLLNRSKESQSLIILSSSNCFQ
35_Picea         723 PLFFMGR-RDNKASSN--LMFHNKLDHT--NL--FYSN------GERQLISKHQGTICSLYNGEEDSGSFMVLSPSDCFR
44_Ginkgo        869 PG---GK-RKNVTGSK--FLFHNRSDQT--NT--FSSN------RGSQFFSKHQGTIRTLPNEEKEGGSFAVLSPSDCSR
51_Physcomitrium 823 INLMNKK-KNNNIILN--YLFKKKR----------YII-NQKDCEKILLLSKTWGIIRTPSNKNQEKSFFLILSPFNLFQ
```

```
T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli         1069 ------------------------------------------------------------------------------AG
0_Nostoc         909 ----------------------------------------------------------DLITVNTSTQPKVKM--
1_Litchi         955 MGPFNDI-KYHNVIKQSIHI------------QKGSLIPIRNSLGPLGT-VLQIANFYSFYY--LITYNQISVT--KYWK
2_Arabidopsis    944 MGPFNHV-KHHNVINQSI--------------KKNTLITIKNSSGPLGT-ATPISNFYSFLP--LLTYNQISLI--KYFQ
3_Gossypium      951 MGPFNDV-KYHNVIKQSI--------------KKDPLIPIKNLLGPLGT-APKIANFYSSFYP-LITHNQTSVA--KYFE
5_Ricinus        958 MDPFNDV-KHHNVIKESI-------------KRDPIIPIRNSLGPLGT-ALQIANLYLFYHLNLITHNRISVT--KYLK
6_Rosa           945 MSPFNDV-KYYDGIKESIKR-----------DRDSLIQITNLLGPLGT-ASQIDLFYSFYHL--LTHNHISVTKYFYLQ
9_Cucumis        951 MDLFNDVKDY-NVIKESS--------------KKDPLISIRNSLGPLGA-APQIVNFYSFYD--LITHNPISLT--KYLQ
11_Nicotiana     951 MGPFKDV-KYHSVIKKSI--------------KKDPLIPIRNSLGPLGT-SLPIENFYSSYH--LITHNQILVT--NYLQ
13_Syringa       956 MGPFNDVIKYHNVIKESIKI------------TKDPLIPLKNSLGPFGT-AFTIANFFSFYH--LITHNQILVN--NYLQ
18_Liquidambar   955 MGPFNDV-KYHNVIKESI--------------KRDPLIPIRNSLGPLGT-ALQIANFYSFYH--LITHNKILVT--KYLQ
19_Papaver       950 MGPFNSVKYNDGVTKEST--------------KRDLRISILNSLGPLGI-VPKFVNFS---SYHLITHNQILVK--KYLL
20_Ananas        943 IGPFNSS-KYNNLTK----------------ESDPLIPIRDSLGLLGAIVPKIANFYSSYH--LITHNQIVLK--KYLL
28_Liriodendron  947 IGPFNGS-KSHKVTKESI--------------KEDPMIPIRNSLGPLGT-VPKIANFYSSYY--LITHNQILLN--KYLL
30_Magnolia      947 IGPFNGS-KSHKVTKESI--------------KEDPMIPIRNSLGPLGT-VSKIANFYSSYY--LITHNQILLN--KYLL
32_Nymphaea      953 IN----VSKYHNVTKESIKE------------KEDTPIPILNLLGPLGT-VPKIHNFSPSYH--SITHNEILLNKYLILD
33_Amborella     926 MSPFKDV-QYSNGIKESI--------------KVEPLIPIRNSLGPLGT-SSQIENFYY----LLKTHNQISVT--KYLQ
35_Picea         790 IVLFNDSKCYDTV-NKSN--------------REDPMRKIIEFSGLLGHLH-SITNRFPSS--HFLTYKKVLSKKHS--I
44_Ginkgo        933 TVLFSGSKYYDTV-KRSI--------------QEDPMMQIIELSGLLGNLH-SIANRFPSP--HLITYNKVLSNKHS--I
51_Physcomitrium 889 TILFDKTKQNLKIENNVEKLFTYEPKKIIKTFNIEKRKNFVEFLGLLGYLQN-ITKSFQLFSCKKFSDKSI---PINFSI
```

```
T. thermophilus 1251 ------------------------------------------------------------------------------
E. coli         1071 GKDLRPALKIV--------DAQG----------------------------------------------------------
0_Nostoc         924 GDLLVAGT---EVATGIFTEESGQVTNVK-----------------------------------------KLG-VKSEELGV
1_Litchi        1017 LDNLKQTFQIC---KFYLMDENGRIYNPDPDSKIVLNPFNLNWYFLHH--------NYCEE--MSTIISLGQFICENVCI
2_Arabidopsis   1004 LDNLKYIFQKI---NSYLIDENGIILNLDPYSNVVLNPFKLNWYFLHQNYHHNYCE----E--TSTIISLGQFFCENVCI
3_Gossypium     1012 LDNLKQAFQVL---NYYLIAENGRIYNFDPCRNIFLNAVNLNWYFPHHHYHH----NYCEE--TSTIISLGQFICENVCI
5_Ricinus       1020 LDNLKQTFRVL---KYYLMDENGRVVNPDPCSNSVLNPFNLNWYFLHHNYHHNYCHNYCEE--SFTIISLGQFICENVCM
6_Rosa          1009 LDNLKQTFQVF---KYYLMDENGRISNSDPCSSILLNPFNLNWHFLDH--------NYCEE--TSTIISLGQFICENLCI
9_Cucumis       1011 LDNLKQTFQVL---KYYLMDENGGIFNSDPCSNIVFNTFNLNWHFLHHNYHNNYCEET--P--TRTRISLGHFFFENVCI
11_Nicotiana    1011 LDNLKQTFQVIK-FKYYLMDENGKIFNPDPCRNIILNPFNLNWYFLHH--------NYCEE--TSKIISLGQFICENVCI
13_Syringa      1019 LDNLKQTFQVI---KYYLMDENEKIYNPEPGSNIILNPFNLNWYFLHH--------NYCQE--TSTIISLGQFICENVCI
18_Liquidambar  1015 LDNLKQTFQVL---NYYLMDENGRIYNPDPCSNIILNPFNLNWYFLHH--------NYCEE--TSTIISLGQFICENVCI
19_Papaver      1010 LDNLKQTFTF-QGLKYYLLDETGRIYNPNLGSHIILNPLNLNWFFLQH--------DYCEE--RATIINLGQFICENVCI
20_Ananas       1001 LDNLKQIFQVLQVLKYCLIDENRRIYNPDPCSNIILNPFHLNWCFFHH--------DYCEE--TSTKISLGQFICENVCL
28_Liriodendron 1007 LDNLKQTFQVL---KYYLMDENGRIYNPNLHSNIIFNPFDLNWCFLRH--------DYCEE--TSTIISLGQFICENVCI
30_Magnolia     1007 LDNLKQTSQVL---KYYLMDENGRIYNPDPRSNIIFNPFDLNWCFLRH--------DYCEE--TSTIISLGQFICENVCI
32_Nymphaea     1014 NNNPKQTFQLL---KYFLVDENGRISNANPCSDIIFNLFGS--CFLPH--------DYCKGTSTTRIISLGQFICENVCL
33_Amborella     984 LDNFTQPFQVL---QYYLMDENGIVYNSDPCSNTRLNPFNLNWHFFHNNYDNNYYQK------KSPIISLGRFFCENVCI
35_Picea         850 FHN---SFNTFQVPKYYFMDENTRISHFDPCRNIISNLLGPNWCSSSS--------EFCKK--IFPVVSPGQLIPESVCI
44_Ginkgo        993 SDN---SGKVSQVSKCYFMGGNTGILNFDSCRNIIFNLFNSNWCSPLS--------NFCKK--KLPAVSLGQLIRESVCI
51_Physcomitrium 965 IDNLKKKIK---ISKWFFLNENKKVQKFFLTQNTILSL--LNWSFPIF--------DLAKK--KTQLFNLGHFFCDGLSI
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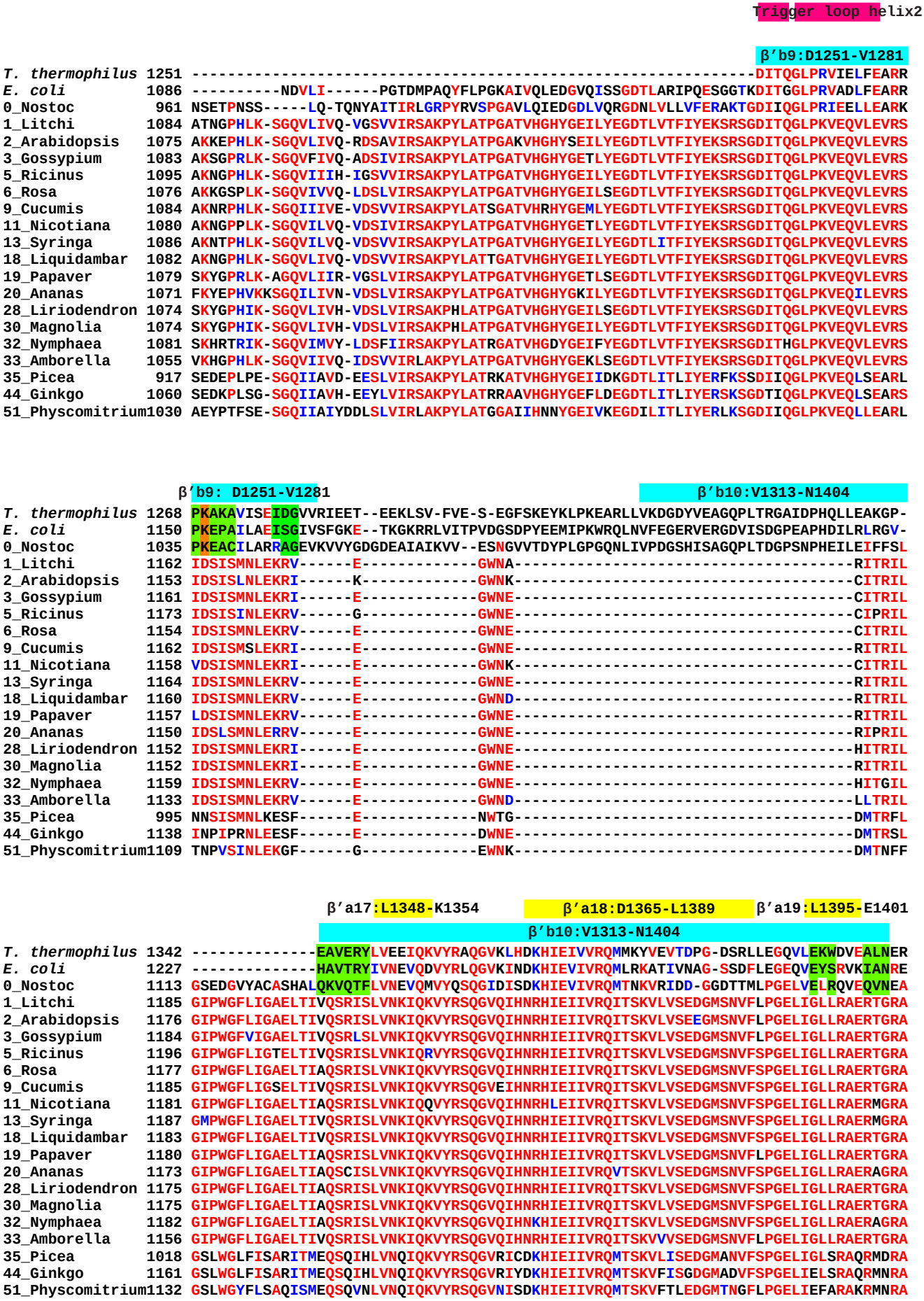
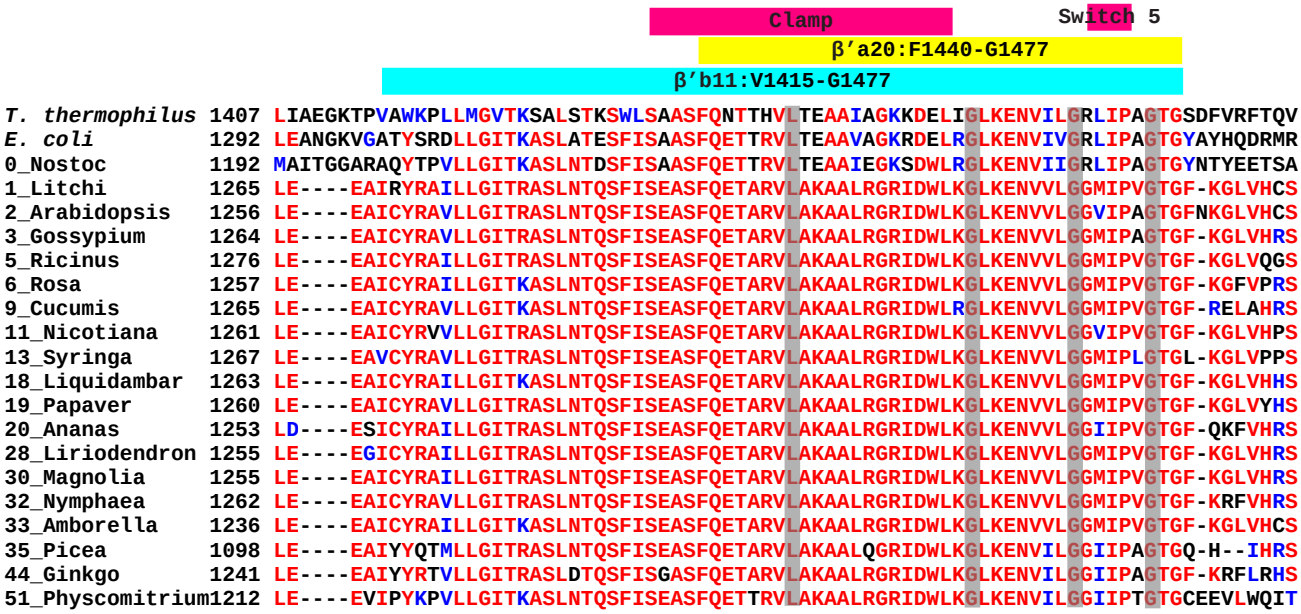
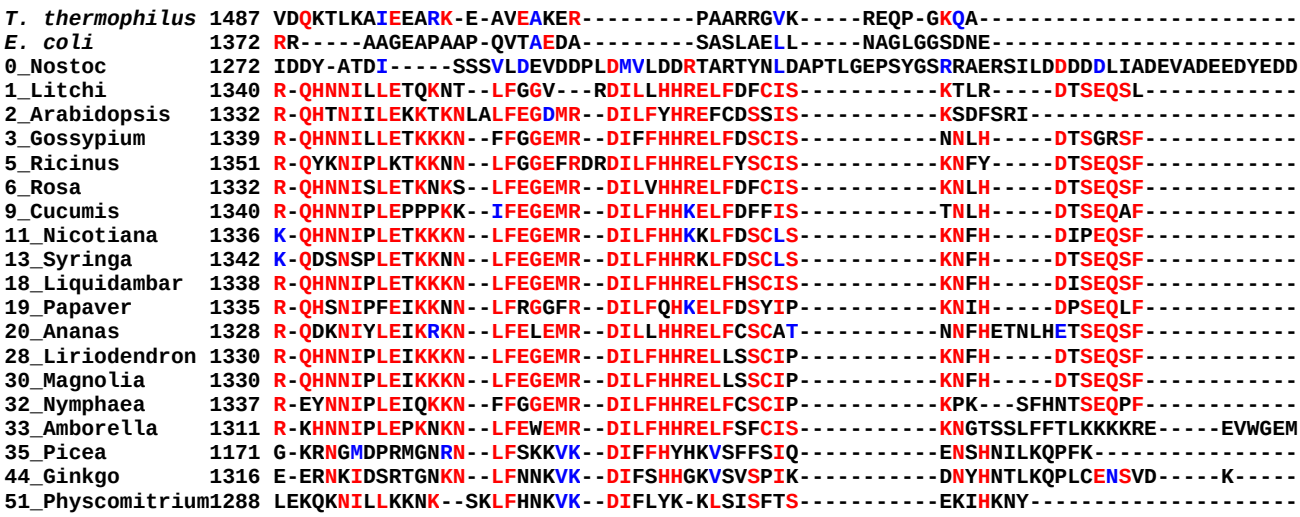
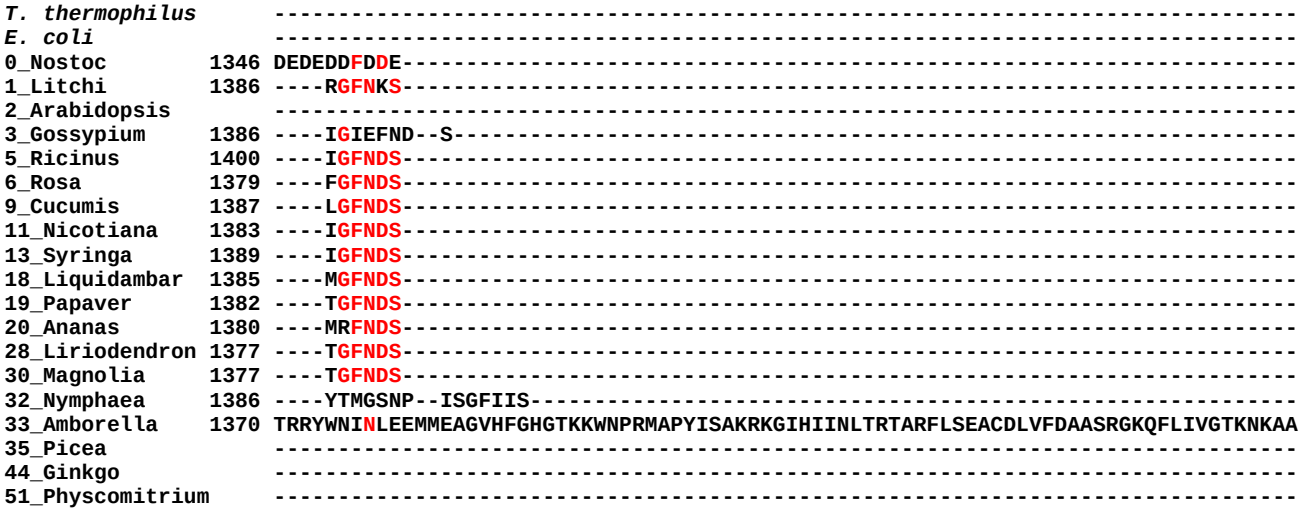

Trigger loop helix2
β'b9:D1251-V1281
T. thermophilus 1251 ----------DITQGLPRVIELFEARR
E. coli 1086 ----------NDVLI------PGTDMPAQYFLPGKAIVQLEDGVQISSGDTLARIPQESGGTKDITGGLPRVADLFEARR
0_Nostoc 961 NSETPNSS-----LQ-TQNYAITIRLGRPYRVSPGAVLQIEDGDLVQRGDNLVLLVFERAKTGDIIQGLPRIEELLEARK
1_Litchi 1084 ATNGPHLK-SGQVLIVQ-VGSVVIRSAKPYLATPGATVHGHYGEILYEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
2_Arabidopsis 1075 AKKEPHLK-SGQVLIVQ-RDSAVIRSAKPYLATPGAKVHGHYSEILYEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
3_Gossypium 1083 AKSGPRLK-SGQVFIVQ-ADSIVIRSAKPYLATPGATVHGHYGETLYEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
5_Ricinus 1095 AKNGPHLK-SGQVIIIH-IGSVVIRSAKPYLATPGATVHGHYGEILYEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
6_Rosa 1076 AKKGSPLK-SGQVIVVQ-LDSLVIRSAKPYLATPGATVHGHYGEILSEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
9_Cucumis 1084 AKNRPHLK-SGQIIIVE-VDSVVIRSAKPYLATSGATVHRHYGEMLYEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
11_Nicotiana 1080 AKNGPPLK-SGQVILVQ-VDSIVIRSAKPYLATPGATVHGHYGETLYEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
13_Syringa 1086 AKNTPHLK-SGQVILVQ-VDSVVIRSAKPYLATPGATVHGHYGEILYEGDTLITFIYEKSRSGDITQGLPKVEQVLEVRS
18_Liquidambar 1082 AKNGPHLK-SGQVLIVQ-VDSVVIRSAKPYLATTGATVHGHYGEILYEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
19_Papaver 1079 SKYGPRLK-AGQVLIIR-VGSLVIRSAKPYLATPGATVHGHYGETLSEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
20_Ananas 1071 FKYEPHVKKSGQILIVN-VDSLVIRSAKPYLATPGATVHGHYGKILYEGDTLVTFIYEKSRSGDITQGLPKVEQILEVRS
28_Liriodendron 1074 SKYGPHIK-SGQVLIVH-VDSLVIRSAKPHLATPGATVHGHYGEILSEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
30_Magnolia 1074 SKYGPHIK-SGQVLIVH-VDSLVIRSAKPHLATPGATVHGHYGEILYEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
32_Nymphaea 1081 SKHRTRIK-SGQVIMVY-LDSFIIRSAKPYLATRGATVHGDYGEIFYEGDTLVTFIYEKSRSGDITHGLPKVEQVLEVRS
33_Amborella 1055 VKHGPHLK-SGQVIIVQ-IDSVVIRLAKPYLATPGATVHGHYGEKLSEGDTLVTFIYEKSRSGDITQGLPKVEQVLEVRS
35_Picea 917 SEDEPLPE-SGQIIAVD-EESLVIRSAKPYLATRKATVHGHYGEIIDKGDTLITLIYERFKSSDIIQGLPKVEQLSEARL
44_Ginkgo 1060 SEDKPLSG-SGQIIAVH-EEYLVIRSAKPYLATRRAAVHGHYGEFLDEGDTLITLIYERSKSGDTIQGLPKVEQLSEARS
51_Physcomitrium 1030 AEYPTFSE-SGQIIAIYDDLSLVIRLAKPYLATGGAIIHNNYGEIVKEGDILITLIYERLKSGDIIQGLPKVEQLLEARL
β'b9: D1251-V1281
β'b10:V1313-N1404
T. thermophilus 1268 PKAKAVISEIDGVVRIEET--EEKLSV-FVE-S-EGFSKEYKLPKEARLLVKDGDYVEAGQPLTRGAIDPHQLLEAKGP-
E. coli 1150 PKEPAILAEISGIVSFGKE--TKGKRRLVITPVDGSDPYEEMIPKWRQLNVFEGERVERGDVISDGPEAPHDILRLRGV-
0_Nostoc 1035 PKEACILARRAGEVKVVYGDGDEAIAIKVV--ESNGVVTDYPLGPGQNLIVPDGSHISAGQPLTDGPSNPHEILEIFFSL
1_Litchi 1162 IDSISMNLEKRV------E------------GWNA----------RITRIL
2_Arabidopsis 1153 IDSISLNLEKRI------K------------GWNK----------CITRIL
3_Gossypium 1161 IDSISMNLEKRI------E------------GWNE----------CITRIL
5_Ricinus 1173 IDSISINLEKRV------G------------GWNE----------CIPRIL
6_Rosa 1154 IDSISMNLEKRV------E------------GWNE----------CITRIL
9_Cucumis 1162 IDSISMSLEKRI------E------------GWNE----------RITRIL
11_Nicotiana 1158 VDSISMNLEKRI------E------------GWNK----------CITRIL
13_Syringa 1164 IDSISMNLEKRV------E------------GWNE----------RITRIL
18_Liquidambar 1160 IDSISMNLEKRV------E------------GWND----------RITRIL
19_Papaver 1157 LDSISMNLEKRV------E------------GWNE----------RITRIL
20_Ananas 1150 IDSLSMNLERRV------E------------GWNE----------RIPRIL
28_Liriodendron 1152 IDSISMNLEKRI------E------------GWNE----------HITRIL
30_Magnolia 1152 IDSISMNLEKRI------E------------GWNE----------RITRIL
32_Nymphaea 1159 IDSISMNLEKRV------E------------GWNE----------HITGIL
33_Amborella 1133 IDSISMNLEKRV------E------------GWND----------LLTRIL
35_Picea 995 NNSISMNLKESF------E------------NWTG----------DMTRFL
44_Ginkgo 1138 INPIPRNLEESF------E------------DWNE----------DMTRSL
51_Physcomitrium 1109 TNPVSINLEKGF------G------------EWNK----------DMTNFF
β'a17:L1348-K1354
β'a18:D1365-L1389
β'a19:L1395-E1401
β'b10:V1313-N1404
T. thermophilus 1342 ----------EAVERYLVEEIQKVYRAQGVKLHDKHIEIVVRQMMKYVEVTDPG-DSRLLEGQVLEKWDVEALNER
E. coli 1227 ----------HAVTRYIVNEVQDVYRLQGVKINDKHIEVIVRQMLRKATIVNAG-SSDFLEGEQVEYSRVKIANRE
0_Nostoc 1113 GSEDGVYACASHALQKVQTFLVNEVQMVYQSQGIDISDKHIEVIVRQMTNKVRIDD-GGDTTMLPGELVELRQVEQVNEA
1_Litchi 1185 GIPWGFLIGAELTIVQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFLPGELIGLLRAERTGRA
2_Arabidopsis 1176 GIPWGFLIGAELTIVQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEEGMSNVFLPGELIGLLRAERTGRA
3_Gossypium 1184 GIPWGFVIGAELTIVQSRLSLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFLPGELIGLLRAERTGRA
5_Ricinus 1196 GIPWGFLIGTELTIVQSRISLVNKIQRVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERTGRA
6_Rosa 1177 GIPWGFLIGAELTIAQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERTGRA
9_Cucumis 1185 GIPWGFLIGSELTIVQSRISLVNKIQKVYRSQGVEIHNRHIEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERTGRA
11_Nicotiana 1181 GIPWGFLIGAELTIAQSRISLVNKIQQVYRSQGVQIHNRHLEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERMGRA
13_Syringa 1187 GMPWGFLIGAELTIVQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERMGRA
18_Liquidambar 1183 GIPWGFLIGAELTIVQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERTGRA
19_Papaver 1180 GIPWGFLIGAELTIAQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFLPGELIGLLRAERTGRA
20_Ananas 1173 GIPWGFLIGAELTIAQSCISLVNKIQKVYRSQGVQIHNRHIEIIVRQVTSKVLVSEDGMSNVFSPGELIGLLRAERAGRA
28_Liriodendron 1175 GIPWGFLIGAELTIAQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERTGRA
30_Magnolia 1175 GIPWGFLIGAELTIAQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERTGRA
32_Nymphaea 1182 GIPWGFLIGAELTIAQSRISLVNKIQKVYRSQGVQIHNKHIEIIVRQITSKVLVSEDGMSNVFSPGELIGLLRAERAGRA
33_Amborella 1156 GIPWGFLIGAELTIVQSRISLVNKIQKVYRSQGVQIHNRHIEIIVRQITSKVVVSEDGMSNVFLPGELIGLLRAERTGRA
35_Picea 1018 GSLWGLFISARITMEQSQIHLVNQIQKVYRSQGVRICDKHIEIIVRQMTSKVLISEDGMANVFSPGELIGLSRAQRMDRA
44_Ginkgo 1161 GSLWGLFISARITMEQSQIHLVNQIQKVYRSQGVRIYDKHIEIIVRQMTSKVFISGDGMADVFSPGELIELSRAQRMNRA
51_Physcomitrium 1132 GSLWGYFLSAQISMEQSQVNLVNQIQKVYRSQGVNISDKHIEIIVRQMTSKVFTLEDGMTNGFLPGELIEFARAKRMNRA


Clamp
Switch 5
β'a20:F1440-G1477
β'b11:V1415-G1477
T. thermophilus 1407 LIAEGKTPVAWKPLLMGVTKSALSTKSWLSAASFQNTTHVLTEAAIAGKKDELIGLKENVILGRLIPAGTGSDFVRFTQV
E. coli 1292 LEANGKVGATYSRDLLGITKASLATESFISAASFQETTRVLTEAAVAGKRDELRGLKENVIVGRLIPAGTGYAYHQDRMR
0_Nostoc 1192 MAITGGARAQYTPVLLGITKASLNTDSFISAASFQETTRVLTEAAIEGKSDWLRGLKENVIIGRLIPAGTGYNTYEETSA
1_Litchi 1265 LE----EAIRYRAILLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KGLVHCS
2_Arabidopsis 1256 LE----EAICYRAVLLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGVIPAGTGFNKGLVHCS
3_Gossypium 1264 LE----EAICYRAVLLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPAGTGF-KGLVHRS
5_Ricinus 1276 LE----EAICYRAILLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KGLVQGS
6_Rosa 1257 LE----EAICYRAILLGITKASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KGFVPRS
9_Cucumis 1265 LE----EAICYRAVLLGITKASLNTQSFISEASFQETARVLAKAALRGRIDWLRGLKENVVLGGMIPVGTGF-RELAHRS
11_Nicotiana 1261 LE----EAICYRVVLLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGVIPVGTGF-KGLVHPS
13_Syringa 1267 LE----EAVCYRAVLLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPLGTGL-KGLVPPS
18_Liquidambar 1263 LE----EAICYRAILLGITKASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KGLVHHS
19_Papaver 1260 LE----EAICYRAVLLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KGLVYHS
20_Ananas 1253 LD----ESICYRAILLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGIIPVGTGF-QKFVHRS
28_Liriodendron 1255 LE----EGICYRAILLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KGLVHRS
30_Magnolia 1255 LE----EAICYRAILLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KGLVHRS
32_Nymphaea 1262 LE----EAICYRAVLLGITRASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KRFVHRS
33_Amborella 1236 LE----EAICYRAILLGITKASLNTQSFISEASFQETARVLAKAALRGRIDWLKGLKENVVLGGMIPVGTGF-KGLVHCS
35_Picea 1098 LE----EAIYYQTMLLGITRASLNTQSFISEASFQETARVLAKAALQGRIDWLKGLKENVILGGIIPAGTGQ-H--IHRS
44_Ginkgo 1241 LE----EAIYYRTVLLGITRASLDTQSFISGASFQETARVLAKAALRGRIDWLKGLKENVILGGIIPAGTGF-KRFLRHS
51_Physcomitrium 1212 LE----EVIPYKPVLLGITKASLNTQSFISEASFQETTRVLAKAALRGRIDWLKGLKENVILGGIIPTGTGCEEVLWQIT


T. thermophilus 1487 VDQKTLKAIEEARK-E-AVEAKER---------PAARRGVK-----REQP-GKQA------------------------
E. coli 1372 RR-----AAGEAPAAP-QVTAEDA---------SASLAELL-----NAGLGGSDNE------------------------
0_Nostoc 1272 IDDY-ATDI-----SSSVLDEVDDPLDMVLDDRTARTYNLDAPTLGEPSYGSRRAERSILDDDDDLIADEVADEEDYEDD
1_Litchi 1340 R-QHNNILLETQKNT--LFGGV---RDILLHHRELFDFCIS----------KTLR-----DTSEQSL------------
2_Arabidopsis 1332 R-QHTNIILEKKTKNLALFEGDMR--DILFYHREFCDSSIS----------KSDFSRI--------------------
3_Gossypium 1339 R-QHNNILLETKKKN--FFGGEMR--DIFFHHRELFDSCIS----------NNLH-----DTSGRSF------------
5_Ricinus 1351 R-QYKNIPLKTKKNN--LFGGEFRDRDILFHHRELFYSCIS----------KNFY-----DTSEQSF------------
6_Rosa 1332 R-QHNNISLETKNKS--LFEGEMR--DILVHHRELFDFCIS----------KNLH-----DTSEQSF------------
9_Cucumis 1340 R-QHNNIPLEPPPKK--IFEGEMR--DILFHHKELFDFFIS----------TNLH-----DTSEQAF------------
11_Nicotiana 1336 K-QHNNIPLETKKKN--LFEGEMR--DILFHHKKLFDSCLS----------KNFH-----DIPEQSF------------
13_Syringa 1342 K-QDSNSPLETKKNN--LFEGEMR--DILFHHRKLFDSCLS----------KNFH-----DTSEQSF------------
18_Liquidambar 1338 R-QHNNIPLETKKKN--LFEGEMR--DILFHHRELFHSCIS----------KNFH-----DISEQSF------------
19_Papaver 1335 R-QHSNIPFEIKKNN--LFRGGFR--DILFQHKELFDSYIP----------KNIH-----DPSEQLF------------
20_Ananas 1328 R-QDKNIYLEIKRKN--LFELEMR--DILLHHRELFCSCAT----------NNFHETNLHETSEQSF------------
28_Liriodendron 1330 R-QHNNIPLEIKKKN--LFEGEMR--DILFHHRELLSSCIP----------KNFH-----DTSEQSF------------
30_Magnolia 1330 R-QHNNIPLEIKKKN--LFEGEMR--DILFHHRELLSSCIP----------KNFH-----DTSEQSF------------
32_Nymphaea 1337 R-EYNNIPLEIQKKN--FFGGEMR--DILFHHRELFCSCIP----------KPK---SFHNTSEQPF------------
33_Amborella 1311 R-KHNNIPLEPKNKN--LFEWEMR--DILFHHRELFSFCIS----------KNGTSSLFFTLKKKKRE-----EVWGEM
35_Picea 1171 G-KRNGMDPRMGNRN--LFSKKVK--DIFFHYHKVSFFSIQ----------ENSHNILKQPFK---------------
44_Ginkgo 1316 E-ERNKIDSRTGNKN--LFNNKVK--DIFSHHGKVSVSPIK----------DNYHNTLKQPLCENSVD-----K-----
51_Physcomitrium 1288 LEKQKNILLKKNK--SKLFHNKVK--DIFLYK-KLSISFTS----------EKIHKNY----------------


T. thermophilus ----------
E. coli ----------
0_Nostoc 1346 DEDEDDFDDE----------
1_Litchi 1386 ----RGFNKS----------
2_Arabidopsis ----------
3_Gossypium 1386 ----IGIEFND--S----------
5_Ricinus 1400 ----IGFNDS----------
6_Rosa 1379 ----FGFNDS----------
9_Cucumis 1387 ----LGFNDS----------
11_Nicotiana 1383 ----IGFNDS----------
13_Syringa 1389 ----IGFNDS----------
18_Liquidambar 1385 ----MGFNDS----------
19_Papaver 1382 ----TGFNDS----------
20_Ananas 1380 ----MRFNDS----------
28_Liriodendron 1377 ----TGFNDS----------
30_Magnolia 1377 ----TGFNDS----------
32_Nymphaea 1386 ----YTMGSNP--ISGFIIS----------
33_Amborella 1370 TRRYWNINLEEMMEAGVHFGHGTKKWNPRMAPYISAKRKGIHIINLTRTARFLSEACDLVFDAASRGKQFLIVGTKNKAA
35_Picea ----------
44_Ginkgo ----------
51_Physcomitrium ----------

```
T. thermophilus      ------------------------------------------------------------------------
E. coli              ------------------------------------------------------------------------
0_Nostoc             ------------------------------------------------------------------------
1_Litchi             ------------------------------------------------------------------------
2_Arabidopsis        ------------------------------------------------------------------------
3_Gossypium          ------------------------------------------------------------------------
5_Ricinus            ------------------------------------------------------------------------
6_Rosa               ------------------------------------------------------------------------
9_Cucumis            ------------------------------------------------------------------------
11_Nicotiana         ------------------------------------------------------------------------
13_Syringa           ------------------------------------------------------------------------
18_Liquidambar       ------------------------------------------------------------------------
19_Papaver           ------------------------------------------------------------------------
20_Ananas            ------------------------------------------------------------------------
28_Liriodendron      ------------------------------------------------------------------------
30_Magnolia          ------------------------------------------------------------------------
32_Nymphaea          ------------------------------------------------------------------------
33_Amborella    1450 DSVAGAAIKARCHYVNKKWLGGMLTNWYTTETRLHKFRDLRTEQKTGRLNRLPKRDAAVLKRQLSHLQTYLGGIKYMTGL
35_Picea             ------------------------------------------------------------------------
44_Ginkgo            ------------------------------------------------------------------------
51_Physcomitrium     ------------------------------------------------------------------------

T. thermophilus      ------------------------------------------------------------------------
E. coli              ------------------------------------------------------------------------
0_Nostoc             ------------------------------------------------------------------------
1_Litchi             ------------------------------------------------------------------------
2_Arabidopsis        ------------------------------------------------------------------------
3_Gossypium          ------------------------------------------------------------------------
5_Ricinus            ------------------------------------------------------------------------
6_Rosa               ------------------------------------------------------------------------
9_Cucumis            ------------------------------------------------------------------------
11_Nicotiana         ------------------------------------------------------------------------
13_Syringa           ------------------------------------------------------------------------
18_Liquidambar       ------------------------------------------------------------------------
19_Papaver           ------------------------------------------------------------------------
20_Ananas            ------------------------------------------------------------------------
28_Liriodendron      ------------------------------------------------------------------------
30_Magnolia          ------------------------------------------------------------------------
32_Nymphaea          ------------------------------------------------------------------------
33_Amborella    1530 PDIVIIVDQQEEYTALRECITLGIPTICLIDTNCDPDLADISIPANDDAIASIRLILNKLVFAILLYDISGVEVGQHFYW
35_Picea             ------------------------------------------------------------------------
44_Ginkgo            ------------------------------------------------------------------------
51_Physcomitrium     ------------------------------------------------------------------------

T. thermophilus      ------------------------------------------------------------------------
E. coli              ------------------------------------------------------------------------
0_Nostoc             ------------------------------------------------------------------------
1_Litchi             ------------------------------------------------------------------------
2_Arabidopsis        ------------------------------------------------------------------------
3_Gossypium          ------------------------------------------------------------------------
5_Ricinus            ------------------------------------------------------------------------
6_Rosa               ------------------------------------------------------------------------
9_Cucumis            ------------------------------------------------------------------------
11_Nicotiana         ------------------------------------------------------------------------
13_Syringa           ------------------------------------------------------------------------
18_Liquidambar       ------------------------------------------------------------------------
19_Papaver           ------------------------------------------------------------------------
20_Ananas            ------------------------------------------------------------------------
28_Liriodendron      ------------------------------------------------------------------------
30_Magnolia          ------------------------------------------------------------------------
32_Nymphaea          ------------------------------------------------------------------------
33_Amborella    1610 QIGGFQVHAQVLITSWVVIAILLGSAILAVRNPQTIPTDGQNFFEYVLEFIRDVSKTQIGEEYGPWVPFIGTLFLFIFVS
35_Picea             ------------------------------------------------------------------------
44_Ginkgo            ------------------------------------------------------------------------
51_Physcomitrium     ------------------------------------------------------------------------
```

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T. thermophilus      ----------------------------------------
E. coli              ----------------------------------------
0_Nostoc             ----------------------------------------
1_Litchi             ----------------------------------------
2_Arabidopsis        ----------------------------------------
3_Gossypium          ----------------------------------------
5_Ricinus            ----------------------------------------
6_Rosa               ----------------------------------------
9_Cucumis            ----------------------------------------
11_Nicotiana         ----------------------------------------
13_Syringa           ----------------------------------------
18_Liquidambar       ----------------------------------------
19_Papaver           ----------------------------------------
20_Ananas            ----------------------------------------
28_Liriodendron      ----------------------------------------
30_Magnolia          ----------------------------------------
32_Nymphaea          ----------------------------------------
33_Amborella    1690 NWSGALLPWKIIELPHGELAAPTNDINTTVALALLTRFHKTLIT
35_Picea             ----------------------------------------
44_Ginkgo            ----------------------------------------
51_Physcomitrium     ----------------------------------------
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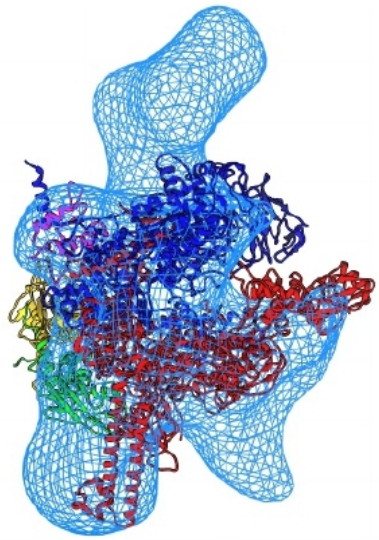
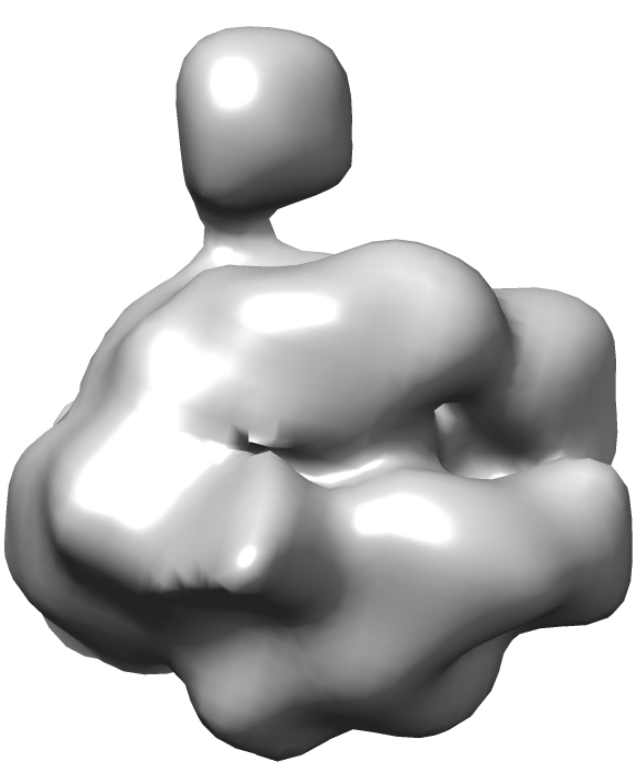
Figure S6: view of the catalytic core from the *E. coli* RNAP (PDB entry: 3LU0 (Opalka *et al*., 2010)) manually fitted into the envelope of PEP using Chimera (Pettersen *et al*., 2004).



Figures S7a and S7b: overall shape of the a) human RNA polymerase II (EMDB entry: EMD-2194; Kassube *et al*., 2013) and b) yeast RNA polymerase III (EMDB entry: EMD-1753; Vanini *et al*., 2010) solved at 25 and 21 Å respectively.:



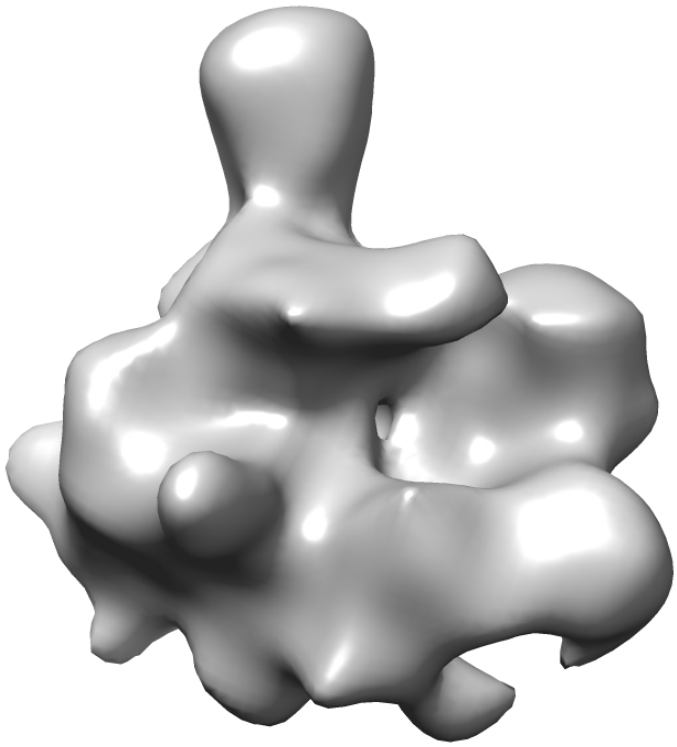


Figure S8: FSC curve for the PEP 3D reconstruction calculated between two independent half maps (gold standard FSC). The dotted line represents the FSC=0.143 cutoff used to determine the resolution.