

1 **Fig1S. Amino acid sequence alignment between the primase domains of T7**
2 **primase-helicase and AtTwinkle.** The six conserved motifs of prokaryotic primases
3 are indicated by roman numbers. The identity of the catalytic conserved amino acids
4 in the RNAP domain and the conserved cysteines that coordinate a zinc atom in the
5 zinc finger of T7 primase are indicated by a red asterisk.

6
7 **Fig 2S. Amino acid alignment of selected plant primase-helicases.** Amino acid
8 alignment between selected plant Twinkles. The conserved cysteines and the
9 catalytic amino acids in the RNAP domain are colored in black.

10
11 **Fig. 3S AtTwinkle oligoribonucleotide synthesis using an array of 64**
12 **trinucleotides sequences labeled with [α -³²P]-ATP.** The reaction contained
13 individual oligonucleotides with the 5'-TTTTTTTXXXTTTTTTT--3' sequence. The
14 identity of each deoxynucleotide is denoted by a color code. The identity of the 3'
15 deoxynucleotide varies in each panel. Panel A contains an adenine, panel B contains
16 a cytosine, panel C contains a guanosine and panel D contains a thymidine. Within
17 each panel reactions 1 to 4 contained an adenine, 5 to 8 a cytosine, 9 to 12 a guanine
18 and 13 to 16 a thymidine. Finally, each of the four groups contained an adenine,
19 cytidine, guanine and thymidine in the first, second, third and four positions
20 respectively). Primase reactions were carried out using 5 μ M of the synthetic
21 template and 0.5 μ M of each recombinant AtPrimase-helicase.

22
23 **Fig. 4S AtTwinkle oligoribonucleotide synthesis using an array of 64**
24 **trinucleotides sequences labeled with [α -³²P]-CTP.** The experimental setup is
25 equal to one described for Fig. 3S.

26
27 **Fig. 5S AtTwinkle oligoribonucleotide synthesis using an array of 64**
28 **trinucleotides sequences labeled with [α -³²P]-GTP.** The experimental setup is
29 equal to one described for Fig. 3S.

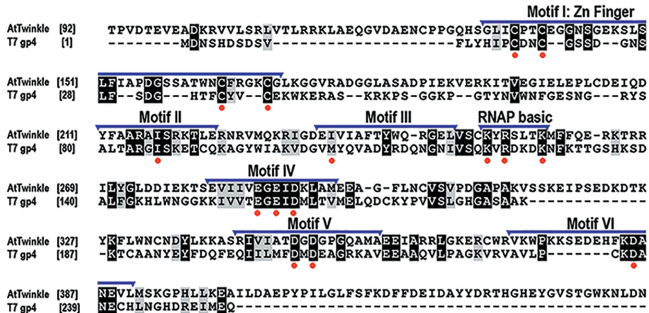
31 **Fig. 6S AtTwinkle oligoribonucleotide synthesis using an array of 64**
32 **trinucleotides sequences labeled with [α -³²P]-UTP.** The experimental setup is
33 equal to one described for Fig. 3S.

34

35 **Fig. 7S Quantification of oligoribonucleotide synthesis by AtTwinkle in**
36 **trinucleotides templates.** Graphical representation of the total amount of
37 synthesized oligoribonucleotides in a GGA template as 100%. The percentage of
38 each RNA product (2-mer to 8-mer) from the GGA template is indicated. The relative
39 abundance of total RNA synthesis and its breakdown from 2-mer to 8-mers, in
40 comparison to the synthesis in the GGA template, is indicated for the rest of the
41 templates.

42

Fig. 1S



Beta vulgaris STHHSARLSVLMKMLELLELGHQSI-PG-QYSHLL... 233
Camelina sativa KRGVSSKLVTRLRKRLAEQIDQNCN-PG-QYSGHLL... 235
Solanum lycopersicum DTTESDHEKALKQLSQQVIGDIDGSCG-PG-QYNGHLL... 226
Vitis vinifera TNSASRLNVLKRLKLELQVDFDQMLA-PG-QYSHLL... 235
Tarenaya hassleriana KXIVLSRLNVLKRLKLELQVDFDQMLA-PG-QYSHLL... 235
Lupinus angustifolius AKVEM-QFELLKRLKLAIGDITACV-PG-QYSHLL... 225
Nelumbo nucifera ETIDISIRNALKRLKLELQVDFDQMLA-PG-QYSHLL... 225
Noccaea caeruleascens KSDVYSLANLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 225
Juglans regia NGLDASQAKLTKLQKLELQVDFDQMLA-PG-QYSHLL... 289
Eucalyptus grandis RGIDT-FVRLKRLKLELQVDFDQMLA-PG-QYSHLL... 249
Musa acuminata EPIFAERLAKLTKLQKLELQVDFDQMLA-PG-QYSHLL... 224
Nicotiana tomentosifoliosa GIAESHVYALKEKLELQVDFDQMLA-PG-QYSHLL... 228
Pyrus x bretschneideri NQMSMQMLRLEKLELQVDFDQMLA-PG-QYSHLL... 239
Brassica rapa GAVQV-RLANLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 227
Raphanus sativus DGAVQVSLANLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 231
Arabidopsis thaliana KRVLVSLRNLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 230
Theobroma cacao WFLMRSLSLELKLKLELQVDFDQMLA-PG-QYSHLL... 234
Phoenix dactylopera RMIIDTRLAKLTKLQKLELQVDFDQMLA-PG-QYSHLL... 227
Gossypium arboreum QPDSRSLIQLNHLKQLGIDITACV-PG-QYSHLL... 234
Ricinus communis EDSKPHLEKRLKLELQVDFDQMLA-PG-QYSHLL... 232
Malus domestica NQMSMQMLRLEKLELQVDFDQMLA-PG-QYSHLL... 239
Manihot esculenta EVKSLKRLKRLKLELQVDFDQMLA-PG-QYSHLL... 229
Cucumis melo KALSSSTLNLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 254
Gossypium hirsutum QPDSRSLIQLNHLKQLGIDITACV-PG-QYSHLL... 234
Prunus mume KRVDENQLSRLLKLELQVDFDQMLA-PG-QYSHLL... 228
Marchantia polymorpha EFPVFNNEKTRLEKLELQVDFDQMLA-PG-QYSHLL... 239
Capsicum annuum ETAESEHMAKQLSQQVIGDIDGSCG-PG-QYSHLL... 221
Nicotiana tabacum GIAESHVYALKEKLELQVDFDQMLA-PG-QYSHLL... 228
Arachis ipaensis NEKER-RFNSLVKYLELQVDFDQMLA-PG-QYSHLL... 218
Daucus carota DAKNSMRLSILNKLKLELQVDFDQMLA-PG-QYSHLL... 218
Arachis duranensis NEKER-RFNSLVKYLELQVDFDQMLA-PG-QYSHLL... 218
Orzyza sativa KKGCEQRLLQKLELQVDFDQMLA-PG-QYSHLL... 237
Sorghum bicolor AAASEERLQKLELQVDFDQMLA-PG-QYSHLL... 243
Citrus sinensis KMLDSRWSLELKLKLELQVDFDQMLA-PG-QYSHLL... 242
Cynara cardunculus EIVDSQKRLKRLKLELQVDFDQMLA-PG-QYSHLL... 222
Solanum tuberosum ETAESEHMAKQLSQQVIGDIDGSCG-PG-QYSHLL... 224
Solanum pennellii DTTESDHEKALKQLSQQVIGDIDGSCG-PG-QYSHLL... 226
Brachypodium distachyon KXACEERLQKLELQVDFDQMLA-PG-QYSHLL... 240
Setaria italica KKAASEERLQKLELQVDFDQMLA-PG-QYSHLL... 244
Vigna radiata KSVLEL-QFNILKRLKLELQVDFDQMLA-PG-QYSHLL... 224
Brassica oleracea GAVQV-RLANLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 227
Medicago truncatula NQMSMQMLRLEKLELQVDFDQMLA-PG-QYSHLL... 219
Zostera marina VDVVLEKRLKLELQVDFDQMLA-PG-QYSHLL... 219
Erythranthe guttata QVQVKKQLKRLKLELQVDFDQMLA-PG-QYSHLL... 245
Coccomyxa subellipsoidea -----TIRNLSVAGIILKQYA-PG-QYSHLL... 118
Cicer arietinum ENKLEMQVGLKRLKLELQVDFDQMLA-PG-QYSHLL... 229
Gossypium raimondii QPDSRSLIQLNHLKQLGIDITACV-PG-QYSHLL... 234
Cucumis sativus KASSSTRNLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 242
Aegilops tauschii RARACEERLQVDFDQMLA-PG-QYSHLL... 195
Amborella trichopoda DANVPERLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 220
Fragaria vesca ETIDQEGRECELRKLELQVDFDQMLA-PG-QYSHLL... 226
Sesamum indicum QLVDEKLLMLRKLKLELQVDFDQMLA-PG-QYSHLL... 153
Populus euphratica PEVKSLELRLKRLKLELQVDFDQMLA-PG-QYSHLL... 233
Morus notabilis KNAS-QFRIKRLKLELQVDFDQMLA-PG-QYSHLL... 206
Nicotiana glauca GIAESHVYALKEKLELQVDFDQMLA-PG-QYSHLL... 228
Capsella rubella KRAVVSLRNLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 226
Arabis alpina KRAIVSNLANLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 219
Zea mays STAESEERLQKLELQVDFDQMLA-PG-QYSHLL... 249
Jatropha curcas EDLQTLNKLKRLKLELQVDFDQMLA-PG-QYSHLL... 205
Eutrema salsugineum KRAVQFRLANLRLKRLKLELQVDFDQMLA-PG-QYSHLL... 229
Prunus persica KRVDENQLSRLLKLELQVDFDQMLA-PG-QYSHLL... 242
Phaseolus vulgaris KSVLEL-QFNILKRLKLELQVDFDQMLA-PG-QYSHLL... 224
Populus trichocarpa PEVKSLELRLKRLKLELQVDFDQMLA-PG-QYSHLL... 226
Citrus clementina MLDSSRWSLELKLKLELQVDFDQMLA-PG-QYSHLL... 134
Gentiana aurea SGVQVNSPELRLKLELQVDFDQMLA-PG-QYSHLL... 229
Ostreococcus tauri AAQESTGPGFLKRLKLELQVDFDQMLA-PG-QYSHLL... 180
Micromonas pusilla -----MQSYT-PG-QH-RTR... 126
Selaginella moellendani -----MDDVT-LG-KEHRL... 117
Ostreococcus lucimaris -----MDHRIVLQSYT-PG-QH-RTR... 127
Micromonas comoda SPI-----ALRVLKLELQVDFDQMLA-PG-QYSHLL... 155
Physcomitrella patens -----ALTKTVKQKLSKGLKLYG-PG-TVRG... 163

Beta vulgaris -----SVG-G--QVIAFTYRRNGVLVLSCKYRDV-TKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DVPT---PDQTKYQVWLNCKEYFEKATIIILADGDFGQALSSEASBBERGRKRVME 378
Camelina sativa -----RIG-D--QVIAFTYWRGELVLSCKYRVL-TKFFQW-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DTPF---EKDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 379
Solanum lycopersicum -----RHS-D--QVIAFTYWRGELVLSCKYRNM-TKFFQW-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---VEKDTKYQVWLNCKEYLEKASIIILADGDFGQALSSEASBBERGRKRVME 371
Vitis vinifera -----SYG-D--QVIAFTYRRNGVLVLSCKYRDV-NKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DTPF---AEKDTKYQVWLNCKEYLEKASIIILADGDFGQALSSEASBBERGRKRVME 380
Tarenaya hassleriana -----RMS-D--EVAIAFTYWRGELVLSCKYRVL-TKFFQWVHVLIK-----TLFSEKDTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPS---ESQDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 385
Lupinus angustifolius -----KYY-D--QVIAFTYRRNGVLVLSCKYRDI-DKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---EQDTKYQVWLNCKEYLEKASIIILADGDFGQALSSEASBBERGRKRVME 370
Nelumbo nucifera GQVCGAIDGKGLLSLSSHG-NT-KIAIAFTYRRNGVLVLSCKYRDV-KFFWQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPS---IEKDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 443
Noccaea caerulea -----RLGD--EIVIAFTYWRGELVLSCKYRFL-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ETPF---EKDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 421
Juglans regia -----RSG-D--QIAIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EVDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---EQDTKYQVWLNCKEYLEKASIIILADGDFGQALSSEASBBERGRKRVME 434
Eucalyptus grandis -----RCE-N--QVIAFTYRRNGVLVLSCKYRDV-KKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DTPF---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 394
Musa acuminata -----RGC-K--KIAIAFTYRRNGVLVLSCKYRDV-TKFFWQ-----EFDKDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DTPF---AEEDTKYQVWLNCKEYLEKASIIILADGDFGQALSSEASBBERGRKRVME 369
Nicotiana tomentosif -----RSG-D--QVIAFTYRRNGVLVLSCKYRDI-TKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---VDDTKYQVWLNCKEYLEKASIIILADGDFGQALSSEASBBERGRKRVME 373
Pyrus x bretschneide -----STG-D--QIAIAFTYRRNGVLVLSCKYRDI-DKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---EKDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 384
Brassica rapa -----RIG-D--EIVIAFTYWRGELVLSCKYRVL-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ETPF---EKDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 372
Raphanus sativus -----RIG-D--EIVIAFTYWRGELVLSCKYRVL-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ETPF---EKDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 376
Arabidopsis thaliana -----RSG-D--EIVIAFTYWRGELVLSCKYRDI-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPS---EKDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 375
Theobroma cacao -----RSG-E--EIAIAFTYRRNGVLVLSCKYRDI-AKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPA---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 379
Phoenix dactylifera -----LYN-N--QVIAFYSVRNGVLVLSCKYRVA-SKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DMPV---EKEDKPYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 371
Gossypium arboreum -----RSG-D--EIAIAFTYRRNGVLVLSCKYRDI-VKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPA---EQDTKYQVWLNCKEYFKKASIIILADGDFGQALSSEASBBERGRKRVME 379
Ricinus communis -----SYG-N--QVIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----ESDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPS---KEQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 377
Malus domestica -----STG-D--QIAIAFTYRRNGVLVLSCKYRDI-DKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---EKDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 384
Manihot esculenta -----SYG-S--QIMIAFTYRRNGVLVLSCKYRDS-NKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---EQDTKYQVWLNCKEYLNKASIIILADGDFGQALSSEASBBERGRKRVME 374
Cucumis melo -----TFG-D--QIAIAFTYRRNGVLVLSCKYRDV-NKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DVPF---ADQDKYQVWLNCKEYLNKASIIILADGDFGQALSSEASBBERGRKRVME 399
Gossypium hirsutum -----RSG-D--EIAIAFTYRRNGVLVLSCKYRDI-AKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPA---EQDTKYQVWLNCKEYFKKASIIILADGDFGQALSSEASBBERGRKRVME 379
Prunus mume -----TTT-V--QICIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DTPF---AEQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 373
Xanthoxylum polymorph -----NNT-G--DVVIAFTYRRNGVLVLSCKYRDI-DKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DTPF---VDDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 416
Capsicum annuum -----RYG-D--QVIAFTYRRNGVLVLSCKYRDM-AKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---VDDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 366
Nicotiana tabacum -----RYG-D--QVIAFTYRRNGVLVLSCKYRDI-TKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---VDDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 373
Arachis ipaensis -----KYD-D--QVIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---REKDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 365
Daucus carota -----RHD-D--KDAIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPA---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 347
Arachis duranensis -----KYD-D--QVIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---REKDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 365
Orzya sativa -----MWN-N--KIVIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----KLPD---KQDKKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 381
Sorghum bicolor -----NWS-N--KISIAFTYRRNGVLVLSCKYRVA-DKFFWQ-----EPDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----KIPD---KEQDKKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 387
Citrus sinensis -----RHS-H--EVIIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----NVPF---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 389
Cynara cardunculus -----STG-D--QIAIAFTYRRNGVLVLSCKYRDI-TKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPS---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 335
Solanum tuberosum -----RHS-D--QVIAFTYRRNGVLVLSCKYRDM-TKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---VDDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 369
Solanum pennellii -----RHS-D--QVIAFTYRRNGVLVLSCKYRDM-TKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---VEKDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 371
Brachypodium distach -----KWN-K--KIVIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EPDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----KLPD---KQDKKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 384
Setaria italica -----KMK-N--KISIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----KIPD---KEQDKKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 389
Vigna radiata -----RYG-D--EIVIAFTYWRGELVLSCKYRVL-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 368
Brassica oleracea -----RIG-D--EIVIAFTYWRGELVLSCKYRVL-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ETPF---EKDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 372
Medicago truncatula -----KYD-D--QIVIAFTYRRNGVLVLSCKYRDV-NKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---LEQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 364
Zostera marina -----KYD-N--KIVIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----ENDAEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----NMLD---KEKDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 363
Fragaria vesca -----RTG-N--QVIAFTYRRNGVLVLSCKYRDI-TKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----SIAS---EEDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 390
Coccomyxa subellipso -----Y-SSKH--TNAIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----ASIFPFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---PEADTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 268
Cicer arietinum -----KYD-D--QVIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---RDQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 374
Gossypium raimondii -----RSG-D--EIAIAFTYRRNGVLVLSCKYRDI-AKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPA---EQDTKYQVWLNCKEYFKKASIIILADGDFGQALSSEASBBERGRKRVME 379
Cucumis sativus -----RGN-N--QIAIAFTYRRNGVLVLSCKYRDA-NKFFWQ-----EPDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DVFP---ADQDKKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 387
Aegilops tauschii -----KRN-N--KIVIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---IEKDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 313
Amborella trichopoda -----RMS-D--QVIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPA---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 365
Fragaria vesca -----RCSIT-D--QISIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DVFP---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 375
Sesamum indicum -----RTG-N--QVIAFTYRRNGVLVLSCKYRDI-TKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ALPS---EEDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 298
Populus euphratica -----GYG-D--QVIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---NQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 380
Morus notabilis -----RYG-D--QFAIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---KEDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 351
Nicotiana sylvestris -----RIG-D--QVIAFTYRRNGVLVLSCKYRDI-TKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---VDDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 373
Capsella rubella -----RIG-D--QVIAFTYWRGELVLSCKYRVL-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ETPF---EKDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 381
Arabis alpina -----RIG-D--EIVIAFTYWRGELVLSCKYRVL-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ETPF---EEDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 364
Zea mays -----MWN-N--KISIAFTYRRNGVLVLSCKYRVA-DKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----KIPD---QDQDKKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 439
Jatropha curcas -----SYG-N--QICIAFTYRRNGVLVLSCKYRDS-TKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----550DLPF---KQDKKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 350
Eutrema salsugineum -----RIR-D--EIIIAFTYWRGELVLSCKYRSL-TKFFQW-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ETPF---EKDTKYKFLWNCNDYLRKASIIILADGDFGQALSSEASBBERGRKRVME 384
Prunus persica -----TTG-V--QICIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 277
Phaseolus vulgaris -----KYE-D--QVIAFTYRRNGVLVLSCKYRDV-SKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---PEQDKKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 369
Populus trichocarpa -----GYG-D--QVIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---NQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 323
Citrus Clementina -----RHS-H--EVIIAFTYRRNGVLVLSCKYRDI-NKFFWQ-----EKDTEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DVPF---EQDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 279
Gentiana aurea -----TKHN-N--TLVIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----EADTDFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----EIPA---EEDTKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 326
Ostreococcus tauri -----NVSPAGS-Y--VDALFFYRRNGVLVLSCKYRDI-EKFFWQ-----VKGAEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ALPS---FEEDRKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 384
Micromonas pusilla -----RVSPAGS-Y--VDALFFYRRNGVLVLSCKYRDI-EKFFWQ-----VKGAEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---FEEDRKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 277
Selaginella moellend -----YSG-S--ELVIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----ARGAARFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ETPD---FEEDRKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 264
Ostreococcus lucimaris -----SVSPAGS-Y--VDALFFYRRNGVLVLSCKYRDI-EKFFWQ-----VKGAEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---FEEDRKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 278
Micromonas commoda -----RVSPAGS-Y--VDALFFYRRNGVLVLSCKYRDI-EKFFWQ-----VKGAEFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----DLPF---FEEDRKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 306
Physcomitrella paten -----WA-NTDLAIAFTYRRNGVLVLSCKYRDI-EKFFWQ-----VKNAPFLFGDDEKASASLIVVSE-DKAMEBGFNRCNSVFGAPFVSK-K-----ELPF---PHEDRKYQVWLNCKEYLDKASIIILADGDFGQALSSEASBBERGRKRVME 309

Beta vulgaris	N6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRGGS	MTETEYVSQMLTKRFAQHSCHWVFAHPQ	MINWAGEAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPI	DRVQ	CVCRVRNKVAGTI	GDAPLSYN	688
Camelina sativa	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	689
Solanum lycopersicum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	691
Vitis vinifera	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	690
Tarenaya hassleriana	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	695
Lupinus angustifolius	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	695
Nelumbo nucifera	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	780
Noccaea caerulescens	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	741
Juglans regia	N6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	734
Eucalyptus grandis	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	704
Musa acuminata	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	679
Nicotiana tomentosif	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	540
Pyrus x bretschneide	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	694
Brassica rapa	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	682
Raphanus sativus	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	686
Arabidopsis thaliana	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	685
Theobroma cacao	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	689
Phoenix dactylifera	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	690
Gossypium arboreum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	681
Ricinus communis	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	689
Malus domestica	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	692
Manihot esculenta	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	684
Cucumis melo	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	689
Gossypium hirsutum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	700
Prunus mume	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	682
Marchantia polymorpha	Q6	FL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	787
Capsicum annuum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	676
Nicotiana tabacum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	540
Arachis ipaensis	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	676
Daucus carota	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	671
Arachis duranensis	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	674
Oryza sativa	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	691
Sorghum bicolor	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	697
Citrus sinensis	N6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	699
Cynara cardunculus	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	626
Solanum tuberosum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	679
Solanum pennellii	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	681
Brachypodium distach	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	694
Setaria italica	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	698
Vigna radiata	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	679
Brassica oleracea	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	685
Medicago truncatula	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	674
Zostera marina	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	673
Erythranthe guttata	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFS	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	700
Coccomyxa subellipso	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	589
Cicer arietinum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	684
Gossypium raimondii	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	689
Cucumis sativus	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	697
Aegilops tauschii	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	603
Amborella trichopoda	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	676
Arabidopsis lyrata	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	686
Sesamum indicum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	608
Populus euphratica	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	690
Morus notabilis	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	695
Nicotiana glauca	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	693
Capsella rubella	E6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	681
Arabidopsis lyrata	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	674
Zeaxanthin	K6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	674
Jatropha curcas	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	749
Eutrema salsugineum	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRTR	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEKAGPLDQV	QV	CVCRVRNKVAGTI	GDAPLSYN	667
Prunus persica	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	597
Phaseolus vulgaris	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	679
Populus trichocarpa	D6	SL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LQWGDGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLSYN	633
Citrus clementina	N6	HL	EDDCLPFIKMWLLD	LAKAAVLRHGVRGLV	DPYNELDHQRFPN	QTETEYVSQMLTKRFAQHSCHWVFAHPQ	LHHVGGAPNLYDI	SSSAHF	INKCDNGI	VI	HNRNDEPAGPDRVQ	QV	CVCRVRNKVAGTI	GDAPLS	

Beta vulgaris	-----SDGWCRVT--GEFTDLT-----DPES-----	707
Camelina sativa	-----RAT--GLYSDSP-----ETPEMRLNKRH-----	710
Solanum lycopersicum	-----RVT--GEFMDID-----EHPKRG-----	697
Vitis vinifera	-----RIG--GVYTDID-----EPTSSE-----	705
Tarenaya hassleriana	-----RAT--GLFSDLE-----KR-----	707
Lupinus angustifolius	-----RVT--GEFMPAD-----NDMKA-----	695
Nelumbo nucifera	-----RTT--GEFKDID-----ETPSKN-----	769
Noccaea caerulescens	-----RAT--GVYSDCN-----VTPLTSSRSNKR-----	765
Juglans regia	-----RVT--GEFMDID-----EFSGKR-----	750
Eucalyptus grandis	-----RVT--GEFMDID-----APFKK-----	720
Musa acuminata	-----RTT--GEFEDID-----VRAISMSITRGG-----	701
Nicotiana tomentosif	-----RVT--GVYTDID-----EPKQKQ-----	705
Pyrus x bretschneide	-----RAT--GQFMDVE-----NTQKSR-----	710
Brassica rapa	-----RAT--GLFSDSP-----ITPEKPERSSRRQ-----	706
Raphanus sativus	-----RAT--GLFSDSP-----ITPEKPERSSRRP-----	710
Arabidopsis thaliana	-----RTT--GSYSDSP-----VTPGMPERRSPKRY-----	709
Theobroma cacao	-----RVT--GVYTDID-----EPKQKQ-----	705
Phoenix dactylifera	-----RVT--GEFMDID-----DKDQKQT-----	699
Gossypium arboreum	-----RVT--GVYNDID-----ESQKK-----	704
Ricinus communis	-----RYENHGTF-----RAT--GQFMDVE-----NTRKST-----	700
Malus domestica	-----RAT--GQFMDVE-----NTRKST-----	710
Manihot esculenta	-----RVT--GEFMDIA-----GEMKLRKSSC-----	694
Cucumis melo	-----RVT--GEFSDAA-----GEMKLRKSSC-----	729
Gossypium hirsutum	-----RVT--GVYNDID-----ESQKK-----	704
Prunus mume	-----RAT--GQFKDIG-----IEKST-----	698
Marchantia polymorph	-----RAT--GEYADVI-----	737
Capsicum annuum	-----RVT--GEFMDID-----EHPKRG-----	692
Nicotiana tabacum	-----RVT--GEFTPVD-----KSKK-----	691
Arachis ipaensis	-----RVT--GVYVDSN-----NTCAVDP-----	698
Daucus carota	-----RAT--GEYADVI-----KSKK-----	689
Arachis duranensis	-----RVS--GEFRDAD-----KDTAKKAAVAANVAK-----APQRKG-----	723
Oryza sativa	-----RVT--GQYKADG-----KSTIAAVTAVQNRQNSYAKSKKDNVAYEMFFHPVEDDSVAEDDGSFGLNSA	761
Sorghum bicolor	-----RVT--GEYMDIV-----	709
Citrus sinensis	-----RVT--GEYMDIV-----	709
Cynara cardunculus	-----RVT--GEYLDIKFKDLKIISTLPTSLLKTPRTERTHITNFNT-----	666
Solanum tuberosum	-----RVT--GEFMDID-----EHPKRG-----	695
Solanum pennellii	-----RVT--GEFMDID-----EHPKRG-----	697
Brachypodium distach	-----RVT--GEYKADG-----KBIIVAKVVKQSKKTAIRR-----	723
Setaria italica	-----RVT--GQFRDAG-----KATIAAATAAQTATRNNSYKSTKDNVAYEMVPHVAEDDSVGLDSL-----	759
Vigna radiata	-----RVT--GEYTATD-----SKRPTDRK-----	698
Brassica oleracea	-----RAT--GLFSDSP-----ITPEKPERSSRRP-----	709
Medicago truncatula	-----RVT--GEYSEDD-----RKR-----	687
Zostera marina	-----RVT--GEYSDLS-----QD-----	685
Erythranthe guttata	-----RVT--GEYMDIN-----NTSQNGKRGQ-----	721
Coccomyxa subellipso	-----RTT--GRYKDL-----	599
Cicer arietinum	-----RVT--GEYVDDD-----SKR-----	697
Gossypium raimondii	-----RVT--GVYKID-----ESQKK-----	704
Cucumis sativus	-----RVT--GEFLDAA-----GDVKLKKPSS-----	717
Aegilops tauschii	-----RTT--GEYKAD-----EAIIVAKVVKQIRQKSTSYQR-----	634
Amborella trichopoda	-----RAT--GEYKAD-----EGH-----	689
Fragaria vesca	-----RAT--GRYMDIF-----KANEK-----	702
Sesamum indicum	-----RVT--GEYSDID-----AAALIKHRA-----	628
Populus euphratica	-----RVT--GEFMNVD-----KSTGSDNGGFKPLRR-----	715
Morus notabilis	-----RVT--GRYDIDQ-----	705
Nicotiana sylvestris	-----RVT--GEFMDLD-----EHPKRG-----	699
Capsella rubella	-----RTT--GLYSDSP-----VSLVMPERRSNKR-----	715
Arabis alpina	-----RAT--GLFSDSP-----VTPERDRANR-----	698
Zea mays	-----RVT--GEFKDAG-----KATAPSAAKQSRKEAYKMPFQHAEDGENSGL-----	794
Jatropha curcas	-----RVT--GEFMDID-----	670
Eutrema salsugineum	-----GCRTNW-----	673
Prunus persica	-----RAT--GQFKDIG-----IKKST-----	612
Phaseolus vulgaris	-----RVT--GEYTPD-----KKPTDRK-----	697
Populus trichocarpa	-----RVT--GEFMNVD-----KSTGSDNGGFKPLRR-----	658
Citrus clementina	-----RVT--GEYMDIV-----	599
Genlisea aurea	-----R-----	637
Ostreococcus tauri	-----VAN--GRYVDVV-----GAGEPLEE-----	699
Micromonas pusilla	-----LSN--GRYEDLK-----GAGEPLEE-----	597
Selaginella moellend	WLIVCSSPLVSFLLNSLKLAFCRVT--GLFSDAGPV-----	618
Ostreococcus lucimaris	-----VSN--GRYVDI-----	592
Micromonas commoda	-----LTV--GRYEDLK-----	622
Physcomitrella paten	-----RVT--GDYEDVR-----D-----	630

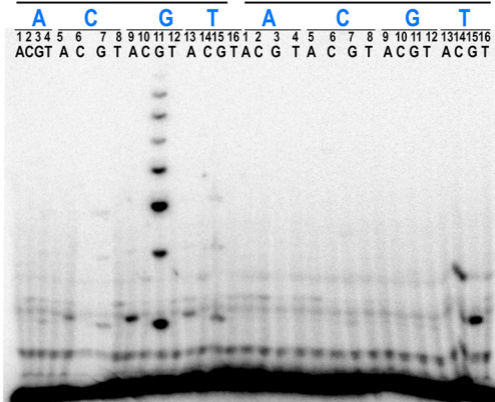
α -³²P rATP

Fig S3

3' 5' p
5' TTTTTT X X X TTTTTT 3'

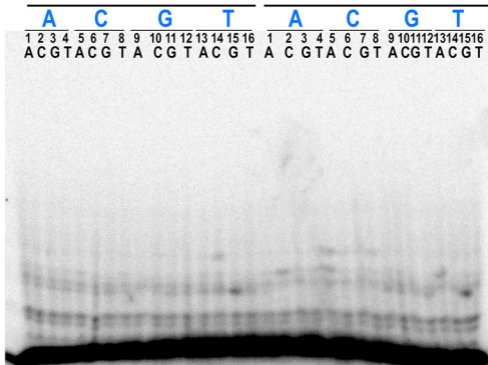
A

C



G

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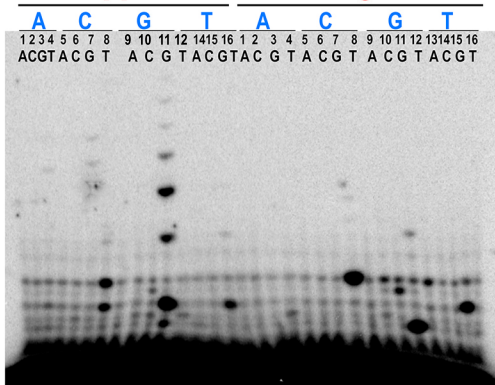


α -³²P rCTP Fig S4

3' 5' p
5' TTTTTT X X X TTTTTT 3'

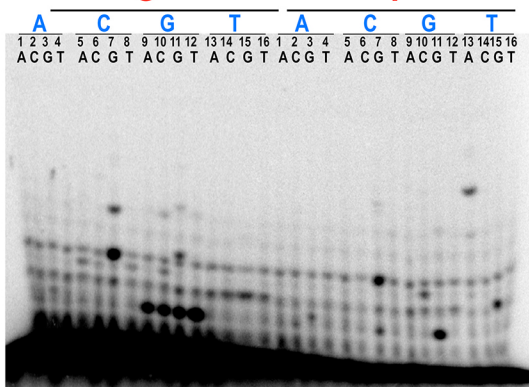
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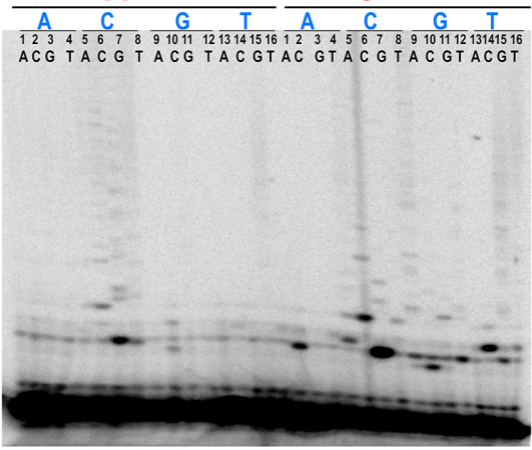


α -³²P rGTP Fig S5

3' 5' p
5' TTTTTT X X X TTTTTT 3'

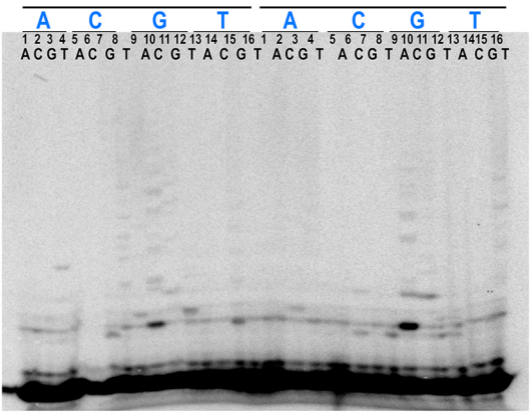
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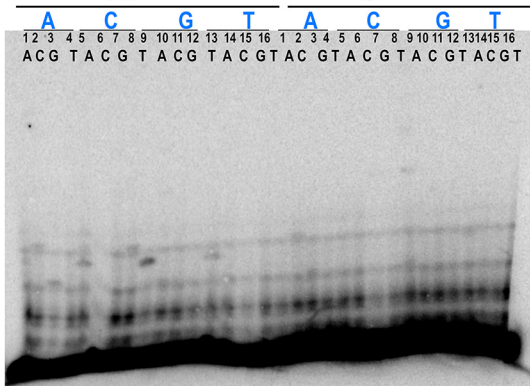
α -³²P UTP

Fig S6



A

C



G

T

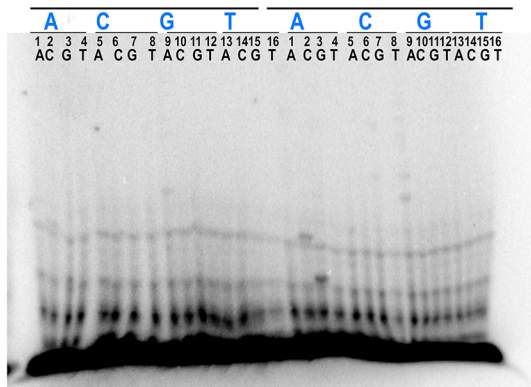


Fig S7

