Nitrogen transporters: comparative genomics, transport activity, and gene expression of NRTs and AMTs in Black Cottonwood (*Populus trichocarpa*)

by

Neil Joseph Jude Baron von Wittgenstein
B.Sc., University of Victoria, 2010

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Supervisory Committee

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Dr. Barbara J. Hawkins, (Department of Biology)
Co-Supervisor

Dr. Jürgen Ehlting, (Department of Biology)
Co-Supervisor

Dr. Steve J. Perlman, (Department of Biology)
Member

Abstract

Supervisory Committee

Dr. Barbara J. Hawkins (Department of Biology, UVic)
Co-Supervisor

Dr. Jürgen Ehlting (Department of Biology, UVic)
Co-Supervisor

Dr. Steve J. Perlman (Department of Biology, UVic)
Member

Black Cottonwood (*Populus trichocarpa*) is a fast-growing, economically important tree species. *P. trichocarpa* was the first tree to have its genome fully sequenced and is considered the model organism for genomic research in trees. Of the macronutrients in plants, Nitrogen (N) is required in the greatest amounts and is generally the limiting nutrient in terrestrial ecosystems. Inorganic N-transport is performed by four families of transporter proteins, AMT1 and AMT2 for ammonium (NH_4^+) and NRT1 and NRT2 for nitrate (NO_3^-). I have created phylogenetic reconstructions of each of these transporter families in 22 members of *Viridiplantae* whose genomes have been fully sequenced. Based on these phylogenies, I have introduced a new classification system for the transporter families that better represents the evolutionary and functional relatedness of the proteins. These phylogenies were supplemented with topology predictions, subcellular localization predictions, and *in silico* expression profiling in order to suggest functional characterization of the groups. This facilitated candidate gene selection for NH_4^+ and NO_3^- uptake transporters from *P. trichocarpa*. Expression profiling was performed on two of these candidates. Results suggest that PtAMT1-1 may be a high-affinity, root-localized NH_4^+ transporter. In contrast, PtNRT2-6 is a high-affinity NO_3^- transporter localized to the dormant bud, but its physiological functions remain largely enigmatic. Flux profiles of NH_4^+, NO_3^-, and H^+ in the first 1.4 cm of root tips of three-week-old *P. trichocarpa* seedlings and cuttings were measured using the Microelectrode Ion Flux mEasurement (MIFE) system to demonstrate the activity of AMTs and NRTs under nutrient-abundant and nutrient-deficient conditions. I found mainly N-efflux from roots of cuttings while seedling roots exhibited N-uptake. This is the first report of such a difference. This highlights an unexpected but clear physiological difference between seedling and cutting roots, which are frequently used in experimental setups.

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1 Introduction

For proper growth, plants require mineral nutrients (Amtmann 2009). Of these nutrients, some are required in relatively small amounts (micronutrients) and others in larger quantities (macronutrients). There are eight micronutrients, including Iron, Zinc, Manganese, Copper, Nickel, Boron, Molybdenum, and Chlorine (Du et al. 2009, Welch 1995). These are required in quantities not exceeding 0.05% dry mass for normal plant functioning (Lukac and Godbold 2010). Micronutrients are critically important for plant growth, seed germination, efficient macronutrient usage (Malakouti 2008), and many other processes. Macronutrients — such as Nitrogen, Phosphorous, Potassium, and Magnesium — are required in much larger quantities, generally exceeding 0.1% dry mass (Lukac and Godbold 2010).

Nitrogen (N) is the macronutrient required in the greatest amounts. N is required for nutritional, osmotic, and signalling functions in plants (Glass *et al.* 2001, Miyagawa 2009). It is required as a constituent of amino acids (Hao *et al.* 2010), chlorophyll and photosynthetic enzymes, as well as N-containing secondary metabolites such as alkaloids (Hao *et al.* 2010, Prsa *et al.* 2007). N influences regulation of non-N-containing secondary metabolites such as flavonoids (Olsen *et al.* 2009). N is often the most limiting nutrient in terrestrial ecosystems, due to factors such as its high mobility across ecosystem boundaries (compared with phosphorous' relatively low mobility) and the large quantities of N required by plants for photosynthesis (Vitousek and Howarth 1991, Cleland and Harpole 2010, Engineer and Kranz 2007). Given N's pivotal physiological roles, and its heterogeneous distribution and variable availability in soil ranging over three orders of magnitude (Glass *et al.* 2002; Remans *et al.* 2006), understanding N-uptake is key to understanding plant nutrition.

N-uptake from the soil is the first step in N acquisition and assimilation (Orsel *et al.* 2001). In soils, N can exist as organic N, in the forms of amino acids, free peptides, and proteins (Nasholm *et al.* 2009, Rennenberg *et al.* 2010), and as inorganic N, in the forms of nitrate (NO_3^-) and ammonium (NH_4^+) (Rennenberg *et al.* 2010). Plants have evolved comprehensive methods of N-uptake to cope with the variable availability of N in soil (Sohlenkamp *et al.* 2002; Remans *et al.* 2006; Glass *et al.* 2001; Kraiser *et al.* 2011). Inorganic N is often the most important form of N taken up by many plant species (Chen *et al.* 2008; Couturier *et al.* 2007). NH_4^+ and NO_3^- uptake from the soil, as well as movement of NH_4^+ and NO_3^- throughout the plant, is regulated

by current N demand for growth and storage (Rennenberg *et al.* 2010), and is performed by two groups of ion transporter proteins, NH_4^+ transporters (AMTs) and NO_3^- transporters (NRTs). Each group can be subdivided into two families based on sequence similarity: NRT1 and NRT2 for NO_3^-, and AMT1 and AMT2 for NH_4^+.

To date, much of the research on the AMT and NRT families has been done on annual herbaceous species. With the recent sequencing of the *Populus trichocarpa* genome, we now have the means to study these N transporter families in trees. *P. trichocarpa* was first sequenced by Tuskan *et al.* in 2006 and is currently at assembly and annotation version 2.2 (however a version 3.0 pre-release is available on phytozome.net). While not yet as extensively studied as *Arabidopsis thaliana*, *P. trichocarpa* is well studied and may serve as a model (deciduous) tree. *P. trichocarpa* grows quickly in lab/greenhouse conditions, and the *P. trichocarpa* genome is relatively small, just over 500 million base pairs, making it ideal for genomic studies.

Poplar is also a valuable economic resource in the pulp industry since it is a fast growing species with exceptional wood fiber qualities: high average fiber length and aspect ratio (length to diameter ratio), and low Runkel Ratio (Ni *et al.* 2006) — an index of wood density (Horn 1978). Poplar pulp is an especially valuable resource considering paper and paperboard demand is predicted to more than triple in China alone by 2050 (Kayo *et al*. 2012).

Poplars and willows have some of the highest photosynthetic capacities, light use efficiencies, and rates of CO_2 exchange of woody species (Karp and Shield 2008). These qualities translate into rapid growth. The quick growth of *P. trichocarpa* is of value in an environmentally conscious future. Fast growth leads to extensive cell wall growth, and the most promising source for sustainable biofuel comes from the enzymatic breakdown of cellulose found in these cell walls (Karp and Shield 2008). Poplar can also be used as a carbon (C) sink. C-sequestration involves plants taking CO_2 from the atmosphere and incorporating it into biomass (long lived wood products) or into the soil C pool (Lemus and Lal 2005). The high tannin content of poplar leaves leads to slow decomposition, and thus the C is retained in the soil for longer (Kraus *et al*. 2003). Growing poplars requires much less N per hectare (20-50% less) than annual crops, allowing plantations on more marginal sites. Karp and Shield (2008) suggest that high N-use efficiency is one of the important traits needed to increase the bioenergy yield of

poplar in a sustainable way. As production of N-fertilizer is very energy intensive, the study of N nutrition, especially N-uptake, for poplar is important.

The aims of my thesis were:

1. To identify candidate genes for NH_4^+ and NO_3^- transport proteins in roots of *P. trichocarpa*.
2. To identify expression patterns of these N transport protein genes in the root region of active N-uptake.
3. To correlate expression patterns of N transport protein genes with NH_4^+ and NO_3^- net uptake in the root region of active uptake.

To select candidate genes, such as those for N-uptake in the current study, a phylogeny is often used as a starting point. This is the approach I took to identify candidate N transporter genes. A phylogeny is a reconstructed evolutionary history based on an extant set of genetic sequences, and suggests which sequences are more or less related. In order to select genes with the highest probability of physiological functions of interest, sequences which code for proteins that have been functionally characterized should be included. Uncharacterized sequences that are closely related to characterized ones may share some of the functions and can be a logical starting point for further investigations. Phylogenies for candidate gene selection may be relatively small, simply containing sequences from the organism of interest and a number of characterized genes from one or more other organisms.

To increase confidence in candidate gene selection, supplementary information can be included in the phylogeny. Sequence similarity is an important criterion for candidate selection; however, the sequence must be expressed in the proper tissue, in the proper cells, and in the proper location within the cell. While an extensive phylogeny can suggest candidate AMTs and NRTs responsible for uptake from the soil environment, correlation of candidate gene expression profiles with NH_4^+ and NO_3^- flux profiles (such as those obtained with the Microelectrode Ion Flux mEasurement system, or MIFE) further suggests this as the true function. In order to be as extensive as possible, the current study analyzes each of the four transporter families separately, across 22 fully sequenced *Viridiplantae* genomes. Fully sequenced genomes were selected in

order to provide confidence that all members of the AMT and NRT families in the genomes had been included.

Given the importance of N nutrition in plants and the economic, environmental, and scientific importance of *P. trichocarpa*, the need for identification and characterization of NRTs and AMTs in the *P. trichocarpa* genome is paramount. The current study provides identification and partial characterization of one NRT family member and one AMT family member in *P. trichocarpa* based on evidence from phylogenetic relationships and multiple tissue expression profiling. As well, my study displays the N-uptake capabilities of the first 1.4 cm of three-week-old *P. trichocarpa* seedling roots under N-limiting and N-sufficient conditions. As well, my study is the first to demonstrate a difference in flux profiles between *P. trichocarpa* seedlings and cuttings.

2 Phylogenetic Analysis

2.1 Introduction

Reconstructing the phylogenetic history of the respective gene families is an important first step in the characterization of transporter proteins. It allows pinpointing of candidate sequences for transporter proteins in an organism of interest, and suggests shared functional characteristics of transporter subfamilies. In many studies of NO_3^- and NH_4^+ transporters, putative phylogenetic relationships have been presented. In most cases, these phylogenies were intentionally limited to functionally characterized genes, often only from model organisms. However, some studies are more extensive, such as that by McDonald *et al.* (2010), which comprises an in-depth analysis of NO_3^- and NH_4^+ transporters in phytoplankton, bacteria, and a small number of land plant species using over 120 sequences. Another study analyzed the NRT1, NRT2, and NRT3 (NAR2) families in a select number of land plant species to determine monocot orthologs of functionally characterized eudicot sequences (Plett *et al*. 2010).

NO_3^- transporters are encoded by two distinct gene families (*NRT1* and *NRT2*) that do not share significant overall sequence similarity. Despite this, both the NRT1 and NRT2 families perform proton-coupled active transport and have 12 putative transmembrane (TM) domains (Chen *et al.* 2008).

The NRT2 family is responsible for the high affinity transport system (HATS) of NO_3^- (Glass 2009). The HATS is composed of saturable transporters that take up NO_3^- at low rates and high affinity and are expressed under NO_3^- limiting conditions. The HATS has inducible members (iHATS), which are expressed when NO_3^- concentrations are low, as well as constitutive members (cHATS), which are not N-inducible (Okamoto *et al.* 2006). It has also been determined that some members of the NRT2 family require association with NAR2 (Nitrate Assimilation-Related, Quesada *et al*. 1993, 1994) proteins for proper functioning. Interaction with NAR2 proteins was shown to be necessary in diverse plant lineages, as the requirement was identified in *A. thaliana*, *Hordeum vulgaris*, *Chlamydomonas reinhardtii* (Okamoto *et al.* 2006), and *Oryza sativa* (Takayanagi *et al.* 2011). A similar requirement has not been observed in the NRT1 family.

NRT1 family members contain a large hydrophilic loop between TM6 and TM7 (Chen *et al.* 2008) and are responsible for the low affinity transport system (LATS). The LATS contains non-saturable transporters that transport NO_3^- at much higher rates than the HATS and are expressed under NO_3^- abundant conditions (Glass 2009). 53 putative members of the NRT1 family have been identified in *A. thaliana*; however, many of these are not NO_3^- transporters, but more likely encode transporters of other N-containing compounds such as small peptides, amino acids, or even glucosinolates (Glass 2009, Nour-Eldin *et al*. 2012). There is also recent research demonstrating transport of abscisic acid (ABA) by member(s) of the NRT1 family (Kanno *et al*. 2012). It remains to be shown whether individual NRT1 subgroups can be defined as transporting distinct substrates.

Both AMT1s and AMT2s contain 11 putative transmembrane domains (Couturier *et al.* 2007, Thomas *et al.* 2000, McDonald *et al.* 2012). The AMT1 family, unlike NRT1 and NRT2, comprises members responsible for both the HATS or LATS of NH_4^+ transport (von Wiren *et al.* 2000). AMT1s are channel-like proteins (D'Apuzzo *et al.* 2004) that act as NH_4^+ uniporters or NH_3/H^+ cotransporters (Yuan *et al.* 2007). The AMT1 family of transporters appears preferentially expressed in the roots (Salvemini *et al.* 2001). There is evidence that many green algal AMT1s, such as those from *Chlamydomonas reinhardtii*, contain introns (McDonald *et al.* 2010), while land plant AMT1s generally do not contain introns, except for LjAMT1-1 from *Lotus japonica* (Salvemini *et al.* 2001). AMT1s are more closely related to prokaryotic NH_4^+ transporters than they are to AMT2s (Couturier 2007 *et al.*, D'Apuzzo *et al.* 2004).

AMT2 genes, unlike most AMT1 genes, contain introns (Couturier *et al.* 2007). Until recently, it was thought that AMT2s do not exist in green algae; however, they are present in *Mamiellales*, although they do not share a common evolutionary origin with AMT2s in land plants. Recent work by McDonald *et al.* (2012) suggests that land plant AMT2s share a common origin with AMT2s from *Archaea*, while a separate horizontal gene transfer event from bacteria may be responsible for the AMT2s in *Mamiellales*. In general, the specific functions of AMT2 proteins are even less well understood than AMT1 proteins (Simon-Rosin *et al.* 2003, Neuhauser *et al.* 2009). AMT2s in many organisms have been shown — usually through yeast complementation — to provide NH_4^+ transport, but are not well understood. However, there are a few AMT2 proteins that have been characterized to some detail, such as LjAMT2-2, which is

exclusively expressed in mycorrhizal roots and is responsible for NH_3 uptake during mycorrhizal symbiosis (Guether *et al.* 2009).

The rapidly growing number of fully sequenced plant genomes is a valuable resource for both molecular genetics and evolutionary research. Here I present comprehensive phylogenies reconstructing the evolutionary history of the NH_4^+ and NO_3^- transporter families, AMT1, AMT2, NRT1, and NRT2. When identifying transporter proteins, it is important to note that not all NRTs and AMTs are responsible for N-uptake from the soil. NRTs and AMTs are also responsible for the movement of the ions within a plant, such as AtNRT1-5, which is responsible for NO_3^- loading into the xylem (Tsay *et al.* 2007), and AtNRT1-6, which plays a role in early embryo development (Almagro *et al.* 2008). The current study analyzes each of the four transporter families separately, across 22 fully sequenced *Viridiplantae* genomes. Fully sequenced genomes were selected in order to provide confidence that all members of the AMT and NRT families had been taken into consideration with all phylogenies. These phylogenies are supplemented with transmembrane domain topology predictions, subcellular localization predictions, and *in silico* expression profiling, where data were available. This provides the basis to build hypotheses on physiological functions of NH_4^+ and NO_3^- transporters, as well as to suggest a classification system for the transporter families based on their evolutionary relationships.

2.2 Materials and Methods

2.2.1 Sequence Acquisition

Individual sequences and accession numbers from functionally characterized NRTs and AMTs were obtained through primary literature research (Engineer and Kranz 2007, Couturier *et al.* 2007, Loque *et al.* 2006, Yuan *et al.* 2009, Li and Shi 2006, Kumar 2003, Neuhauser *et al.* 2009, Almagro *et al.* 2008, Okamoto *et al.* 2003, Cai *et al.* 2008). These protein sequences were used in BLASTP searches against the *A. thaliana*, *P. trichocarpa*, *O. sativa*, and *Zea mays* proteome annotations using Phytozome (Goodstein *et al*. 2011, http://phytozome.net/) and Genbank (http://www.ncbi.nlm.nih.gov/genbank). Sequences obtained from the initial BLAST searches were then used as query sequences against all organisms present on Phytozome as of January 10th, 2011. Organism names and gene name prefixes as displayed in figures are as follows: *Carica papaya* - Cp, *Populus trichocarpa* - Pt, *Ricinus communis* - Rc, *Manihot*

esculenta - Me, *Cucumis sativus* - Cs, *Prunus persica* - Prp, *Medicago trunculata* - Mt, *Glycine max* - Gm, *Mimulus guttatus* - Mg, *Arabidopsis thaliana* - At, *Arabidopsis lyrata* - Al, *Aquilegia coerulea* - Ac, *Oryza sativa* - Os, *Brachypodium distachyon* - Bd, *Setaria italica* - Si, *Zea mays* - Zm, *Sorghum bicolor* - Sb, *Selaginella moellendorffii* - Sm, *Physcomitrella patens* - Pp, *Vitis vinifera* - Vv, *Chlamydomonas reinhardtii* - Cr, *Volvox carteri* - Vc, and *Leptospirillum rubarum* - Ls. Over 1800 sequences in total were obtained. Sequences that are putative transporters are given letters (PtNRT1-A, PtNRT1-B, etc.) and sequences that are functionally characterized to some degree retain the name they were given in the paper in which they were identified. The protein BLAST algorithm parameters used were BLOSUM62 comparison matrix, default word length of 3, allow gaps (existence cost of 11 and extension cost of 1), and included a filter of low complexity regions. Sequences were accepted from BLAST results as long as they were not a series of small fragments, shared at least 30% identity, and had an expect threshold lower than $1e^{-50}$. Glaucophytes were not included as fully sequenced genomes of these organisms are not available. Red algal sequences were obtained by using green algal or *P. patens* and *A. thaliana* sequences as probes into a BLAST search of the red algal genome. Results were not included in the phylogenies, but were reported.

2.2.2 Alignments and Phylogeny Construction

The sequences for the NRT2, AMT1 and AMT2 families were aligned using DiAlign (Morgenstern 1999) using the Mobyle Portal (Neron *et al.* 2009). The DiAlign program provides a scoring system based on local similarity of aligned blocks that indicates the alignment quality at each position. I removed all positions that had a diagonal similarity of <40%. As the NRT1 family was too large to perform DiAlign, sequences from the NRT1 family were aligned using ClustalW (Thomson *et al*. 1994) implemented through BioEdit (Hall 1999) to generate a 1200 sequence alignment. Phylogenetic reconstructions were generated using Phylip software programs (Felsenstein 1989). Maximum likelihood trees were generated locally using BioEdit as a user interface, while parsimony and neighbour-joining trees were generated through the Mobyle Portal web service. Neighbour-joining trees were generated based on distance matrices using the Jones-Taylor-Thornton model. The Jones-Taylor-Thornton model was also used for the maximum likelihood tree. The resampling method was bootstrapping and consisted of 100 replicates. Phylogenies were visualized and rooted in FigTree (Rambaut 2006) using green algae or *P. patens*.

While analyzing initial phylograms, any sequences with especially long branches were investigated in the original alignment. If the sequence had large gaps where no gaps existed in other sequences, or contained areas of extensive differences throughout the sequence (likely indicating a gene modeling artifact), it was excluded and the sequences were re-aligned and new phylogenies reconstructed. OsAMT1-2 was one such sequence and was therefore excluded from the phylogeny. Bootstrap values were reported within groups (as defined below) if the support was higher than 70% and were reported on branches outside groups when the respective clade was contained in the majority–rule consensus tree derived from the bootstrapping replicates. To determine monophyly of the families, sequences from each group of each family were used as probes in additional BLAST searches against the GenBank database (excluding *Viridiplantae* sequences) to identify publically available non-plant sequences. Only the top BLAST hits (lowest expect value) were retained. These sequences were added to the respective sequence collection, the family was re-aligned and new phylogenies were reconstructed. If the non-*Viridiplantae* sequences were monophyletic, the plant family was considered monophyletic. If a selection of these sequences formed a sister clade to a group, then only those rooted by the same non-*Viridiplantae* sequences were considered monophyletic.

2.2.3 Expression Profiling, Transmembrane Predictions, Subcellular Predictions

Subcellular localization predictions were performed using MultiLoc2 (Blum *et al.* 2009) with the MultiLoc2-HighRes (Plant), 10 Locations algorithm. All predictions were recorded, but only the highest probability prediction was reported in the final figures. Transmembrane domain predictions were performed using TopCons (Bernsel *et al.* 2009) with no restrainment options selected. The TopCons website reports on several topology prediction programs' results in addition to the TopCons-exclusive prediction, but only the TopCons-exclusive prediction was recorded in my study. *In silico* expression profiling (heatmapping) was performed using the Bio-Array for Plant Biology (BAR) eFP (electronic fluorescent pictograph) browser (Winter *et al.* 2007, Wilkins *et al.* 2009). Tissue and organ gene expression data for each gene were downloaded from the respective eFP browser site and compiled into a data table. This was used to generate heatmaps where colour coding was used to visualize expression levels. These visualizations were performed using Microsoft Excel. Only organisms present in my phylogenies and on the BAR were analyzed. Organisms analyzed include *A. thaliana*, *P. trichocarpa*, and *O. sativa*.

2.3 Results and Discussion

Functionally characterized NRTs and AMTs (Engineer and Kranz 2007, Couturier *et al.* 2007, Loque *et al.* 2006, Yuan *et al.* 2009, Li and Shi 2006, Kumar 2003, Neuhauser *et al.* 2009, Almagro *et al.* 2008, Okamoto *et al.* 2003, Cai *et al.* 2008) were used for BLASTP searches against the annotated proteomes derived from 22 plant genome sequences present in the Phytozome v6.0 database (Goodstein *et al.* 2011). Over 1500 sequences in total were obtained (Table 1, Supplemental File 1). Sequences not named beforehand were given letters (PtNRT1-A, PtNRT1-B, etc.) and sequences that had been named or functionally characterized to some degree retained the original name assigned. A two-letter prefix was used to define the species (see Table 2.1 for a list of species included and abbreviations used). Only neighbour-joining trees are displayed; however, corresponding parsimony phylogenies are shown in supplemental files 2-4. Parsimony and neighbour-joining trees more closely resembled each other than either resembled the maximum likelihood trees, therefore the maximum likelihood trees are not reported. Neighbour-joining trees more closely resemble the generally accepted plant evolutionary history as presented on Phytozome (Goodstein *et al.* 2011) as well as the angiosperm phylogeny presented by Stevens (2001 onwards) than the parsimony trees. In addition, the neighbour-joining method is commonly used in similar studies (Couturier *et al.* 2007, Guether *et al.* 2009, Li *et al.* 2009, Nour-Eldin *et al.* 2012, Orsel *et al.* 2002, Ouyang *et al.* 2010, Plett *et al.* 2010, Segonzac *et al.* 2007, Suenaga *et al.* 2003, Zhao *et al.* 2010), and therefore the phylogenies I have presented can be compared to many other studies without tree-construction method being a confounding factor.

The AMT1, AMT2, and NRT2 transporter classes are encoded by small gene families in most plants with an average of four members (ranging from one to ten), similar to other transporter families such as the vacuolar H^+-pumping ATPase proteolipid family with 7 members, or the amino acid selective channel family with 4 members in *A. thaliana* (Kyte and Doolittle 1982, Tusnady and Simon 1998, Ng *et al.* 2000, Ward 2001). In contrast, the NRT1/PTR family can have more than 80 members. Gene family sizes as found for the NRT1/PTR family are not unusual for transporter families in plants, for example the ABC transporter family contains more than 130 members, plasma membrane H^+-ATPase family contains more than 80 members, and the organic solute cotransporter family contains more than 270 members in *A. thaliana* (Kyte and Doolittle 1982, Tusnady and Simon 1998, Ng *et al.* 2000,

Ward 2001). *P. trichocarpa* has a high number of AMT1s, NRT1s, and NRT2s relative to the other organisms analyzed. It also has the greatest number of AMT2 family members of the organisms analyzed (Table 2.1). This is likely due to the recent whole genome duplication (WGD) event in *Salicaceae* (Tuskan *et al.*, 2006). WGDs are relatively common in plants, with more than 15 WGDs being documented in the land plant lineage (Lee *et al*. 2012, Tang *et al*. 2008). While this can increase functional/mutational freedom of duplicate genes allowing subfunctionalization or neofunctionalization to occur, the most likely fate of these duplicates is loss of (redundant) function.

Green algal genomes, *Chlamydomonas reinhardtii* and *Volvox carteri* analyzed here, contain NRT2 and AMT1 family members, but not NRT1s and AMT2s. When present, green algal and embryophyte sequences each form monophyletic sister groups suggesting that a single NRT2 and AMT1 gene was present in the ancestor of *Viridiplantae*. Within the land plants (*Embryophyta*), several gene birth and death events apparently occurred throughout the lineage, giving rise to a complex mixture of subfamilies as outlined in more detail below.

Clades were initially characterized as chlorophyte (containing the green algae), lycopod, bryophyte, or angiosperm. Within the angiosperms, 'groups' were defined where there was a single common ancestor between a eudicot and a monocot clade (i.e. giving rise to group I *E* for eudicots, group I *M* for monocots). Angiosperm groups were further subdivided where duplications had occurred early after the divergence of eudicots and monocots but before speciation (e.g. group I*E*i, group I*M*ii). In some cases, such as in the AMT1 family, there were even further subdivisions, resulting in strongly supported groups such as I*E*ia. In each case, groups were only defined if supported by high bootstrap values ($\geq$70). In some families, paraphyletic clades each containing only eudicot or monocot sequences were combined as one group if bootstrap support for the tree topology in question was low. In the case of the NRT1 family, the phylogeny was too large to define groups, and instead supergroups were defined where lycopod and bryophyte sequences separated clades. Again, paraphyletic supergroups (by the above definition) were combined when not supported by high bootstrap support ($\geq$70).

Table 2.1 Members from each of AMT1, AMT2, NRT1/PTR, and NRT2 gene families present in each of the 22 fully sequenced *Viridiplantae* genomes analyzed

Taxonomic Denomination	Organism	# of AMT1s	# of AMT2s	# of NRT1/PTRs	# of NRT2s
Eudicot	*A. coerulea* (Ac)	2	7	48	2
	A. lyrata (Al)	7	1	49	6
	A. thaliana (At)	5	6	51	7
	C. papaya (Cp)	3	3	43	3
	C. sativus (Cs)	5	3	49	2
	G. max (Gm)	6	8	96	3
	M. esculenta (Me)	6	7	61	3
	M. truncatula (Mt)	4	4	53	1
	M. guttatus (Mg)	6	5	52	8
	P. trichocarpa (Pt)	6	14	70	7
	P. persica (Prp)	5	5	49	2
	R. communis (Rc)	4	5	41	4
	V. vinifera (Vv)	1	7	44	2
Monocot	*B. distachyon* (Bd)	2	6	67	6
	O. sativa (Os)	3	9	66	4
	S. italic (Si)	2	6	74	7
	S. bicolor (Sb)	2	6	67	4
	Z. mays (Zm)	3	5	52	4
Lycopod	*S. moellendorffii* (Sm)	2	3	31	2
Bryophyte	*P. patens* (Pp)	8	11	18	8
Green Algae	*C. reinhardtii* (Cr)	7	0	0	3
	V. carteri (Vc)	9	0	1	3

2.3.1 The AMT1 Family

The AMT1 gene family is comprised of 1-7 family members with either 11 or 12 predicted transmembrane domains. The majority of AMT1 family members are predicted to be localized to the secretory pathway, namely endoplasmic reticulum (ER) or golgi apparatus (Figure 2.1). Phylogenetic reconstructions (Figure 2.1 shows a neighbour-joining distance analysis and Supp. File 2 the corresponding Parsimony analysis) suggest the existence of two evolutionarily distinct clades of AMT1 members in eudicots (group I *E* and group II *E*), which are separated by sequences from monocots, lycopods, and bryophytes (Fig. 2.1). All *P. patens* sequences form a monophyletic group at the base of the group I clade. Surprisingly, the single AMT1 from the lycopod *Selaginella moellendorffii* grouped at the base of the moss clade rather than at the base of either one of the angiosperm clades as would have been expected based on the species phylogeny. Additional lycopod or other basal vascular plant sequences may be needed to better resolve this part of the phylogeny. The angiosperm clade I divides further into two major groups separating eudicotyledonous plants (eudicot I) from monocotyledonous plants (monocot I). Eudicot I AMT1s are mostly predicted to be ER localized, but five proteins are predicted to be golgi apparatus localized and one has a peroxisome prediction. All monocot I members are predicted to be localized in the ER. Both clades can each be further divided into two large clades, named eudicot Ii and Iii, and monocot Ii and Iii, respectively. Each subclade contains members from all species in the respective group. There is high bootstrap support (≥70%) for all major clades. Taken together, this suggests that the last common ancestor of bryophytes and angiosperms contained a single type I AMT1. Several gene duplication events in the bryophyte lineage then led to the existence of the six AMT1 isoforms in *P. patens*. The single-copy status of the type I AMT1 has been maintained in the vascular plant lineage until shortly after the separation of monocots and eudicots. Since this separation there has been a duplication event early in the monocot lineage leading to monocot groups Ii and Iii, both of which have been maintained in all monocot species analyzed. There is some evidence of subsequent duplication in some monocot lineages, for example in the case of *Z. mays* leading to ZmAMT1-A and ZmAMT1-C (monocot Ii).

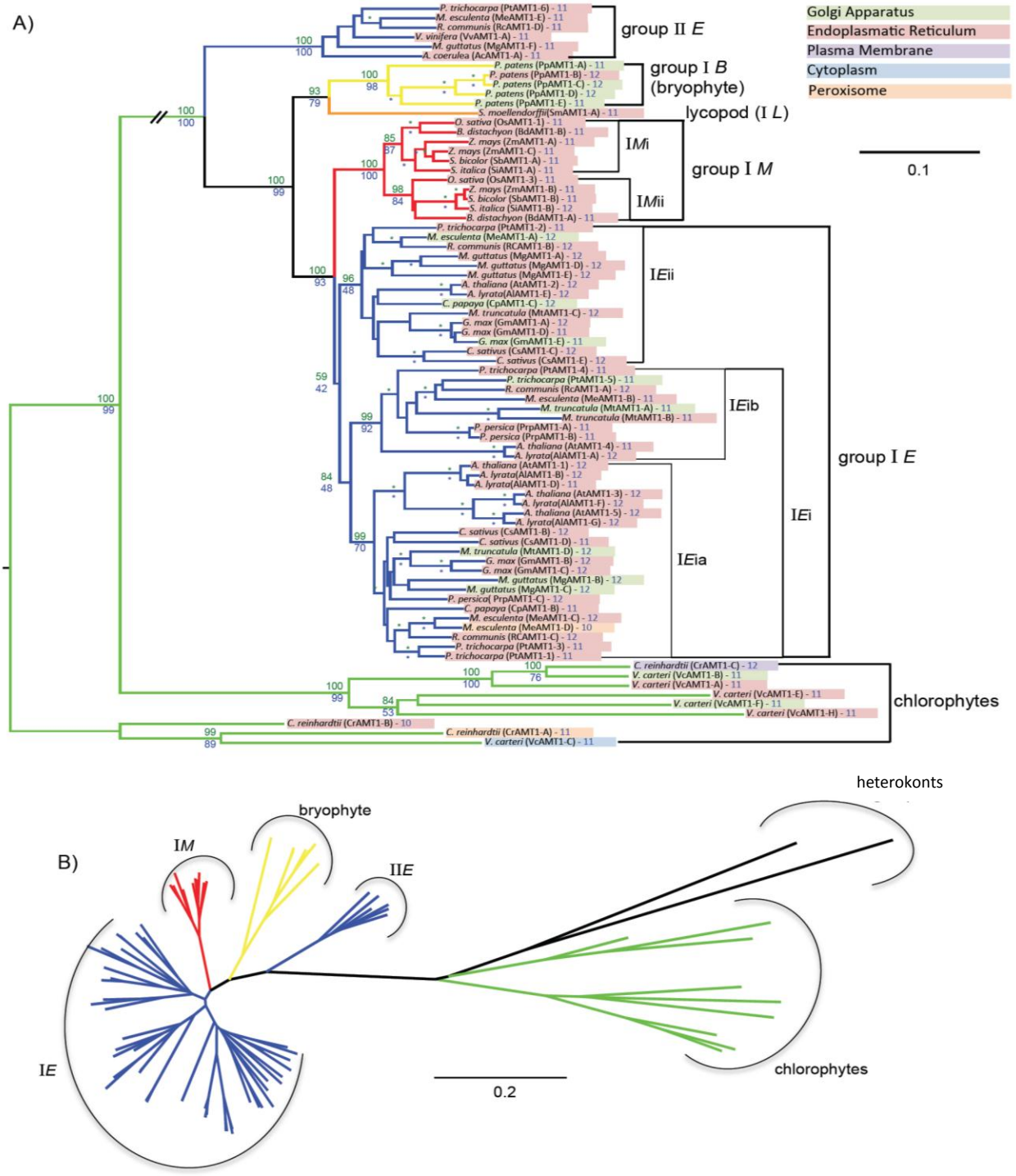

Figure 2.1. Neighbour-Joining phylogenetic reconstruction (based on a JTT distance matrix) of the AMT1 family. Clades are coloured such that blue=eudicot, red=monocot, green=chlorophyte, yellow=bryophyte, orange=lycopod. A) Phylogram of the AMT1 family supplemented with neighbour-joining bootstrap values (in green) and corresponding parsimony bootstrap values (in blue) (within groups, bootstrap values ≥70% are displayed as *). Subcellular localization predictions are highlighted as coloured boxes framing gene identifiers and transmembrane topology predictions are given as numbers to the right of the gene identifier. A proposed classification system is indicated as group labels to the right (E=eudicot, M=monocot). B) Unrooted phylogeny of

the AMT1 family including a heterokont group suggesting monophyly of the AMT1 family presented. The broken branch in A) is ~1/3rd the original length. In B), this branch (between the chlorophytes/heterokonts and land plants) is not interrupted.

All three rice AMT1s have been functionally shown to encode NH_4^+ transporters by complementing an NH_4^+ uptake-deficient yeast strain (Sonoda et al. 2003). All show maximal transcript levels in seedling roots, but OsAMT1-1 (belonging to group monocot Ii) is also expressed to appreciable levels in shoots and mature flowers (Figure 2.2). Both OsAMT1-1 and OsAMT1-2 are also NH_4^+-responsive: their gene expression levels are induced by ammonia when plants were previously N-starved (Sonoda *et al*. 2003), but are repressed by transfer from low to high NH_4^+, which correlates with high affinity NH_4^+ uptake (Kumar *et al*. 2003). Kumar *et al*. (2003) showed OsAMT1-3 (monocot Iii) transcript levels remained largely unaffected by the treatments described above; however, Sonoda et al. (2003) showed induced expression of OsAMT1-3 under N-deficient conditions. This may suggest functional divergence within the monocot type I subclades, but more detailed studies are needed to substantiate such differences.

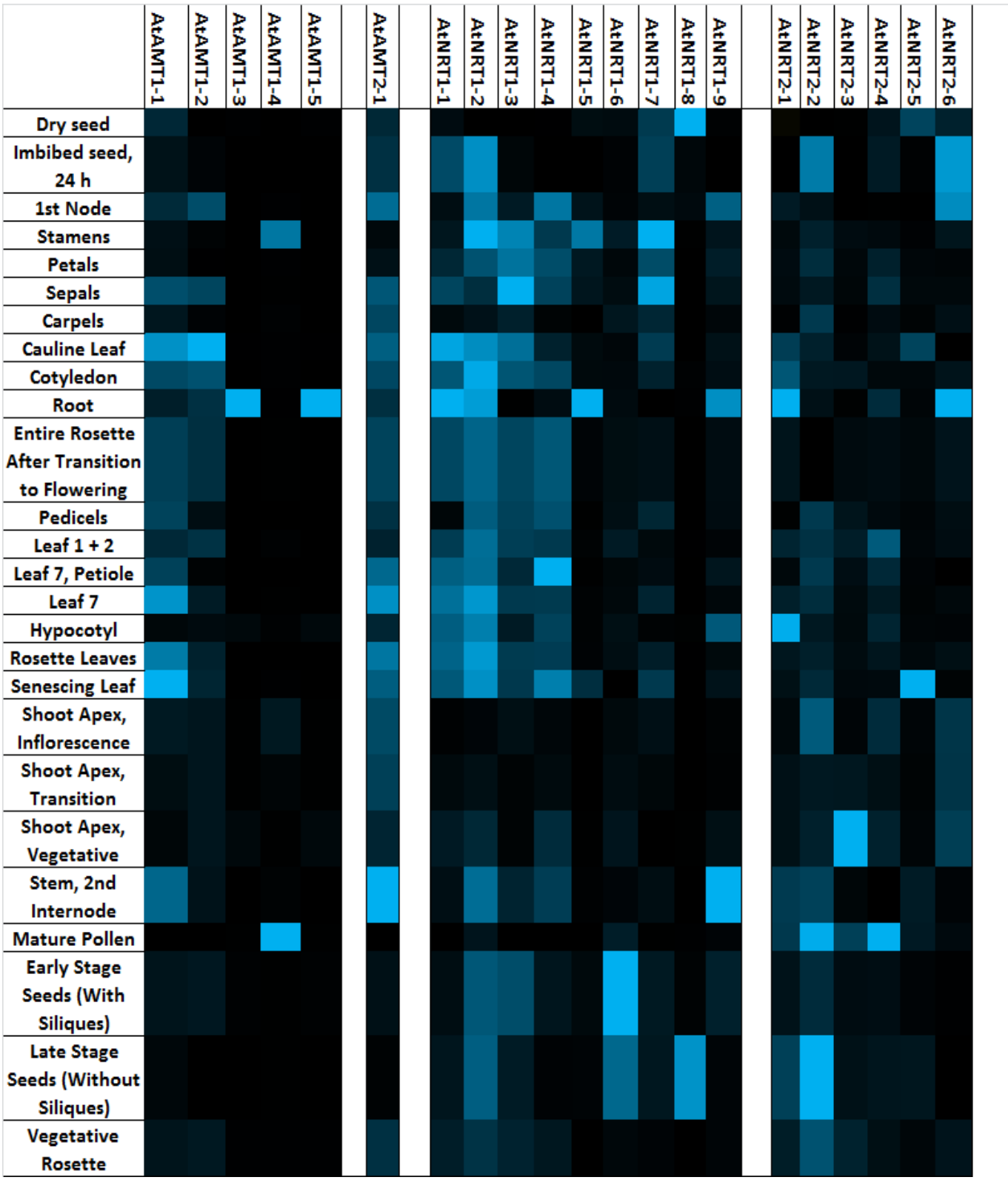

Figure 2.2. *In silico* expression profile of all available putative AMT and NRT sequences from *A. thaliana* based on microarray data obtained from The Bio-Array Resource for Plant Biology (Winter *et al*. 2007). Continued next page.

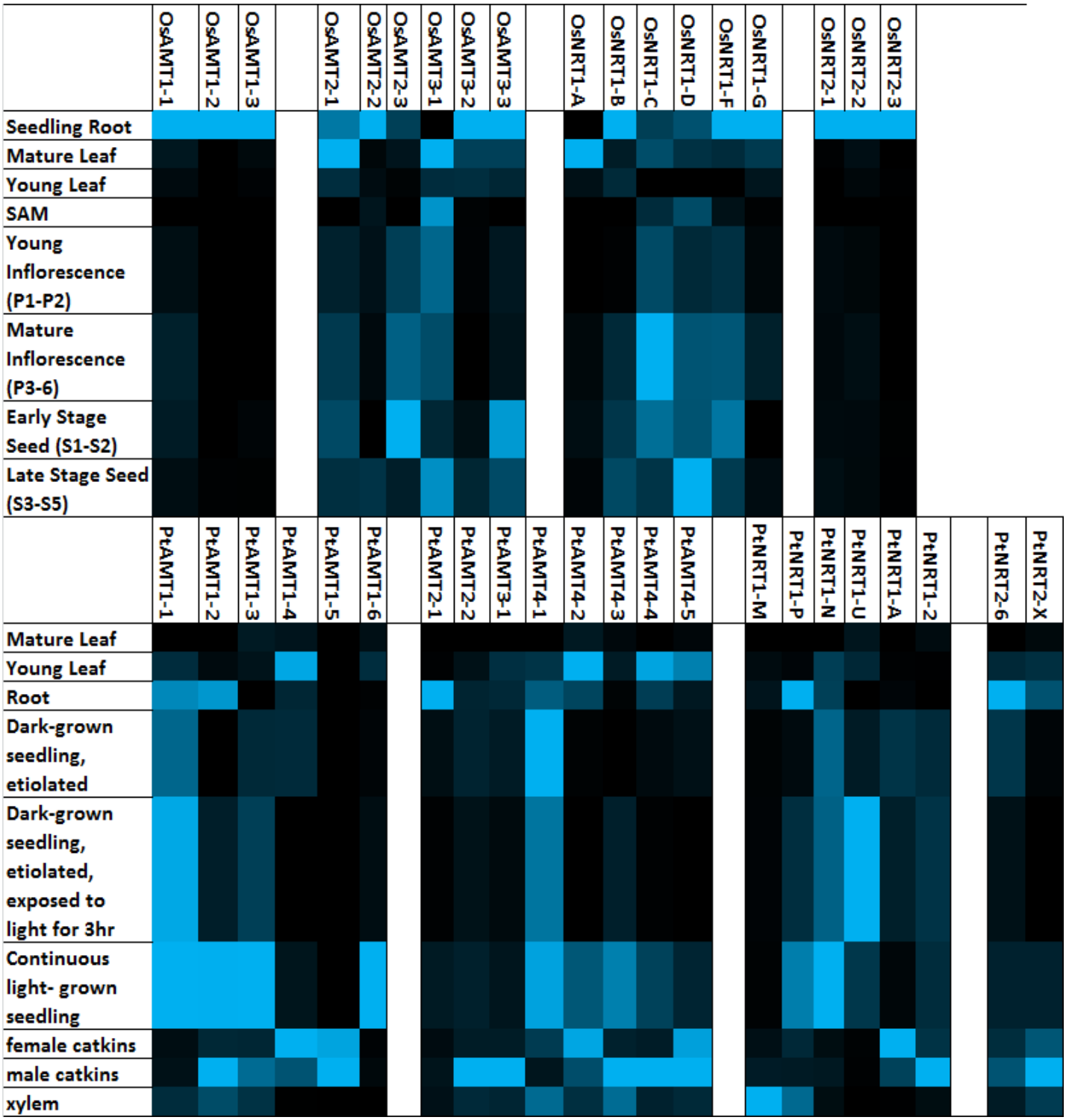

Figure 2.2. Continued. *In silico* expression profile of all available putative AMT and NRT sequences from *O. sativa* and *P. trichocarpa* based on microarray data obtained from The Bio-Array Resource for Plant Biology. AMT3s and AMT4s are members of the AMT2 family.

As is the case in the monocot group, there appears to have been an ancient duplication event early in the eudicot lineage, leading to the eudicot groups Ii and Iii (Figure 2.1). Both Ii- and Iii-type AMT1s have been maintained in all but two eudicot species analyzed (*P. persica* appears to contain only eudicot Ii-type AMT1s and *A. coerulea* contains only II-type AMT1s; however, both genomes have been completed only very recently, and additional genes may be present in genome areas not yet well covered or annotated). A single copy of eudicot Iii-type AMT1 is present in most eudicots, but there has been extensive species-specific amplification of the gene in a few species, leading to multiple eudicot Iii genes in *M. guttatus*, *C. sativus*, and *G. max* that are all more closely related to copies in the same species than to copies in other species (paralogs). In contrast, the eudicot Ii-type AMT1 family is generally more expanded and can be further subdivided into clades eudicot Iia and Iib. Of the 13 eudicot species analyzed, all but two contain Iia genes, but Iib genes are absent in five species (Figure 2.1). In most species eudicot Iia genes are duplicated and form genus specific paralogous groups containing two to five members. The paralog group in *Arabidopsis* contains the well characterized *A. thaliana* AtAMT1-1 (plus three *A. lyrata* orthologs), AtAMT1-3 (plus one *A. lyrata* ortholog) and AtAMT1-5 (plus one *A. lyrata* ortholog). AtAMT1-1 is expressed in the rhizoderm and root cortex (Loque *et al*. 2006) while AtAMT1-2 is expressed in endodermal root cells (Neuhauser *et al*. 2007). AtAMT1-1 and AtAMT1-3 are plasma membrane localized, and all three genes encode high affinity NH_4^+ transporter proteins and are involved in root-uptake of NH_4^+ in an additive manner (Loque *et al*. 2006, Gazzarrini *et al.* 1999). While AtAMT1-3 and AtAMT1-5 are root specific, AtAMT1-1 is expressed more broadly, including roots, leaves, and sepals (Figure 2.2). In addition to its function in root NH_4^+ uptake, a prominent regulatory role for AtAMT1-3 in NH_4^+-induced lateral root branching was described recently (Lima *et al.* 2010). In contrast, the single *A. thaliana* Iib-type AMT1 (AtAMT1-4) is not expressed in roots, but is specifically expressed in pollen. It also encodes a plasma membrane localized high-affinity NH_4^+ transporter (Yuan *et al.* 2009). Both *P. trichocarpa* Iib-type AMT1s (PtAMT1-4 and PtAMT1-5) are expressed in male and female flowers, and, in the case of PtAMT1-4, in leaves (Figure 2 and Selle *et al.* 2005). The Iia-type PtAMT1-1 and PtAMT1-3 are expressed in whole seedlings as well as roots in the case of PtAMT1-1 (Figure 2.2). Taken together, this may suggest distinct physiological functions for Iia and Iib-members in root uptake and reproductive organ supply of ammonia, respectively.

The fifth *A. thaliana* AMT1 family member *AtAMT1-2* belongs to clade Iii (Fig 1.1) and encodes a lower-affinity transporter (which still contributes mainly to the HATS), which is expressed in young root endodermal cells and more mature cortical cells, but is not induced by low N availability (Gazzarrini *et al.* 1999; Yuan *et al.* 2007). In addition to roots, AtAMT1-2 is also expressed in flowers and stem nodes with maximal expression in cauline leaves (Figure 2.2). The sole Iii-type gene from *P. trichocarpa*, PtAMT1-2, has high levels of expression in roots (Selle *et al*. 2005), but also in other tissues such as seedlings grown in continuous light and male catkins (Figure 2.2). It is induced by ectomycorrhizal symbionts together with PtAMT1-4 and PtAMT1-6 (named PtAMT1-3 in Selle *et al.* 2005, but PtAMT1-6 in Couturier *et al*. 2007 and at phytozome.net). The *P. tremula x tremuloides* PttAMT1-2 ortholog encodes a high affinity transporter with similar expression patterns (Selle et al. 2005). Together, this may suggest broader functions for eudicot Iii members in within-plant and plant-symbiont NH_4^+ distribution rather than immediate high affinity uptake from the soil.

In summary, it is obvious that both in eudicots and monocots early gene duplication events generated the two monocot and three eudicot subclades. It must be assumed that this produced an adaptive advantage, as the gene copies have been maintained in most if not all species analyzed. Expression profile and physiological differences of subclade members shows functional diversifications in individual species, but more detailed information from additional species is necessary to generalize such functional diversifications to the subgroups identified here.

There appears to have been a duplication event in the green algae prior to speciation as both *V. carteri* and *C. reinhardtii* have two copies, one of which is more closely related to a copy from the other algal species than to the second copy in its own species (orthologs). No functional data are available for any of the green algal AMT1 transporters.

Surprisingly, there is another eudicot clade between the monophyletic green algal and moss clade, which I designated eudicot II. One explanation for this is that a lateral gene transfer event occurred after the separation of monocots and eudicots. Another explanation is that the last common ancestor of byrophytes and land plants had two copies of the gene and one of them has been lost in bryophytes/lycopods/monocots, but has been maintained in some eudicots. To test these hypotheses, I used representative members of each group to identify the most similar non-

plant members present in GenBank. This resulted in an overlapping set of two sequences from unicellular algae belonging to the heterokonts (Stramenopiles) (the pelagophyte *Aureococcus anophagefferens* and the diatom *Cylindrotheca fusiformis*). These sequences were up to 50% identical with the baits used and were added to my phylogenetic reconstructions (Figure 2.1B). All non-plant sequences, regardless of the group-bait used to identify them, form a monophyletic cluster. If hypothesis one had been correct, then some of these sequences (the presumed origin of the lateral gene transfer) should have grouped at the base of group II instead. Given the monophyly of the non-plant sequences included, this suggests that all plant AMT1s analyzed in my study are monophyletic, that green algae are the appropriate root in the plant lineage, and that type I AMT1s separated from type II AMT1s prior to the bryophyte/embryophyte split. Introns are absent from both group I and group II, lending support to the conclusion that group II type AMT1s were lost in mosses and monocots. If introns had been present in either group I or group II, and absent in the other, it would have suggested a horizontal gene transfer event as a possible explanation for group II's peculiar positioning in the phylogeny. It has to be noted that only the top non-*Viridiplantae* GenBank hits for each group were included in the phylogeny presented. It is also noteworthy that for baits used, heterokont sequences provided the best BLAST similarities in GenBank, not other eukaryotes more closely related to the *Viridiplantae* (e.g. red algae and glaucophytes). Screening the sole available genome from the red algae *Cyanidioschyzon merolae* (Matsuzaki *et al*. 2004) revealed two sequences with less than 35% sequence identity to *Viridiplantae* AMT1s. Also, screening GenBank limited to red algae revealed as a best hit (lowest e-value) a sequence from *Griffithsia japonica* (genome not fully sequenced). This protein (NCBI accession AAM94014.1) has 40% identity to AtAMT1-2, but when these sequences were included in the phylogeny, they were separated from *Viridiplantae* sequences by the heterokonts (data not shown). Although further investigation into resolving the relationship between bacterial and eukaryotic AMT1s is warranted, these analyses suggest that *Viridiplantae* AMT1s were gained independently of other eukaryotic AMT1s. Important in the context of this analysis, all *Viridiplantae* AMT1s are likely monophyletic and the green algal sequences represent the proper root of the tree shown in Fig 2.1A.

Thus, given that no bryophyte, lycopod, or monocot homologs to the eudicot II members are present in extant species analyzed, it is likely that the ancestral copies of the type II gene were lost in bryophytes, lycopods and monocots, suggesting that gene loss of these II-type genes

was not important in these organisms. Also, most eudicot species analyzed here do not contain eudicot II type AMT1s, including all species within the *Brassicales*, further suggesting a specialized function of these AMT1s. This may indicate that II-type AMT1s perform a unique function in species that maintained them. Among them, PtAMT1-6 expression is increased upon ectomycorrhizal symbiosis (Couturier *et al*. 2007), and this may indicate that members of group II*E* perform symbiont-related transport, such as NH_4^+ uptake from mycorrhizae.

The AMT1 family in *Populus trichocarpa*

A study of AMT1 expression in *P. trichocarpa* (Couturier *et al*. 2007) provided a valuable first step into the research of individual members of AMT1s in *P. trichocarpa*. These data also aid in the characterization of the groups in the AMT1 phylogeny presented here (Figure 2.1), as PtAMT1-1, PtAMT1-2, and PtAMT1-4 are identified as putative NH_4^+ transporter proteins (Couturier *et al*. 2007). PtAMT1-1, PtAMT1-2, and PtAMT1-4 are good candidates for further research as they share subgroups with characterized *A. thaliana* AMT1s (AtAMT1-1 in I*E*ia, AtAMT1-2 in I*E*ii, and AtAMT1-4 in I*E*ib, respectively) and are predicted to be localized to the endomembrane system (endoplasmic reticulum). In the case of PtAMT1-1 and PtAMT1-2, expression in root tissue has been observed (Couturier *et al*. 2007). PtAMT1-6 is not likely to be responsible for uptake of NO_3^- from the soil environment as its highest expression is in leaf tissues, with lower expression in fruit and petiole tissues (Couturier *et al*. 2007), and there are no closely related functionally characterized AMTs that perform uptake from the soil environment. While *P. trichocarpa* has a high number of AMT1s relative to the other organisms analyzed in my study (Table 2.1), it has fewer AMT1s (6 members) than any of the other N-transporters within *P. trichocarpa* (14 AMT2s, 70 NRT1s, 7 NRT2s). Since AMT1s often perform uptake from the soil environment, this suggests that *P. trichocarpa* does not require a large variety of uptake transporters. This may be due to the fact that *P. trichocarpa* often forms symbiotic relationships with and obtains NH_4^+ from ectomycorrhizae, requiring only a few types of transporters to perform uptake from the symbiont. More research would be needed to test this hypothesis.

2.3.2 The AMT2 Family

The AMT2 gene family is comprised of 1-10 family members with the vast majority possessing 11 transmembrane domains. Most AMT2 family members are predicted to be localized to the cytoplasm or secretory pathway, namely the ER and the golgi apparatus. Phylogenetic reconstructions (Figure 2.3 shows a neighbour-joining distance analysis and Supp. File 3 the corresponding parsimony analysis) suggest there are at least five major clades of AMT2 genes: four comprised of angiosperms and one bryophyte specific clade. The single monophyletic bryophyte clade contains all *P. patens* sequences. It appears that extensive duplication events happened in the bryophyte lineage, both ancient and more recent, leading to nine copies of AMT2 present in *P. patens*. Green algal genomes analyzed here (both belonging to the *Chlorophyceae*) do not contain genes with sequence similarity to AMT2s (Table 2.1). In contrast, McDonald *et al.* (2010) identified green algal AMT2 genes in *Mamiellophyceae* (a distinct class within the Chlorophyta that was not included in this study). However, these AMT2 sequences are more closely related to bacterial AMT2s than to land plant AMT2, which share a common evolutionary origin with AMT2s from *Archaea*. Thus, AMT2 genes present in *Mamiellales* and land plants likely arose from independent horizontal gene transfer (HGT) events, and are therefore not suitable as an outgroup for my study (McDonald *et al*. 2010). Instead, I used the extremophile chemoautotrophic bacterium *Leptospirillum rubarum* and chemolithotroph *Acidithiobacillus caldus* as a bacterial group as they were most similar to representative AMT2 proteins from each plant AMT2 group in GenBank BLASTP searches excluding *Viridiplantae* sequences from the results. As with AMT1s, taking more than just the top hit from the BLAST search would have lent further support to the monophyly of the *Viridiplantae* suggested here. McDonald *et al.* (2010) also identified *L. rubarum* as intermediate between typical *Archaea* AMT2s and land plant AMT2s. Almost all other bacterial genomes lack this type of AMT2, thus it has been argued that the *L. rubarum* AMT2 likely arose through a HGT event from a member of *Archaea* (McDonald *et al.* 2010). The *L. rubarum* sequence places the moss clade basal to the type III and IV AMTs from angiosperms (Figure 2.3B). Together with the bacterial group analysis, this suggests that the most recent common ancestor of bryophytes and angiosperms possessed two AMT2 genes and one copy was lost in the bryophytes. Interestingly, the BLAST search into the red algal genome results in the same hit as the AMT1 BLAST search (NCBI accession AAM94014.1), but now sharing only 29% identity

to AtAMT2-1. When included in the phylogeny, it groups with the bacteria on an extremely long branch (data not shown) confirming that this red algal sequence more likely belongs to the AMT1 rather than the AMT2 family.

The ancient separation of type I/II and type III/IV AMT2s in angiosperms together with the fact that both clades were maintained in all angiosperm species analyzed clearly suggests a functional difference between type I/II and type III/IV AMT2s. AMT2s are generally poorly understood, thus this information is very valuable when studying potential activity of AMT2s. Angiosperm groups I, III, and IV contain both eudicot and monocot clades, while angiosperm group II contains only eudicots (Figure 2.3). There are subgroups that are exclusively eudicot or monocot, such as III*M*i, III*M*ii, and III*M*iii.

Group I, group III, and group IV contain at least one eudicot clade and one monocot clade. This suggests there were at least three duplication events preceding the separation of monocots and eudicots. Group III proteins are mostly predicted to be ER-localized, as well as three sequences localized to the golgi and four to the cytoplasm. In group III there is one eudicot clade (IIIi) and three monocot clades (IIIi, IIIii, and IIIiii), suggesting that there were two additional duplication events prior to the separation of monocots and eudicots, followed by loss of IIIii and IIIiii members in eudicots (Figure 2.3). While III*M*ii and III*M*iii should have been separate groups based on my previous definition, I chose not to label them as such due to the lack of bootstrap support separating these clades. It is possible that sequencing more plant genomes may identify group members in the respective taxonomic clade, i.e. eudicots belonging to subgroups IIIii or IIIiii. However, it is likely, given the depth of species analyzed, that eudicot sequences from IIIii, and IIIiii have been lost early in the respective lineages. There is either only a single copy of type III AMT2 present in eudicots, or type III sequences are absent from eudicot genomes, as is the case in *A. thaliana*.

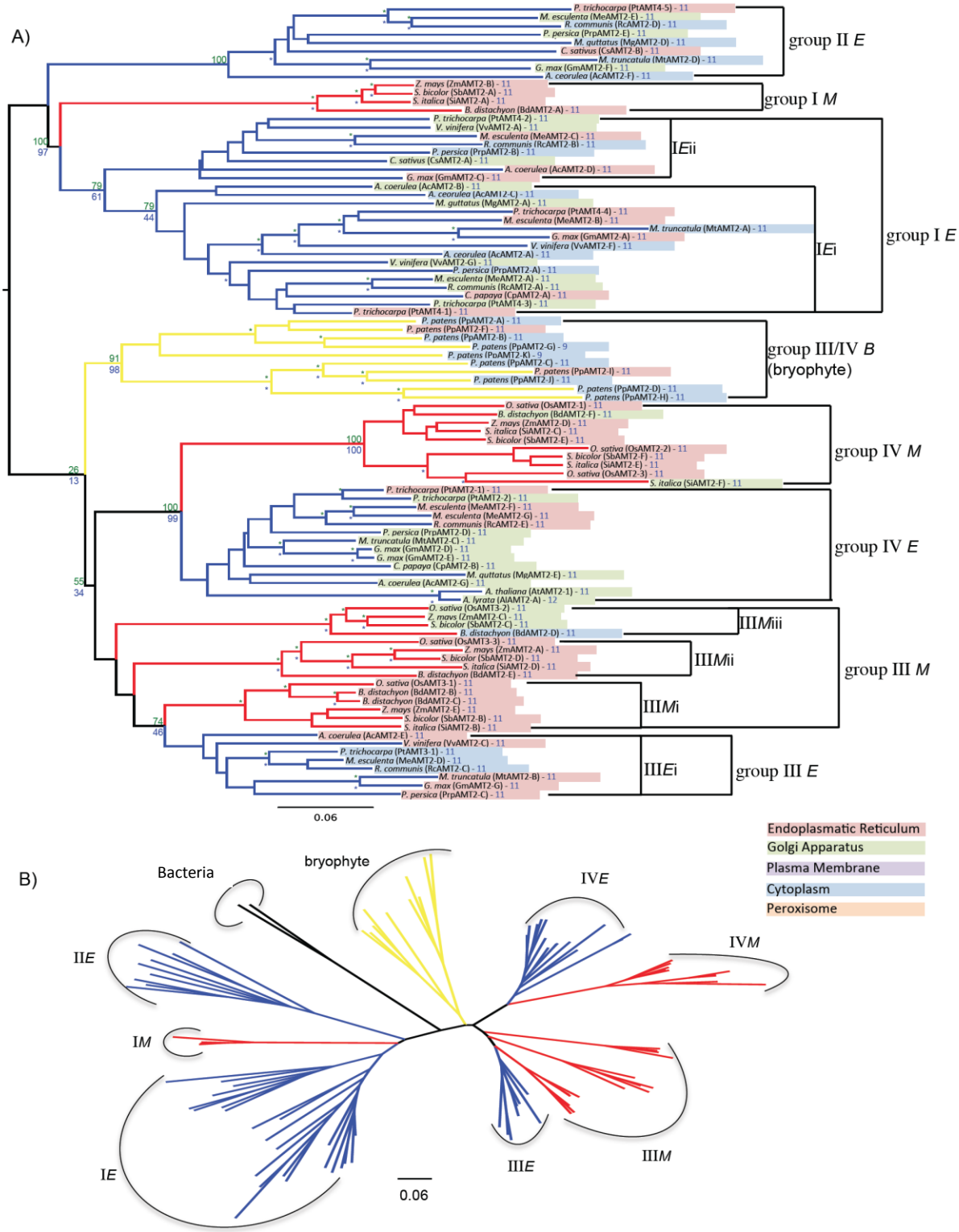

Figure 2.3. Neighbour-Joining phylogenetic reconstruction based on a JTT distance matrix of the AMT2 family. Clades are coloured using the same system as Figure 2.1. A) Phylogram of the AMT2 family supplemented with neighbour-joining bootstrap values (in green) and corresponding parsimony bootstrap values (in blue), subcellular localization predictions, topology predictions, and proposed classification system. The root of this tree was defined by the analysis shown in B). B) Unrooted phylogeny of the AMT2 family with an included bacterial group identified

in GenBank (excluding *Viridiplantae* sequences) searches of representative members from each family of plant AMT2s. This suggests that the most similar sequences outside the *Viridiplantae* (available in GenBank) form a monophyletic group rather than being basal to individual plant clades. In consequence, this indicates the monophyly of the AMT2 family presented.

Functional characterizations of group III AMT2s are scarce: of the eudicots in this group, PtAMT3-1 has maximal expression in male catkins and has virtually no expression in roots (Figure 2.2). PtAMT3-1 transcripts are strongly up-regulated during senescence, but if it actually functions as an NH_4^+ transporter remains unclear, as the gene is unable to complement MEP (MEthylammonium transPorter) deficient yeast (Couturier *et al.* 2007). In monocots, the group III subfamilies are encoded mostly as single copy genes, but one duplication event since speciation in the monocots is apparent in *B. distachyon* (IIIi) (Figure 2.3). While all monocot IIIi and IIIii proteins are predicted to be ER-localized, the IIIiii proteins may be localized in the golgi or cytoplasm (Figure 2.3). Of the monocot genes in group III, OsAMT3-1 (IIIi) has expression in many tissues, but highest expression in seeds of stage S4. OsAMT3-3 (IIIii) and OsAMT3-2 (IIIiii) have high expression levels in the seedling root; however, OsAMT3-3 (IIIii) is also expressed to high levels during early seed development (Figure 2.2). OsAMT3-1 (IIIi) has much lower expression levels than OsAMT2-1 (in group IV) both in in roots and shoots (Suenaga *et al.* 2003).

Group IV has equal numbers of members predicted to be localized to the golgi and ER (Figure 2.3). There is no evidence of early duplication events prior to speciation in the eudicot IV clade; however, there have been three duplication events since speciation. These duplications are present in *P. trichocarpa*, *M. esculenta*, and *G. max*; the remainder of the species contain only a single type IV AMT2 gene (Figure 2.3). Of the eudicots in group IV, PtAMT2-1 has nearly exclusive expression in roots and has confirmed NH_4^+ transport activity, shown through complementation of MEP deficient yeast (Couturier *et al.* 2007). PtAMT2-2 has also been shown to have NH_4^+ transport activity in MEP deficient yeast as well as detectable expression in roots (Courturier *et al.* 2007) in addition to high expression in male catkins (Figure 2.2). The sole AMT2 gene in *A. thaliana* (AtAMT2-1) belongs to group IV and has maximal expression in the second internode of stems as well as notable expression levels in leaves and flowers, based on published microarrays (Figure 2.2). Sohlenkamp *et al.* (2002) also noted expression in roots. AtAMT2-1 has been shown to have NH_4^+ transport activity similar to that of AtAMT1-1 in yeast

complementation assays (Sohlenkamp *et al*. 2002). However, the transport capacity of AtAMT2-1 is an order of magnitude lower than that of AtAMT1-1 at pH 6.5, and AtAMT2-1's transport capacity increases with increasing pH while AtAMT1-1's transport capacity decreases resulting in an equivalent transport activity at pH 7.5. Taken together, these data suggest that eudicot proteins in group IV have different functions from those in group III. Many eudicot proteins from group IV have been shown to have NH_4^+ transport activity in yeast and are expressed to some degree in root tissue, whereas the only functionally characterized protein from the Group III eudicots is strongly up-regulated during senescence, has no expression in roots, and is unable to complement MEP deficient yeast.

The monocot group IV appears to have undergone an early duplication event preceding speciation in the monocots, leading to two sets of orthologous proteins. One of these sets is present in all species analyzed as a single gene, while the other is apparently absent in *Z. mays* and *B. distachyon* but is duplicated again in *S. italica* and *O. sativa* (Figure 2.3). Of the monocot genes in group IV, OsAMT2-1 is expressed to high levels in mature leaves, seedling roots, and during late inflorescence and early seed development (Figure 2.2). Suenaga *et al.* (2003) also found OsAMT2-1 to have a fairly broad expression in both roots and shoots. OsAMT2-1 was shown to have NH_4^+ transport activity in yeast complementation tests (Suenaga *et al*. 2003). However, OsAMT2-1 was only able to rescue the yeast mutant when grown at high N concentrations (5mM NH_4^+), and was not able to rescue yeast growing on agar media containing only 1mM NH_4^+, which is in contrast to rice transporters of the AMT1 family. OsAMT2-3 appears more specifically expressed during inflorescence development and late stages of seed development (Figure 2.2), while OsAMT2-2 shows high expression levels specifically in the seedling root (Figure 2.2). OsAMT2-2 transcripts are induced upon supply of NH_4^+ (Li *et al.* 2006), and have maximal expression levels in seedling roots, suggesting a role for OsAMT2-2 in NH_4^+ uptake from the soil. All three of the rice genes are predicted to be localized to the secretory pathway (ER). The combined evidence suggests both an evolutionary and functional divergence of group IV monocot proteins compared to those in group III. While group IV monocot proteins have proven NH_4^+ uptake activity and high expression in roots and leaves (with the exception of OsAMT2-3), group III proteins have not yet been shown to have uptake activity despite having high expression in roots and in seeds.

Group I/II sequences in angiosperms were separated from group III/IV sequences prior to the bryophyte / embryophyte split and are present in all species analyzed except *A. thaliana*, *A. lyrata*, and *O. sativa*. Group I contains both monocot and eudicot sequences, while group II only contains eudicots. Group I eudicots have almost equal numbers of members predicted to be localized to the ER, golgi, and cytoplasm; however, group I monocots are all predicted to be localized to the ER (Figure 2.3) and are present in a single copy in the species that maintained this type of AMT2. The eudicot group I may have undergone an additional duplication event early in eudicot evolution annotated as subclades I*E*i and I*E*ii. Most species are represented in both subclades and the node separating the two clades has high bootstrap support (Figure 2.3). However, not all species are represented in both clades, suggesting similar functions performed by members of each subclade. Group I*E*ii shows no signs of recent duplication events, leading to only one copy of the gene in each species. In contrast, clade I*E*i has undergone multiple recent duplication events, leading to multiple copies of class I*E*i AMT2s in some species. Of the eudicot genes in group I, PtAMT4-4 (I*E*i) and PtAMT4-3 (I*E*i) have highest level of expression in male catkins; however, PtAMT4-4 is also expressed to high levels in young leaves, and PtAMT4-3 in continuous light grown seedlings (Figure 2.2). PtAMT4-1 (I*E*i) is constitutively expressed with maximal expression in etiolated dark grown seedlings. PtAMT4-2 (I*E*ii) has high expression levels in female catkins and young leaves. None of the class I AMT2s have been functionally characterized in any detail so far, perhaps because it is only distantly related from characterized AMT2s and is not present in model organisms such as *A. thaliana* or *O. sativa*.

Group II contains almost equal numbers of sequences predicted to be localized to the cytoplasm, or to the secretory pathway such as the ER or golgi. Since group II contains only eudicot sequences, but group I contains both monocot and eudicot sequences, a likely scenario is that the homologous II-type monocot sequences were lost. As with the AMT1 family, this indicates that II-type AMT2s perform a function that is not necessary in monocots. Contrary to the AMT1 family, however, is that most eudicots are represented in the AMT2 group II. This indicates that group II AMT2s do not perform a specialized function, but rather perform a function correlating with the difference between monocots and eudicots. Group II also seems to lack any duplication events as all species maintained this type as a single copy gene, which may suggest selection against allowing redundancy of the encoded function. No type II sequences are present in the genomes of *A. thaliana*, *A. lyrata*, *C. papaya*, and *V. vinifera*. None of the II type

AMT2s have been functionally characterized in great detail, but PtAMT4-5 is expressed to high levels in reproductive organs (both male and female catkins) and in young leaves (Figure 2.2). The PtAMT2, PtAMT3, and PtAMT4 groups are members of the AMT2 family; however, they are phylogenetically distinct from each other within the AMT2 family. As such, they have been named with AMT3 and AMT4 in prior literature (in *P. trichocarpa* by Couturier *et al*. 2007 and in *O. sativa* by Li and Shi 2006). Members of PtAMT4 are found in group I and II, PtAMT2 in group IV, and PtAMT3 in group III (Fig 2.3A). Couturier *et al.* (2007) describe expression of PtAMT4-5 in roots and state that it is unable to complement MEP deficient yeast. As PtAMT4-5 is the only characterized protein in group II, it may serve as an indicator that II-type AMT2s likely are not responsible for root uptake of NH_4^+.

The AMT2 family in *Populus trichocarpa*

P. trichocarpa has the highest number of AMT2s of all organisms analyzed (Table 2.1). This is due, in part at least, to the recent whole genome duplication in *Salicaceae*, but also suggests that AMT2 is either a particularly important family in *P. trichocarpa*, or that there is no selection against duplication of the members within it. In addition to PtAMT4-5 described above, the only AMT2s in *P. trichocarpa* with any characterization are PtAMT2-1 and PtAMT2-2, which are root-expressed with confirmed NH_4^+ transport capability, suggesting soil-uptake functions (particularly for PtAMT2-1). As there are no other biochemically functionally characterized AMT2s in *P. trichocarpa*, and AMT2s are also poorly characterized in other species, predicting functions of PtAMT2s is difficult. *Populus* may be a very amenable species to study functional divergence within the AMT2s, because it maintained copies of all four groups (unlike other model systems such as *Arabidopsis* or rice). The expression profiles (Figure 2.2) suggest distinct functions both within and between groups: while the group IV member (*PtAMT2-1*) is the sole exclusively root-specific AMT2 member in poplar, the group III gene (*PtAMT3-1*) is expressed only in male catkins. The phylogenetically distinct group I/II members also show distinct expression pattern with preferred expression in leaves and reproductive organs. This information may guide future research, which is needed to accurately determine functional differences of these genes.

2.3.3 The NRT1/PTR Family

The NRT1/PTR is named after the functions of its founding members, namely NO_3^- transporters (NRT1) and peptide transporters (PTR). The gene family is comprised of 53 family members on average, ranging from just one copy in *V. carteri* to 96 copies in *G. max*. Given the large size of the resulting phylogenetic reconstructions (Figure 2.4), sequences were separated into seven larger clades referred to as supergroups. These supergroups are defined where vascular plant clades are separated from each other by lycopod and bryophytes proteins. Supergroups were only defined when such a separation is supported with high (≥70) bootstrap support; sister clades that are separated by bryophyte sequences but only with low bootstrap support were joined as a single supergroup until a monophyletic clade with high support was reached. Within each supergroup, several subclades exist that contain monocots and / or eudicot sequences (i.e. that correspond to the groups proper by the definition used in the other N transporter families). The functions in this family cover a wide range, from glucosinolate transport (AtGTR1 and AtGTR2; Nour-Eldin *et al*. 2012), abscisic acid transport (AtAIT1; Kanno *et al*. 2012), peptide transport (e.g. AtPTR3; Karim *et al*. 2005), to NO_3^- excretion (AtNAXT1; Segonzac *et al*. 2007) and NO_3^- uptake (e.g. AtNRT1-1; Liu and Tsay 2003). As such, the name NRT1/PTR is not a true reflection of the functional diversity of the family, but was maintained here for consistency with the published literature. To test whether these diverse plant sequences likely form a plant specific monophyletic group, I used representative sequences from multiple subgroups within each supergroup in additional BLASTP searches against the GenBank database, excluding *Viridiplantae* from the results. For most searches, a similar set of BLAST results was obtained and keeping only the best non-plant hit (lowest expect value) for each plant NRT1/PTR group resulted in a small set of only three eukaryotic, invertebrate[1] sequences (from *Trichoplax adhaerens* [belonging to a basal animal phylum called *Placozoa*], from the sea anemone *Nematostella vectensis* [phylum *Cnidaria*], and from the acorn worm *Saccoglossus kowalevskii* [phylum *Hemichordate*]). These sequences share 28-30% sequence similarity with plant NRT1/PTRs. In contrast, prokaryotic sequences share less than 25% identity. Inclusion of the three animal sequences into the phylogenetic reconstruction resulted in

[1] A *Canis lupus* (dog) sequence (XM_548544) shared much higher similarity, but comparison of this apparent dog sequence revealed that it is almost identical to a *Z. mays* NRT/PTR member (possibly the dog or the researchers isolating genomic DNA from the animal had popcorn prior to extraction and whole genome sequencing).

a monophyletic group of animal sequences contained within supergroup 5 (Figure 2.4). This suggests that, despite the variety of functions, the NRT1/PTR family is monophyletic in plants. It is noteworthy that animals rather than other *Archaeplastida* (i.e. red algae and glaucophytes) eukaryotic proteins emerged as most similar non-*Viridiplantae* sequences. Focusing on red algae, the eukaryotic groups closest to the *Viridiplantae*, revealed that the sole available genome sequence of a red alga (*Cyanidioschyzon merolae*, Matsuzaki *et al*. 2004) produced no significant BLAST result with NRT1 protein baits. Expanding these searches to GenBank (non redundant (nr) and EST databases limited to red algae) also produced no BLAST results with an expect value of $e<10^{-5}$. Together these analyses suggest that NRT1/PTR family members are absent in red algae.

Targeted analyses of the green algal (*C. reinhardtii* and *V. carteri*) genomes revealed a single protein from *V. carteri*. Expanding BLAST searches against GenBank (nr database) yielded no additional green algal sequences with significant similarity across the full length of the baits. In the phylogenetic reconstruction, the *V. carteri* gene is located between the animal clade and the remainder of the *Viridiplantae* sequences (indicate by a green branch in Figure 2.4). This may suggest that the *V. carteri* genes shares a common ancestry with other *Viridiplantae* NRT1/PTRs. However, other green algae appear to lack this family, as only partial sequences are present in the *C. reinhardtii* and *Ostreococcus* genomes and no additional green algal sequences were identified in searches against GenBank. No functional data are available for the *V. carteri* gene.

The number of bryophyte and lycopod groups basal to a group of angiosperms suggests that the most recent common ancestor of embryophytes had between six and nine copies of genes encoding the various forms of transporters in this family. A more precise number cannot be determined given the low bootstrap support at some nodes separating basal clades. All labeled NRT1s, and most members of supergroup 1 and 2, possess 12 transmembrane domains (data not shown). The recreation of the large phylogeny (Figure 2.4) was an attempt to discern if transporters of discreet functions formed separate clades. By my definition of supergroups, it is clear that functions are not separated by supergroups as a rule.

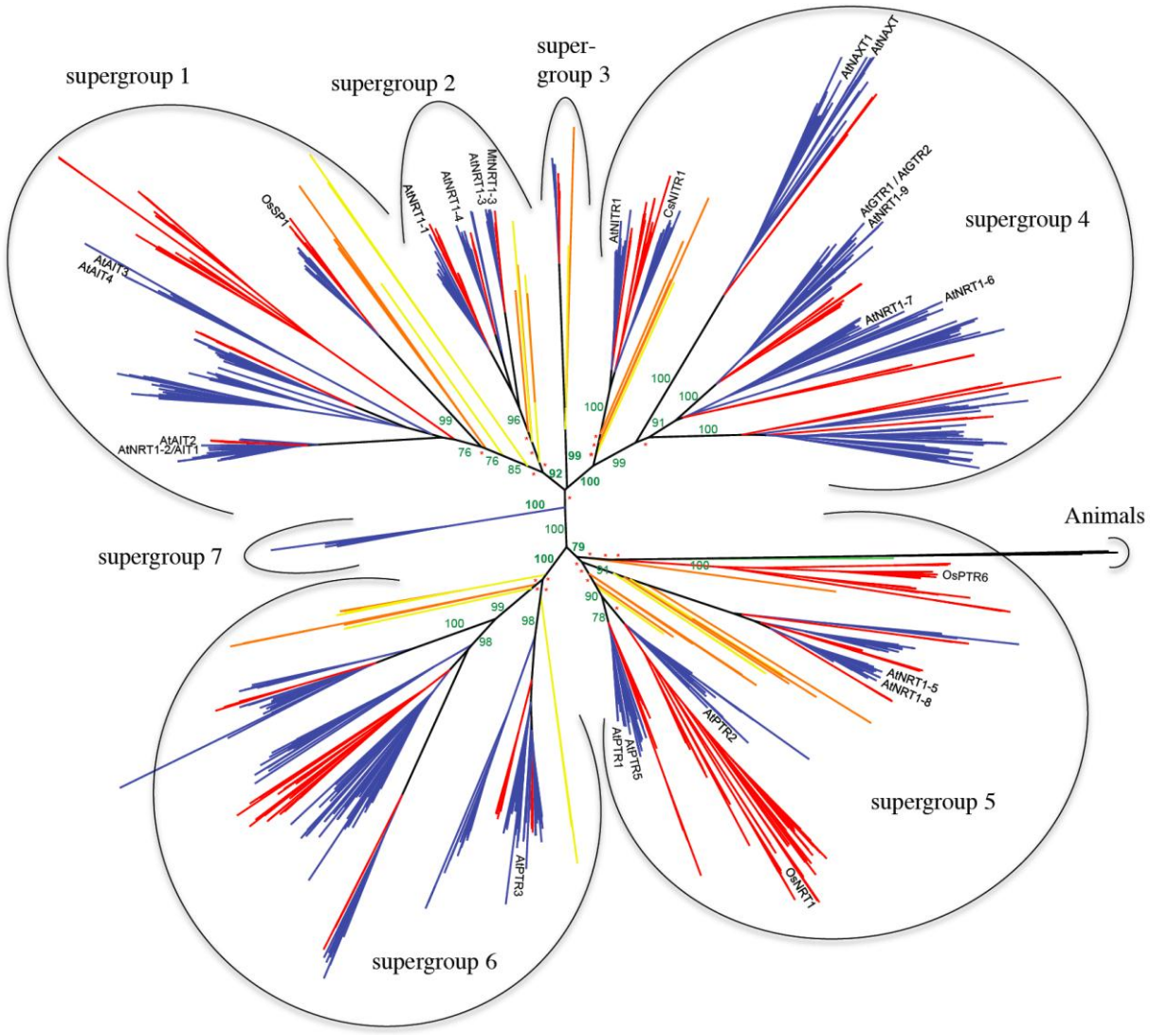

Figure 2.4. Unrooted neighbour-joining phylogenetic reconstruction (using a distance matrix) of the NRT1/PTR family in 22 fully sequenced plant genomes. The clades are coloured using the same system as Figure 2.1; however, red asterisks are included where there is low (≤70) bootstrap support. Bootstrap values within clades are not given. An animal group is included to demonstrate the monophyly of the NRT1/PTR family. Characterized transporters are labelled to indicate functional characteristics of the groups. Biochemically characterized proteins are named with NRT: nitrate transporter, GTR: glucosinolate transporter, PTR: peptide transporter, NITR: nitrite (NO_2^-) transporter, NAXT: nitrate excretion transporter, and AIT: abscisic acid (ABA) transporter.

In Supergroup 1, AtNRT1-2 is quite distantly related to other *Arabidopsis* NRT1s present in the sister clade defined as supergroup 2, which is separated by lycopod/bryophyte sequences. AtNRT1-2 has high expression levels in flower stamens and rosette leaf 2 (Figure 2.2), and Huang *et al.* (1999) have also reported high levels of AtNRT1-2 expression in roots. AtNRT1-2 expression is constitutive; however, there is a transient repression of AtNRT1-2 as AtNRT1-1 (in supergroup 2) expression increases in response to NO_3^- supply (Huang *et al*. 1999). AtNRT1-2 has been shown to have NO_3^- transport activity with a Km of 5.9±1.9 mM through cRNA insertion in *Xenopus* oocytes, and there is *in vivo* evidence of NO_3^- transport activity of AtNRT1-2 through chlorate (a NO_3^- homolog) uptake assays (Huang *et al.* 1999). AtNRT1-2 is unlikely a peptide transporter because it could not transport Gly-Gly, Ala-His, Ala-Leu, or His-His (Huang *et al*. 1999). However, AtNRT1-2 also transports the plant hormone abscisic acid (ABA), indeed with greater affinity than NO_3^- (Kanno *et al*. 2012). This suggests that ABA may be the actual substrate rather than NO_3^- for AtNRT1-2. Kanno *et al*. (2012) suggest ABA import activity for three additional members of supergroup 1: AT1G27040, AT3G25260, AT3G25280. The only other functionally characterized member of supergroup 1 is OsSP1. OsSP1 is expressed in the plasma membrane and is needed for panicle elongation in rice (Li *et al*. 2009, Zhao *et al*. 2010). Both voltage-clamp and yeast/bacteria mutant complementation failed to show NO_3^- transport activity indicating that it either requires partner proteins to perform its transport function, or that it transports an alternate substrate that was not tested. Given the recent ABA transporting function of other supergroup 1 members, this alternative substrate could be ABA. ABA is synthesized in the roots and is transported to the aerial parts where it exerts its hormonal functions (Davies and Zhang 1991), which includes impacts on floral development (Wang et al., 2013). Thus, a possible ABA transporting function may explain the *sp1* phenotype in rice. If this is the case, supergroup 1 may be an ABA Importing Transporter (AIT as named by Kanno *et al*. 2012)/NRT clade. Further research, especially into the transported substrate of OsSP1, will be needed to further substantiate this.

Supergroup 2 is likely an NRT-exclusive clade as it contains four characterized NRTs (AtNRT1-1, AtNRT1-3, AtNRT1-4, and MtNRT1-3). Each *A. thaliana* NRT1 is in a different group (as previously defined) and MtNRT1-3 is in the same group as AtNRT1-3. AtNRT1-1 has high expression levels in many tissues, with maximal expression in roots and cauline leaves. AtNRT1-1 is one of the most intensely studied NO_3^- transporters in *A. thaliana* with extensive

functional data available. AtNRT1-1 is a dual-affinity NO_3^- transporter, performing both low-affinity and high-affinity transport, mediated by the phosphorylation of threonine 101 (Liu and Tsay 2003). Until very recently, AtNRT1-1 was the only known dual-affinity NO_3^- transporter; however, another has been characterized in *M. truncatula* (MtNRT1-3) by Morere-Le Paven *et al.* (2011). AtNRT1-1 has also been described as a NO_3^- sensor (Ho *et al.* 2009). It also functions in stomatal opening (Guo *et al.* 2003) and performs a role in the regulation of AtNRT2-1 (Munos *et al.* 2004).

In addition to being the only other dual affinity NO_3^- transporter characterized, MtNRT1-3 is involved in primary root growth, NO_3^- sensing, and is developmentally regulated in roots with increasing expression after germination in N-free medium (Morere-Le Paven *et al*. 2011). Interestingly, MtNRT1-3 is up-regulated in the absence of NO_3^-, down-regulated upon addition of NO_3^- to roots (Morere-Le Paven *et al*. 2011), and is most closely related to AtNRT1-3. AtNRT1-3 has high expression levels in many tissues with highest expression in late stage flower petals and sepals (Figure 2.2). AtNRT1-3 has inducible expression only in shoots; in contrast, it has NO_3^- repressible expression in roots and its actual function is unclear (Okamoto *et al.* 2003). AtNRT1-4 has constitutive expression in the roots; however, expression in the shoots has been described as either being induced upon supply with NO_3^- (Okamoto *et al.* 2003) or as NO_3^- insensitive (Chiu *et al.* 2004). My *in silico* expression profiling (Figure 2.2) shows AtNRT1-4 having high expression levels in many tissues with highest expression in leaf 7 petiole. AtNRT1-4 was shown to have NO_3^- transport activity in *Xenopus* oocytes with a Km ~2.4 mM (Chiu *et al.* 2004). Consistent with my heatmap, Chiu *et al.* (2004) also showed highest expression levels of AtNRT1-4 in the petiole suggesting that AtNRT1-4 is responsible for NO_3^- accumulation in the petiole. Together, there is strong evidence that multiple members of supergroup 2, each belonging to distinct groups are *bona fide* NO_3^- transporters. This suggests that supergroup 2 is NRT exclusive.

Supergroup 3 and supergroup 7 contain no functionally characterized members. Supergroup 3 is most closely related to NO_3^- or nitrite (NO_2^-) transporter clades and as such is unlikely to be a peptide transporter clade. Supergroup 7 is small and not closely related to any functionally characterized sequences. Further research into the members of supergroup 3 and 7 is required to suggest a transport type.

Supergroup 4 indicates a polyphyletic relationship of the N-transporting proteins present in the NRT1/PTR family. There is a clade separated by bryophyte/lycopod sequences containing NO_2^- transporters (NITRs), suggesting there may be subdivisions between NO_3^- and NO_2^- transporter clades. However, there is another clade containing functionally characterized glucosinolate transporters (AtGTR1 and AtGTR2) and a NO_3^- transporter (AtNRT1-9), suggesting that there is no clear functional separation of clades within the NRT1/PTR family.

The NO_2^- transporter (NITR) containing clade of supergroup 4 is rooted by lycopod and bryophyte sequences. Due to low bootstrap support at the base of the clade, it was not defined as its own supergroup; however, my phylogenetic reconstruction suggests that it forms a functionally discreet clade with two groups (as previously defined) (Figure 2.4). The functionally characterized NO_2^- transporter members contained are AtNITR1 from *A. thaliana* and CsNITR1 from *C. sativus*. CsNITR1 mediates NO_2^- efflux when expressed in yeast, is expressed in chloroplast membranes of leaf cells in plants, and may load cytosolic NO_2^- into chloroplast stroma (Sugiura *et al*. 2007). AtNITR1 is an *A. thaliana* homolog of CsNITR1 and *Atnitr1* knockout mutants accumulate NO_2^- in leaves, suggesting it performs the same role as CsNITR1, transporting cytosolic NO_2^- to the chloroplast stroma (Sugiura *et al*. 2007). Angiosperm NITR homologs form an exclusive clade within supergroup 4 with high bootstrap support. Low bootstrap support for inclusion of the lycopod and bryophyte sequences into this clade excluded the formation of separate supergroups: it remains possible that some of the bryophyte/lycopod sequences are actually roots of the NAXT/GTR/NRT1 clade.

The NO_3^- excretion (NAXT) clade appears to be a group (as previously defined) within supergroup 4. This clade contains one characterized NAXT protein; however, Segonzac *et al*. (2007) identified six additional sequences as NAXTs all present in the same clade. NAXT1 is a plasma membrane localized protein expressed in the cortex of mature roots (Segonzac *et al*. 2007). NO_3^- efflux capabilities of the NAXT proteins was demonstrated *in vitro*, and RNAi transgenic plants grown on high N-medium had 30% higher NO_3^- in roots and 26% lower NO_3^- in shoots compared to wild type (Segonzac *et al*. 2007). This suggests a role in the distribution of NO_3^- in plants. As there are no other characterized types of transporters present in this clade, this would suggest that a NAXT-exclusive group exists within supergroup 4.

The clade containing two AtGTRs and one AtNRT1 is one of only two groups in the family which contains two different types of transporters. AtGTR1 and AtGTR2 were identified and characterized by Nour-Eldin *et al*. (2012). AtGTR1 is localized to the vasculature tissue in leaves, particularly the veins and mesophyll cells, and two-electrode voltage clamp measurements in *Xenopus laevis* demonstrated 4-methylthiobutyl glucosinolate transport activity. AtGTR1 likely performs a role in the distribution of glucosinolates within the leaf, possibly performing an import function into glucosinolate-rich S-cells adjacent to the phloem (Nour-Eldin *et al*. 2012). AtGTR2 transports 4-methylthiobutyl at 75% of the rate of AtGTR1, is localized to veins in leaves, and likely performs a major role in apoplastic phloem-loading of glucosinolates (Nour-Eldin *et al*. 2012). AtNRT1-9 is the NO_3^- transporter that shares the group with the GTRs. AtNRT1-9 has highest expression in roots (Figure 2.2) and has been shown to have NO_3^- transport activity in *Xenopus* oocytes, with a Km of ~7 mM (Wang and Tsay 2011). It is not rapidly induced upon NO_3^- supply; rather, expression levels are increased over long-term exposure to NO_3^-. GFP fusion protein indicated that AtNRT1-9 is located in the plasma membrane and expressed in the companion cells of phloem of roots (Wang and Tsay 2011). These data, combined with the data showing that AtNRT1-9 knockout mutants have reduced NO_3^- concentrations in phloem, indicates that AtNRT1-9 is responsible for phloem loading of NO_3^-. Interestingly, AtNRT1-9 and AtNRT1-7 (in a distinct group within supergroup 4), which are both functionally characterized NO_3^- transporters (Wang and Tsay 2011, Shu-Chun *et al*. 2009), were shown to have some glucosinolate transport activity at 17% and 3%, respectively, the rate of AtGTR1 (Nour-Eldin *et al*. 2012). These data suggest that GTRs may have arisen from AtNRT1-9 and this clade is where GTRs have evolved from NRTs (Nour-Eldin *et al*. 2012). OsPTR2 (named, by Ouyang *et al*. 2010 but not labeled in my study) also falls into this group with AtNRT1-9, AtGTR1, and AtGTR2, but Ouyang *et al.* (2010) found that OsPTR2 does not transport Leu-Trp or Gly-Leu in yeast. This evidence, combined with my supporting analysis that OsPTR2 is more closely related to *A. thaliana* NRT1s, suggests that it may not be a peptide transporter, but is more likely an NRT or GTR. While this group contains both NRTs and GTRs, there is functional overlap and it is expected that also other members of this group will show broader transport capacities.

There is one group proper within supergroup 4 that appears to be NRT-exclusive, containing AtNRT1-6 and AtNRT1-7. AtNRT1-6 has highest expression levels in seeds,

reaching maximal expression in stage 4 seeds (Figure 2.2). AtNRT1-6 is not responsible for the uptake of NO_3^- from the soil; instead, it is only expressed in reproductive tissues and expression increases immediately after pollination (Almagro *et al.* 2008). AtNRT1-6 cDNA injected *Xenopus* oocytes confers transport activity, confirming that AtNRT1-6 is indeed a low-affinity NO_3^- transporter with a Km of ~ 6 mM, however. It has been suggested that AtNRT1-6 plays a role in transporting NO_3^- from maternal tissue to the developing embryo (Almagro *et al.* 2008). AtNRT1-7 has been shown to transport NO_3^- in *Xenopus* oocytes with a Km of 2.8±0.9 mM (Fan *et al*. 2009); however, the expression of AtNRT1-7 is highest in leaves and negligible in root tissues. My *in silico* expression profiling of AtNRT1-7 localized it to late-stage flower sepals and stamens (Figure 2.2). In contrast, Fan *et al*. (2009) found that AtNRT1-7 levels increase in leaves as the leaves age, is localized to the minor veins, and determined that AtNRT1-7 is likely responsible for phloem loading of NO_3^- for remobilization from sink to source, from older to younger leaves. Taken together, it would appear that supergroup 4 contains distinct groups with members that all perform the same types of transport, thus it may be possible to functionally label each clade defining a group.

Supergroup 5 contains PTRs and NRTs, and is the clade that contains the chlorophyte and metazoan sequences included and thus constitutes the base of the *Viridiplantae* NRT1/PTR phylogeny. OsPTR6 is in a clade that is rooted by a single lycopod sequence, contains the only chlorophyte sequences present in the entire NRT1/PTR family, and is most similar to the animal group (Figure 2.4). While eight peptide transporters in *O. sativa* have been named (Ouyang *et al*. 2010), only for OsPTR6 was peptide transport function experimentally demonstrated. OsPTR6 is capable of transporting Gly-His and Gly-His-Gly in yeast complementation assays and is expressed in relatively low levels in developing seeds (Ouyang *et al*. 2010).

AtNRT1-5 and AtNRT1-8 are in an NRT-exclusive group within supergroup 5, which contains a total of three groups (as previously defined). This NRT-exclusive clade is rooted by lycopod and bryophyte sequences and would be in a separate supergroup was it not for the low bootstrap support preventing separation from the other clades in supergroup 5. AtNRT1-5 and AtNRT1-8 have highest expression levels in seeds separated from siliques; however, AtNRT1-5 also has relatively high expression levels in roots and flowers (Figure 2.2). AtNRT1-5, like AtNRT1-1, is NO_3^- inducible and strongly expressed in roots; however the response of AtNRT1-

5 to NO_3^- supply is much slower than that of AtNRT1-1 (Lin *et al.* 2008). AtNRT1-5 has been shown to have NO_3^- transport activity *in vivo* through depletion assays and is also inhibited by potassium limitation (Lin *et al*. 2008). AtNRT1-8 has also been shown, in *Xenopus* oocytes, to have NO_3^- transport activity with a Km of 12 mM (Li *et al.* 2010). AtNRT1-8 has high expression levels in xylem parenchyma cells in the stele, and T-DNA insertion mutants have increased concentrations of NO_3^- in the xylem, suggesting that AtNRT1-8 is responsible for removing NO_3^- from the xylem (Lin *et al.* 2010). Thus, AtNRT1-5 and AtNRT1-8 appear to define a group responsible for movement of NO_3^- within the plant.

The last clade in supergroup 5 is rooted by bryophyte and lycopod sequences, but, again, low bootstrap support at the base of this clade prevented it from being defined as a separate supergroup. This clade clearly contains both NRT1s and PTRs. While AtPTR1 and AtPTR5 are in a separate group from OsNRT1, AtPTR2 is in the same group as OsNRT1. AtPTR1 transports di-/tripeptides with low selectivity as well as substrates lacking a peptide bond, is expressed in vascular tissue throughout the plant (Dietrich *et al*. 2004), and likely performs a role in long distance transport. AtPTR5 mediates high-affinity transport of dipeptides and likely supplies peptides to maturing pollen, developing ovules, and seeds (Komarova *et al*. 2009). Interestingly, overexpression of AtPTR5 resulted in enhanced shoot growth and increased N content (Komarova *et al*. 2009).

AtPTR2 and OsNRT1 share a group within supergroup 4 and is the second group proper combining distinct functions. AtPTR2 was the first di-/tripeptide transporter identified in *Arabidopsis* (Frommer *et al*. 1994, Rentsch *et al*. 1995, Song *et al*. 1996, Dietrich *et al*. 2004) with high mRNA expression levels in germinating seed, root, and young leaf tissues (Rentsch *et al*. 1995). AtPTR2 antisense transgenic plants displayed delayed flowering time and arrested seed development (Song *et al*. 1996, 1997). OsNRT1 is constitutively expressed in the most external layer of the root (epidermis and root hairs) (Lin *et al*. 2000). Like most other NRT1s, OsNRT1 is a low-affinity transporter (Zhao *et al*. 2010) with a Km value of 9 mM (Lin *et al*. 2000). Despite the fact that OsNRT1 is more closely related to PTRs than to other NRT1s, Lin *et al*. (2000) observed no peptide transport in *Xenopus* oocytes expressing OsNRT1. So far, this is the only clade in the entire NRT1/PTR family analyzed to contain two transporters with no overlapping function; however, this could be due to the low number of characterized proteins in

this family. Further characterization of members of the NRT1/PTR family may identify more cases where transporters with no overlapping functions share clades.

Supergroup 6 contains only one functionally characterized member, AtPTR3. AtPTR3 is induced in the cotyledons and lower leaves by the amino acids histidine, leucine and phenylalanine and in the whole plant upon salt stress (Karim *et al*. 2005). Germination frequency of *ptr3* mutants was reduced on salt-containing media, indicating that AtPTR3 performs a role in stress tolerance during germination (Karim *et al*. 2005). AtPTR3 is also induced upon mechanical wounding, and *ptr3* mutants have increased susceptibility to virulent pathogenic bacteria *Erwinia carotovora* subsp. *carotovora* and *Pseudomonas syringae* pv. tomato (Karim *et al*. 2007) suggesting that AtPTR3 also performs a role in plant defense against bacterial pathogens. Thus, supergroup 6 appears to be PTR specific; however, it is a very large supergroup containing up to nine groups proper and only one protein has been functionally characterized. Further research is clearly needed to more confidently identify functional characteristics of supergroup 5.

The NRT1/PTR family in *Populus trichocarpa*

There are no functionally characterized PtNRT1s; however, PtNRT1-2 is in supergroup 2 grouped with AtNRT1-1, AtNRT1-3, and AtNRT1-4. It is thus very likely that PtNRT1-2 performs a NO_3^- transport role. PtNRT1-N and PtNRT1-P are in supergroup 1 with AtNRT1-2 and are predicted to be localized to the golgi, suggesting they are targeted to the secretory pathway and may perform uptake functions. PtNRT1-N, like AtNRT1-2, is found in supergroup 1 and has highest expression in root tissues (Figure 2.2), indicating that it may perform a role in ABA transport. As the NRT1/PTR family is large, data like these are essential to determine the selection of candidate genes for further analyses.

2.3.4 The NRT2 Family

The NRT2 gene family is comprised of one to eight family members with 11 or 12 transmembrane domains. The majority of NRT2 family members are predicted to be localized to the peroxisome or cytoplasm (Figure 2.2). Phylogenetic reconstructions (Figure 2.5 shows a neighbour-joining distance analysis and Supp. File 4 the corresponding Parsimony analysis) suggest there are two major groups of NRT2s in angiosperms (group I and II), separated by

bryophytes (group I *B*) and lycopods (group I *L*). Either these two angiosperm groups were present already in the last common ancestor of land-plants and were separated by speciation, or one of them was gained by other means, e.g. through horizontal gene transfer (more likely group II, because these are absent in many angiosperms and in non-vascular plants). To assess these possibilities, representative members of each group were used for additional GenBank searches excluding *Viridiplantae* sequences from the results, as performed with the previous families. The non-redundant set of best hits (lowest e-value) included only two sequences: a red algal sequence from *Pyropia yezoensis* (Accession BAG70346) was found when using AtNRT2-5 from group II and CrNRT2-A from the chlorophyte group as a bait, and the gamma-proteobacterial sequence from *Salinisphaera shabanensis* (Accession ZP_08551421) was found as the hit with the lowest e-value when using OsNRT2-2 and AtNRT2-6 from group I and OsNRT2-1 from group II as a bait. Both sequences were added to the sequence set and the complete sequence set was used for re-alignment and reconstruction of a new phylogeny. If group II would have arisen from HGT, it should have been expected that the source organism or a relative would be located at the base of this group, while the copy derived vertically would be expected to 'root' the Viridiplantae clade (assuming that relatives of each are present in GenBank). This topology has not been observed. Instead, the red algal NRT2 groups with the gamma-proteobacterial sequence, and together they form a sister clade to the green algal sequences (Fig 2.5 B). This, in turn, suggests that all *Viridiplantae* NRT2s are monophyletic and that the most recent common ancestor of land plants and green algae had only one copy of NRT2. In the chlorophyte clade, there have been two lineage specific duplication events in each of *V. carteri* and *C. reinhardtii* leading to each species possessing three copies of NRT2. No functional characterizations of any green algal NRT2s have been reported to date.

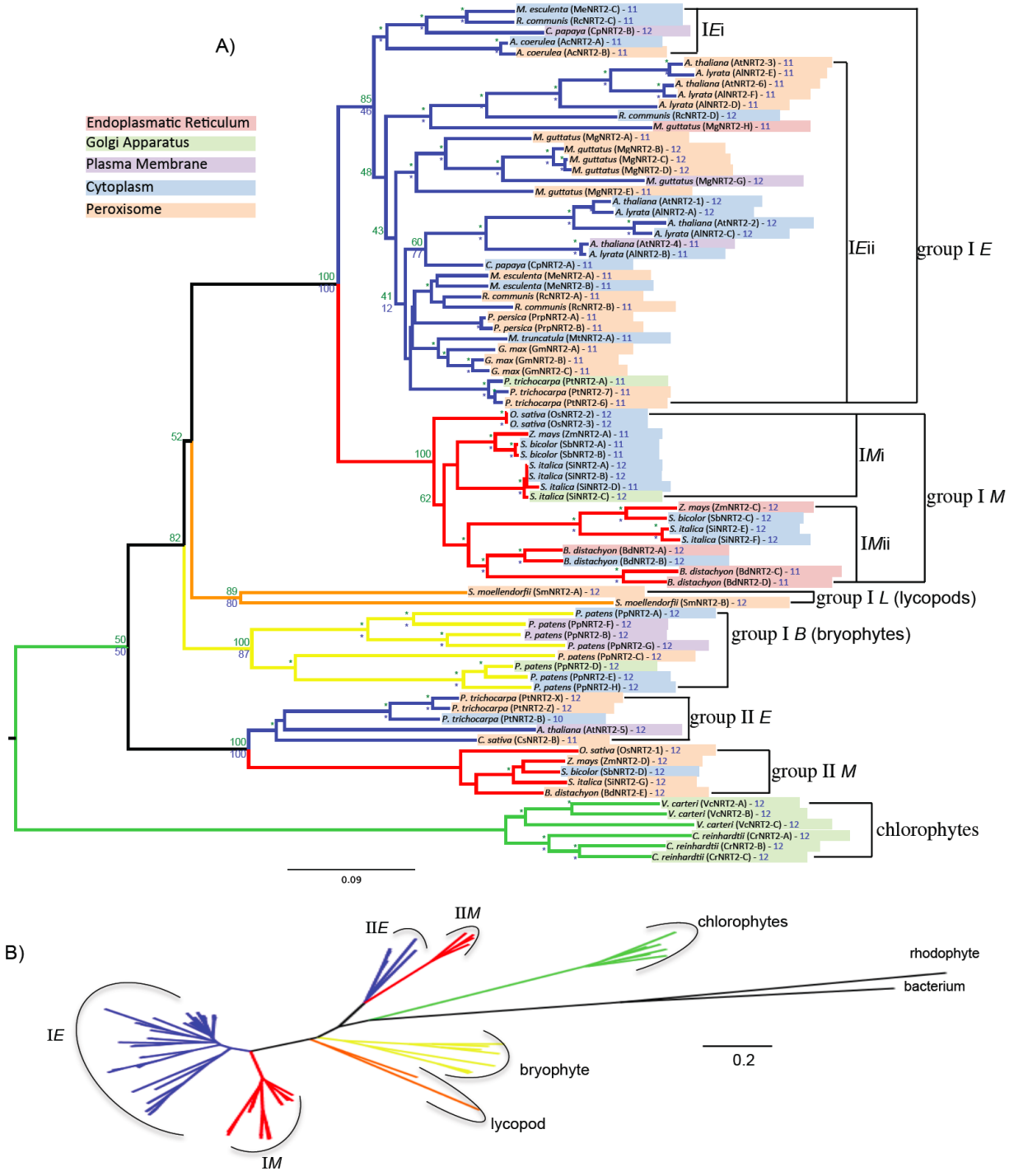

Figure 2.5. Neighbour-Joining phylogenetic reconstruction (using a distance matrix) of the NRT2 family. Clades are coloured using the same system as Figure 2.1. A) Phylogram of the NRT2 family supplemented with neighbour-joining bootstrap values (in green) and corresponding parsimony bootstrap values (in blue), subcellular localization

predictions, topology predictions, and proposed classification system. B) Unrooted phylogeny of the NRT2 family with included bacterial and rhodophyte sequences demonstrating the monophyly of the NRT2 family presented.

Interestingly, the location of group II, between the chlorophyte and the bryophyte/lycopod clades, reflects the situation observed for the AMT1 family. Given high bootstrap support (≥70) separating all major clades, my phylogenetic reconstruction suggests there was a duplication event prior to the divergence of embryophytes and bryophytes and that the copy in bryophytes/lycopods was lost subsequently. As there are only few organisms represented in group II, it may be the case that gene loss in this group is common. There are both monocots and eudicots present in group II, suggesting that, contrary to AMT1 and AMT2, the function performed by group II NRT2s is shared across eudicots and monocots. Within this group, AtNRT2-*5* has maximal expression in senescing leaves according to my gene expression heatmap (Fig. 2.2), but is described as being NO_3^- repressible, expressed in roots and shoots, and, contrary to root-uptake NRT2s, having maximum expression in the absence of NO_3^- (Okamoto *et al.* 2003). This may indicate a function in remobilization of NO_3^- from stored pools into the cytosol (Orsel *et al.* 2004). While not functionally characterized, the expression profile for PtNRT2-X (group II) shows maximal expression in male catkins. Together, this may suggest that eudicot group II NRT2s fulfill functions in NO_3^- remobilization within the plant rather than having root uptake activities. In contrast, the rice OsNRT2-1 has maximal expression in seedling roots, is NH_4^+ repressible, and, as found for typical root-uptake NRT2s, has transcriptional up-regulation upon treatment with low concentrations of NO_3^- (Feng et al 2011). It is interesting to note, however, that unlike *A. thaliana* NRT2s, there is no transcriptional down-regulation of *OsNRT2-1* upon treatment with high concentrations of NO_3^-. This divergent group thus contains *bona fide* NRTs that may be responsible for both root uptake and mobilization of NO_3^- within the plant; however more functional data is required to separate these functions in an evolutionary context.

The bryophyte clade contains all *P. patens* NRT2s and is basal to the major land plant clade. As would be expected, based on the species phylogeny, the lycopods are at the base of the angiosperms. In the bryophyte clade, there have been multiple duplications. The most ancient duplication event in *P. patens* created two smaller subclades. There have been three subsequent duplications in each of the bryophyte subclades leading to a total of eight *P. patens* NRT2s. In

the lycopod clade, there has been one duplication event leading to two copies of NRT2 in *S. moellendorffii*. None of these genes have been functionally characterized; however, the ancient duplication likely means the two subclades of bryophytes may have different functions, while it may be speculated that the more recent duplications may have led to subfunctionalization.

Group I *E* contains the majority of eudicot NRT2s and can be subdivided into two subclades, I*E*i and I*E*ii. Group I*E*i is small, containing only four different organisms; however, there is strong bootstrap support that it is a separate clade and that the majority of eudicots likely have lost I*E*i-type NRT2s. As there are no functionally characterized members of group I*E*i, potential specialized functions that provide the adaptive advantage to keep this subgroup in certain species cannot be speculated at present. The majority of Group I *E* is predicted to be peroxisome or cytoplasm localized, but includes two proteins predicted to be localized to the secretory pathway, one to the golgi, and one sequence to the ER. As well, three proteins are predicted to be localized to the plasma membrane. Group I *E*ii has undergone extensive species-specific amplification in every organism except *M. truncatula*, which contains only one NRT2. The NRT2 family is best characterized in *A. thaliana*. Within group I*E*ii two sets of *Arabidopsis* paralogs can be identified: one comprising AtNRT2-1, -2, and -4, and the other containing AtNRT2-3 and -6, each alongside their *A. lyrata* orthologs (Fig. 2.5A). AtNRT2-1 and AtNRT2-6 have maximal expression in the root. AtNRT2-3 has maximal expression in the vegetative shoot apex and AtNRT2-4 has maximal expression in mature pollen. Also AtNRT2-2 is expressed in pollen, but in addition it is also expressed in seeds (Fig. 2.2). In summary, obvious differences in expression patterns, both within and between the groups of paralogs in *Arabidopsis*, already suggests differential functions of individual group I*E*ii members.

AtNRT2-1 is responsible for HATS transport in roots and also directly regulates lateral root formation under N-limiting conditions (Remans *et al.* 2006). AtNRT2-1 transcripts are induced upon supply with low levels of NO_3^- as would be expected of a high affinity transporter (Filleur and Daniel-Vedele 1999). Interestingly, while the mRNA levels are rapidly increased upon supply of NO_3^-, the protein content in the plasma membrane changes only slowly over the course of several days (Wirth *et al.* 2007). This delayed protein response is likely due to the two-part mode of activity of NRT2 proteins, which require association with an NAR2 protein to perform transport activity. Regulation of the NAR2 protein would regulate the transport activity

of the NRT2 protein without the need to quickly regulate the levels of NRT2 protein itself. AtNRT2-2, like AtNRT2-1, is a member of the HATS in roots (Li *et al.* 2007). My *in silico* expression analyses indicates high expression in pollen and seeds, suggesting AtNRT2-2 may perform additional transport functions in other tissues or perhaps a role in signaling. A knockout mutant of either *AtNRT2-1* or *AtNRT2-2* results in a reduction of iHATS; however, a double knockout is required to reduce the cHATS, suggesting partially redundant functions of these paralogs (Li *et al.* 2007). Furthermore, the more divergent AtNRT2-4 is over-expressed in *Atnrt2;1/Atnrt2-2* double knockouts, suggesting a compensation function; however, over-expression of AtNRT2-4 does not restore NO_3^- transport function in the double knockout (Orsel *et al.* 2004). Thus, it has been suggested that AtNRT2-4 is responsible for the re-mobilization of stored NO_3^-, potentially from a source such as the vacuole, but that it cannot replace the root uptake functions mediated by AtNRT2-1 and 2. AtNRT2-3 is not well characterized; however, it does have very slow inducible expression in shoots and constitutive expression in roots, with slight down-regulation in roots after six hours of exposure to a NO_3^- supply (Okamoto *et al.* 2003). AtNRT2-6 has very low constitutive expression levels, but highest expression is in the roots. It has been suggested that AtNRT2-6 may be responsible for very high affinity NO_3^- transport, although this is highly speculative (Orsel *et al.* 2004). In conclusion, individual group I*E*ii members in *A. thaliana* fulfill distinct physiological functions and even close paralogs (e.g. AtNRT2-1 and -2) only have partially redundant functions. It can thus be expected that functional 'radiation' within this group led to the maintenance of multiple copies with diverse functions also in other species.

Also the monocot sister clade, group I *M*, has undergone multiple gene duplications at different times in its evolutionary history. Group I *M* consists of two large subclades (I*M*i and I*M*ii). The majority of group I *M* proteins are predicted to be localized to the cytoplasm, but includes five proteins predicted to be localized to the secretory pathway, with one localized to the golgi and four to the ER. There has been a duplication event for group I *M* NRT2s prior to the speciation of monocots, which has led to two sets of orthologs defining the subclades I*M*i and I*M*ii. Almost all plants are present in each subclade; however, it is interesting to note that there are only I*M*i-type transporters present in *O. sativa* and only I*M*ii-type transporters present in *B. distachyon*. In I*M*i there has been one duplication event in each organism, except *S. italica*, which has had three duplications. In I*M*ii there have been three duplication events in *B.*

distachyon and one in *S. italica.* Both rice NRT2s, OsNRT2-2 (I*M*i) and OsNRT2-3 (I*M*i), have maximal expression in seedling roots. Little functional data are available for OsNRT2-2 and OsNRT2-3; however Cai *et al.* (2008) showed that OsNRT2-2 is rapidly induced in roots upon NO_3^- supply, then down-regulated quickly. OsNRT2-3 has a transient inducible response to NO_3^-, peaking at 15 minutes after exposure to a NO_3^- supply. As well, Yan *et al.* (2011) have shown that OsNRT2-1, OsNRT2-2, and OsNRT2-3, like the NRT2s in *A. thaliana*, must interact with an additional protein, OsNAR2-1, to perform transport activity. As there are no functionally characterized I*M*ii -type NRT2s, it remains open whether or not there is a functional difference between I*M*i and I*M*ii.

The NRT2 family in *Populus trichocarpa*

The *P. trichocarpa* genes in the NRT2 family are generally poorly characterized. PtNRT2-6 and PtNRT2-X are the only genes in this family for which data beyond sequences are available. PtNRT2-X from group II shows highest expression in the male catkins, but it is also expressed to detectable levels in female catkins, xylem, and roots (Fig. 2.2). It shares a phylogenetic group with NRT2s from *A. thaliana* and *O. sativa* that are root-expressed. Further research into the functional characteristics of PtNRT2-X will determine if it shares any functions in the root tissues. PtNRT2-Z and PtNRT2-B from group II are closely related to PtNRT2-X and together they form a group of paralogs (Fig. 2.5). PtNRT-X and PtNRT2-Z are both located on chromosome 15 separated by just one additional gene, suggesting they arose from a tandem duplication. In contrast, PtNRT2-B is located on chromosome 12. PtNRT2-Z and PtNRT2-B do not have previously published expression profiles/microarray data, as such it cannot be determined whether they are inactive duplicates, or perform redundant (or even novel) functions. The same situation is true for group I, where PtNRT2-6, PtNRT2-7, and PtNRT2-A form a cluster of *P. trichocarpa* paralogs. Interestingly, as there are no studies on specific NRT2s from *P. trichocarpa*, the number identifiers PtNRT2-6 and PtNRT2-7 come from their labels on Phytozome.net. These names were given to these sequences by phytozome because previously named NRT2-6s and NRT2-7s (respectively) from other organisms are the most homologous sequences. As they are truly uncharacterized themselves, letter identifiers would have also been appropriate. Also, Table 2.1 indicates there are seven *P. trichocarpa* NRT2s. While this is true, PtNRT2-C (supplemental file 1) was excluded from the phylogeny due to overall sequence

dissimilarity leading to a long branch. More research into the NRT2 family in *P. trichocarpa* will be required to determine the exact number of members present. PtNRT2-A and PtNRT2-7 are not present in my *in silico* expression analysis due to their absence in the eFP browser. As PtNRT2-6 has published microarray data showing high expression in the roots, further research will be needed to determine if PtNRT2-A and PtNRT2-7 perform distinct or redundant functions, or are inactive duplicates.

2.4 Conclusion

To my knowledge, there has not been a single study analyzing all of the AMT1, AMT2, NRT1, and NRT2 families together in such a large number of land plant species. The study by McDonald *et al.* (2010) describes extensive NRT and AMT phylogenetic research across diverse eukaryotic and prokaryotic kingdoms. Focusing in particular on NH_4^+ transporters, the study provides convincing evidence for key horizontal gene transfer event leading to the AMT2s in land plants, as well as another HGT event leading to AMT2s in the green algae that do contain them. For all four families, McDonald *et al.* (2010) suggest monophyly of the land plant clades, but given the broader scope of the study, they did not resolve the evolutionary history within this taxonomic group and it remained undiscussed whether the 'unusual' angiosperm clades located between the green algae and bryophytes, as found here for the AMT1 and NRT2 families, were included. In contrast, Plett *et al.* (2010) analyzed the NRT1 and NRT2 families in monocots and eudicots, but only six species were included in the phylogenies. Despite the small number of species used in the Plett *et al*. (2010) study, it largely confirms the NRT1 supergroups identified in my study. Supergroup 2 (containing AtNRT1-1, AtNRT1-3, and AtNRT1-4), supergroup 1 (containing AtNRT1-2), supergroup 4 (containing AtNRT1-6 and AtNRT1-7), and supergroup 5 (containing AtNRT1-5 and AtNRT1-8), are also indicated in the phylogeny presented by Plett *et al*. (2010, Figure 2). Supergroup 6 and 7 are only observed in my study due to the large number of species analyzed, and because Plett *et al*. (2010) did not include characterized PTRs. The two groups I identified in the NRT2 family are also in agreement with the Plett *et al*. (2010) study, with the only major difference being the inclusion of AtNRT2-7 in Plett *et al*.'s (2010) phylogeny. Because AtNRT2-7 has extensive differences throughout the sequence (leading to the long branch observed in Plett *et al*. (2010) Figure 4), it was excluded from my study to avoid phylogenetic distortions caused by long branch attraction.

The phylogenies presented in the current study are a vital first step for further functional characterization of NO_3^- and NH_4^+ transporters in the 22 fully sequenced plant species presented. Beyond this, it can be assumed that most if not all groups of N-transporters in angiosperms have been defined in this study, and that addition of more species will not lead to the definition of more groups as defined here. Although not conclusive in all cases, the functionally characterized transporters included in the phylogenies may indicate potential functional characteristics of the putative transporters sharing the same clade.

The subcellular localization and transmembrane domain analyses indicate the likelihood that the putative transporters are more or less similar to the functionally characterized transporters as well as indicating possible functional distinctions. The subcellular localization, in particular, supports the proposed break of the clades into discrete groups and subgroups. Some of the localization is unexpected, such as the high degree of peroxisome localization in the NRT2 family. This could be due to the fact that prediction tools rely heavily on the 5' region of genes, which can be particularly faulty in gene models. Uncertainty in the prediction of peroxisome localization is further suggested by the relatively low confidence ratings obtained from MultiLoc2 (data not shown); however, at the least, similarity in localization indicates similarity among the genes. Additional functional information may be inferred from localizations, for instance, the extensive golgi, ER, and plasma membrane prediction in the AMT2 family indicates possible steps towards membrane localization (i.e. part of the endomembrane system) which may be associated with a transport function. The transmembrane domain prediction analysis does not help to discern discrete clades, but rather flags sequences that possess 9, 10, or 13 transmembrane domains as potentially not being NO_3^- or NH_4^+ transporters or as being incomplete gene models.

Current nomenclature of the NO_3^- and NH_4^+ transporters, which is essentially based on the order of discovery, is insufficient to indicate the phylogenetic relationships among the transporters. The naming system I have suggested in my Figures 2.1, 2.3, 2.4, and 2.5 better expresses these relationships. My naming system does not pertain to the transcript number (1-1 or 2-3 etc.) nor the letters in place of the transcript numbers in the case of yet to be-functionally characterized genes (-CC or -A etc.). My naming system pertains to the groups displayed on the far right hand side of Figures 2.1, 2.3, 2.4, and 2.5 (Group I *E*, Group I *M*, I*M*i, II*E*ii, etc.). A

group is defined where a monocot and eudicot clade form sister clades and thus share a single common ancestor. This simple rule allows for future sequences to be added to groups easily, and for new groups to be formed with little controversy. The group names also indicate phylogenetic relatedness and it is easier to determine how similar two sequences are, without referring back to phylogenetic reconstruction.

The NRT1 family has been described as a NO_3^- and peptide transporter family (Glass 2009, Plett *et al.* 2010, McDonald *et al.* 2010), containing over 50 members in *A. thaliana* and over 80 in *O. sativa* (Wang and Tsay 2011, Miller *et al.* 2007, Ouyang *et al.* 2010). Plett *et al.* (2010) avoided using any uncharacterized sequences in their analysis of the NRT1 family to ensure they did not include any PTRs. I included sequences from all 22 fully sequenced plant genomes in an analysis of the NRT1 family to determine whether or not NRT1s and PTRs shared clades. My analysis indicates that the NRT1 family is polyphyletic and share at least one clade with PTRs; however, there appear to be multiple cases in which functional labels can be applied to groups proper. In addition, I am the first to provide an extensive phylogeny (Figure 2.4) that suggests which clades are likely responsible for each type of transport.

In conclusion, my study provides a vital first step in the characterization of NO_3^- and NH_4^+ transporters present in the 22 fully sequenced algae and plant species analyzed. This was done in the form of comprehensive phylogenies, which indicate potential functional characteristics of putative transporters. Furthermore, my study suggests a nomenclature system that better expresses the phylogenetic relationships between the transporters in the NRT1, NRT2, AMT1, and AMT2 families. My study also serves to clarify the NRT1/PTR phylogeny and suggests which sequences are likely responsible for which type of transport. Further research is needed to functionally characterize the genes present in the phylogenies. Also, more sequences from evolutionarily divergent plant species (especially from non-angiosperm lineages including gymnosperms, pteridophytes, and additional non-vascular plants) need to be included in the current phylogeny to better resolve the relationships between the major transporter clades. Potentially, this could explain the evolutionary histories especially of those angiosperm groups not rooted by *P. patens* / *S. moellendorffii* sequences.

3 Ion Flux Analysis

3.1 Introduction

Correlation of the activity of NH_4^+ and NO_3^- transporters along root tips with gene expression of the candidate genes identified in Chapter 2 in those same root sections will support the hypothesis that the candidate genes code for AMTs and NRTs responsible for ion uptake from the soil environment. Correlation of the activity of NH4+ and NO3- transporters in roots with expression of the candidate genes identified in Chapter 2 in the same root regions would support the hypothesis that the candidate genes code for AMTs and NRTs responsible for ion uptake from the soil environment. The activity of N-ion transporters in the root plasma membrane can theoretically be quantified by measurement of ion flux. Ion flux is the rate at which ions move across a membrane. An ion flux profile of a root tip demonstrates the regions of higher and lower uptake. Regions of high net uptake indicate high transporter activity, and high levels of expression of the respective transporter would be expected, as demonstrated in *O. sativa* (Takayanagi *et al*. 2011), *A. thaliana* (Okamoto *et al*. 2003), and *Z. mays* (Sorgona *et al*. 2011). Alber *et al.* (2012) also attempted, unsuccessfully, to correlate N-ion transporter expression with N ion flux in white spruce (*Picea glauca*). As *P. trichocarpa* has a fully sequenced genome, the identification of N transporters should be more specific than in spruce, and the likelihood of correlating N ion flux with N transporter gene expression was expected to be greater. *P. trichocaropa* is a fast growing tree species; therefore, I hypothesized that it will have an ion flux profile similar to other fast growing plant species.

As N often limits plant growth in terrestrial systems (Vitousek and Howarth 1991), determining *P. trichocarpa*'s capacity for NH_4^+ and NO_3^- uptake along roots is critical in the understanding of its N-nutrition. Variation in the fluxes of these ions along root tips can correlate to soil pH (Hinsinger *et al.* 2003), nutrient availability (Rennenberg *et al.* 2010), internal ion concentration (Britto and Kronzucker 2003), and developmental zones, for example, the zone of elongation is often correlated with high proton efflux (Hawkins *et al.* 2008, Reinhardt and Rost 1995). In some species, such as *Eucalyptus nitens*, however, little to no variation in ion fluxes along root tips is observed (Garnett *et al.* 2001), indicating the variation in fluxes between species and the importance of determining the flux profile of a species individually.

Increased uptake of NH_4^+ and NO_3^- is inducible (Glass *et al.* 2001); however, the uptake of NO_3^- can be repressed by the presence of NH_4^+ (Lee and Drew 1989). Given this, knowledge of *P. trichocarpa*'s N ion uptake under varying concentrations of these ions is imperative. As NH_4NO_3 is a typical N-fertilizer (Heilman and Xie 1994, DesRochers *et al.* 2003, Ahmed *et al.* 2011) and both ions are usually present in soil solution, it is the substrate of choice for determining inorganic N ion uptake profiles. Insight into the magnitude of NH_4^+ and NO_3^- transport would also elucidate the preference of *P. trichocarpa* for either NH_4^+ or NO_3^-, and whether or not this preference changes under different concentrations of NH_4NO_3. As proton (H^+) flux can be an indicator of plant stress (Hinsinger *et al.* 2003, Kennedy and Gonsalves 1987) or key developmental zones (Bloom *et al.* 2002), measuring proton flux can provide insight into the complex system of root ion transport.

Many studies have been done using *Xenopus* to show transport activity of N-ion transporters (Doddema and Telkamp 1979, Huang *et al.* 1999, Tong *et al.* 2005, Guether *et al.* 2009, Ho *et al*. 2009). Heterologous expression in *Xenopus* and yeast is a powerful tool; however, it does not demonstrate flux rates or functions of proteins *in vivo*. Demonstrating ion uptake by specific transporters *in vivo* can be difficult; however, *A. thaliana* NH_4^+ transporters AtAMT1-1, AtAMT1-2, and AtAMT1-3 have shown increased expression in roots correlated with increased ion uptake after N-starvation (Gazzarini *et al*. 1999).

Depletion assays are commonly used in conjunction with gene expression analyses to indicate potential transporters. One such example is ZmNRT2-1 in *Z. mays*, which has maximum expression in the 4-6 cm region of the root, correlated with peak NO_3^- uptake in the same region (Sorgona *et al.* 2011). While depletion assays or ^{15}N labelled uptake assays are often used to determine uptake rates, a more rigorous system of determining ion fluxes is the Microelectrode Ion Flux mEasurement (MIFE) system. The MIFE is a non-invasive system that uses ion-selective microelectrodes placed close to the root surface. The microelectrodes are moved between the initial position and 40 μm further away from the root surface. The difference in ion concentration between these two points is calculated, determining the direction and magnitude of net flux. Only a few labs possess the required equipment and software to perform this type of flux analysis.

The MIFE is capable of measuring ion fluxes at discrete positions along roots in real time (Newman 2001), providing rare and valuable insight into plants' ion uptake activity. This is demonstrated by Hawkins *et al.* (2008, 2010) who provide ion flux profiles in Douglas fir, lodgepole pine, and soybean roots grown under various N nutrition and pH regimens. *In situ* there would likely be other confounding factors, such as mycorrhizal associations. As only some genes are affected by mycorrhizal associations, phylogenetic analyses and previously characterized transporters can guide selection of candidates. PtAMT1-2 and PtAMT1-6 have increased expression after mycorrhizal inoculation (Couturier *et al*. 2007), and, as suggested in chapter 2, all members of group II*E* may perform a function in NH_4^+ uptake from mycorrhizae. Couturier *et al*. (2007) also suggested that PtAMT1-2 and PtAMT1-6 are diurnally regulated and are expressed in the absence of mycorrhizae. It would appear that PtAMT1-2 and PtAMT1-6 may also perform transport (or other) functions in the absence of mycorrhizae. Thus, obtaining flux profile and gene expression data for all genes of interest in the absence of mycorrhizae provides valuable baseline information.

The MIFE does not necessarily measure the flux provided by any individual transporter protein, rather the overall net flux (both influx and efflux) resulting from the combination of all transporters active at a given point. However, if an ion flux profile from the MIFE was spatially correlated with expression of candidate transporter gene sequences determined through gene expression profiling, it would strongly suggest the candidate gene sequences did indeed code for active soil-to-plant transporter proteins as well as identify the location of their highest activity. Alber *et al.* (2012) attempted this in *Picea glauca*, but they observed no correlation of their candidate NRT and AMT gene expression with ion flux profiles.

The current study sought to use the MIFE in conjunction with gene expression profiling to identify and characterize NRTs and AMTs along the first 1.4 cm of three-week-old *P. trichocarpa* roots exposed to 100 µM, 1000 µM and 1500 µM NH_4NO_3. As cuttings are often used in molecular studies of *Populus* spp. (Couturier *et al*. 2007, Selle *et al*. 2005, Frost *et al*. 2012) and are a common method of poplar propagation (Xu *et al*. 2012), my initial analyses in both ion flux analysis and expression profiling used cuttings. After numerous rounds of ion flux analysis observing extensive N-efflux (see Results), I attempted ion flux analysis using

seedlings. In contrast with cuttings, I observed net N-uptake in seedlings and therefore performed further ion flux profiling and expression profiling on seedlings.

My attempt to correlate ion flux profiles with gene expression was not entirely successful as a poor RNA extraction led to insufficient template for gene expression analysis along the entire length of a root. The ion flux analysis, however, was successful in providing a flux profile of the first 1.4 cm of the roots of three-week-old *P. trichocarpa* seedlings exposed to three different concentrations of NH_4NO_3.

3.2 Materials and Methods

3.2.1 Cutting Collection and Growing Conditions

Three-node *P. trichocarpa* cuttings were collected from Nisqually 1 clones on March 29th, 2011 at the University of Victoria. The cuttings were trimmed to just below the lowest node. The lowest node had the buds removed, was wounded with a razor blade, and Rootech Original Cloning Gel (Technaflora Plant Products Ltd., Port Coquitlam, B.C., Canada) rooting hormone was applied to the wound. Two cuttings per pot were planted in 60 pots filled with perlite. Cuttings were grown for three weeks in the Beverly Glover greenhouse at the University of Victoria (average daily temperature ~23°C, nightly temperature ~19°C, 11 hours daylight). Pots were covered with cellophane for the first week to maintain high humidity. Cuttings were watered every other day and, after one week of growth, were given 65 mL per pot of 1000 µM NH_4NO_3 Pretreatment Solution (NH_4NO_3 dissolved in 200 µM $CaSO_4$ and 1M KNO_3) every third day.

3.2.2 Cutting Flux Analysis

After three weeks of growth, six cuttings were removed roughly 17 hours prior to ion flux analyses. Cuttings were gently removed from the soil and dipped in water to remove as much excess soil as possible. Great care was taken not to break, bend, or pull on the roots. Once cleaned, cuttings were laid on an acrylic plate and gently tied down with string. The acrylic plate (with cutting attached) was then placed into a test tube containing distilled water. The cuttings were placed under a constant light source with a bubbler gently aerating the solution, ensuring the bubbles were not directly contacting the roots of the seedlings. In order to induce expression of NH_4^+ and NO_3^- transporters, whilst not saturating the cuttings with nutrient, the water was replaced with either 100 µM NH_4NO_3, 1000 µM NH_4NO_3, or 1500 µM NH_4NO_3 Treatment

Solution (same as the Pretreatment Solution, except the 1M KNO_3 is excluded) five hours prior to measurement.

Fluxes of H^+, NH_4^+, and NO_3^- were measured using a non-invasive MIFE (Unitas Consulting, Hobart, Australia) as described in Shabala *et al*. (1997) and Shabala and Newman (1997). Electrode blanks were pulled from 1.5 mm borosilicate glass capillaries, dried in an oven at 220°C for four hours and salinized with tributylchlorosilane (catalog no. 90796, Fluka). Cooled microelectrodes were backfilled with 200 mM NH_4Cl for NH_4^+, 500 mM KNO_3 plus 100 mM KCl for NO_3^-, and 15 mM NaCl plus 40 mM KH_2PO_4 (adjusted to pH 6.0 using 0.1 M NaOH) for H^+. Electrode tips were then filled with commercially available ion-selective H^+ or NH_4^+ cocktails (Fluka catalog no. 95297 and 09882, respectively), or an NO_3^- -selective cocktail containing 0.5% methyltridodecylammoniumnitrate (MTDDA NO_3^-), 0.084% methyltriphenylphosphonium bromide (MTPPB), and 99.4% n-phenyloctylether (NPOE) (Plassard *et al.* 2002). The electrodes were calibrated in a set of known standards.

The electrodes were mounted on an electrode holder (MMT-5, Narishige, Tokyo, Japan) providing three-dimensional positioning. The electrodes were positioned in a line 10 µm above the cutting root surface with their tips spaced 4 to 5 µm apart. The chamber was attached to a computer-controlled micromanipulator (PatchMan NP2, Eppendorf AG, Hamburg, Germany). During the flux measurements, the MIFE computer gently moved the chamber up and down, providing virtual movement of the electrode surface, in a 10 s square-wave cycle. The concentration of each ion was calculated from its electrochemical potential at each position. The flux of each ion was later calculated from the measurements of the difference in the electrochemical potential between these positions (Shabala *et al.* 1997). Fluxes were measured for 10 minutes each at the tip and 0.3, 0.6, 1.3, and 1.6 cm (+/- 0.1 cm) along the root. This root region was expected to exhibit high net N-uptake in poplar, based on preliminary studies. Two replicate plants from each treatment were measured each day for four days. Flux data recorded from the MIFE were imported to Microsoft Excel. Mean net fluxes of H^+, NH_4^+, and NO_3^- were calculated from a two minute period (20 flux data points) of consistent measurement, i.e. without electromagnetic interference or other disturbance.

3.2.3 Seed Collection and Growing Conditions

P. trichocarpa capsules were collected on June 12, 2011 at the University of Victoria near the Murray and Anne Fraser Building. Seeds and seed tufts were separated from the capsules by hand; seeds were then separated from seed tufts by placing seed tufts in a sieve and using the bench-top air hose to force seeds through the sieve. As there is no stratification required for *P. trichocarpa* seeds, they were planted the next day in pots filled with peat/pearlite/vermiculite (1:1:1). Seeds were planted in nine pots per day, with 20 seeds per pot, over five days (45 pots total). Pots were covered with cellophane to maintain high humidity. Seedlings were grown for three weeks in the Beverly Glover greenhouse at the University of Victoria (average daily temperature ~23°C, nightly temperature ~19°C, 11 hours daylight). Seedlings were watered every day. After the first week, seedlings were given 65 mL per pot of 1000 µM NH_4NO_3 Pretreatment Solution every other day.

3.2.4 Seedling Flux Analysis

Preparation of seedlings for flux analysis and measurements of ion flux were as for cuttings. Fluxes of H^+, NH_4^+, and NO_3^- were measured using the MIFE for ten minutes each at 0.2, 0.4, 0.6, 0.8, 1.2, and 1.4 cm (+/- 0.1 cm) along the root. In *P. menziesii* and *Pinus contorta*, the zones of maximal uptake for both NH_4^+ and NO_3^- are 2-3 cm from the tip, with fluxes declining to near-zero around 4 cm from the tip (Hawkins *et al.* 2008). In that study, flux measurements were made at the tip then at 5, 10, 20, 30, 40, 60, and 80 mm from the root tip. However, in order to measure the flux profile on a finer scale over a smaller distance, I measured net fluxes every 2 mm up to 1.4 cm. Two measurements per 5 mm of root were taken to correlate ion flux data with gene expression data of candidate NO_3^- and NH_4^+ transporters analyzed in 0.5 cm sections of root. Two replicate plants from each treatment were measured each day for four days. Plants measured on the second day were taken from pots planted on the second day etc. to ensure identical growing time for the seedlings measured.

Flux data recorded from the MIFE were imported to Microsoft Excel. Mean net fluxes of H^+, NH_4^+, and NO_3^- were calculated from a two minute period (20 flux data points) of consistent measurement. Up to eight replicate plants from each N treatment were measured until four replicates were obtained without electromagnetic interference, broken electrode tips or physical interference distorting fluxes. Mean net NH_4^+, NO_3^-, and H^+ fluxes measured at each position on the root of the four replicate plants per treatment were compared by Analysis of Variance

(*ANOVA*), with N ion and root position and their interaction as fixed effects, and the effect of tree nested within N treatment (PROC GLM, SAS Institute Inc., Cary, NC). The effect of tree was not significant in any analysis. If the interaction term of N treatment * root position was significant for an ion ($P \leq 0.10$), net ion fluxes in each N treatment were compared among root positions with a one-way ANOVA with root position as a fixed effect (PROC GLM). Flux means were compared by least significant difference test (LSD, PROC GLM).

3.3 Results

3.3.1 Cuttings vs. Seedlings

Proton flux was near-zero in both cuttings and seedlings; however, extensive N-efflux was observed in cuttings (Figure 3.1). As my initial goal was to correlate N-uptake with expression of NRT and AMT proteins responsible for N-uptake from soil environments, the N-efflux observed in cuttings made this correlation difficult. In ion flux analyses using seedlings instead of cuttings, net N-uptake was observed (Figure 3.2). I determined that using seedlings for the ion flux and gene expression analyses was the best way to correlate N-uptake with transporter protein gene expression.

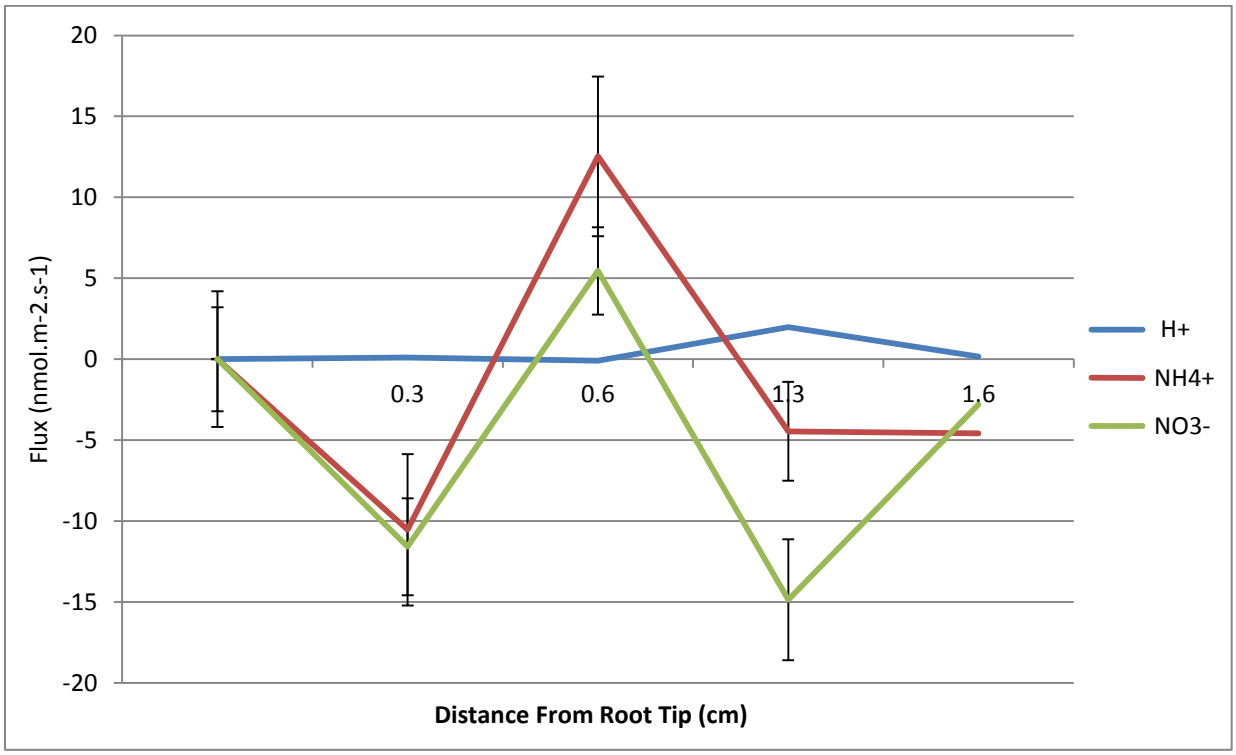

Figure 3.1. Mean H^+, NH_4^+, and NO_3^- net fluxes (with standard error) measured at intervals from the tip to 1.6 cm of three-week-old *P. trichocarpa* cutting roots. Cuttings were nutrient starved for 12 hours, then treated with 1500 µM NH_4NO_3 for five hours. Negative values indicate net efflux.

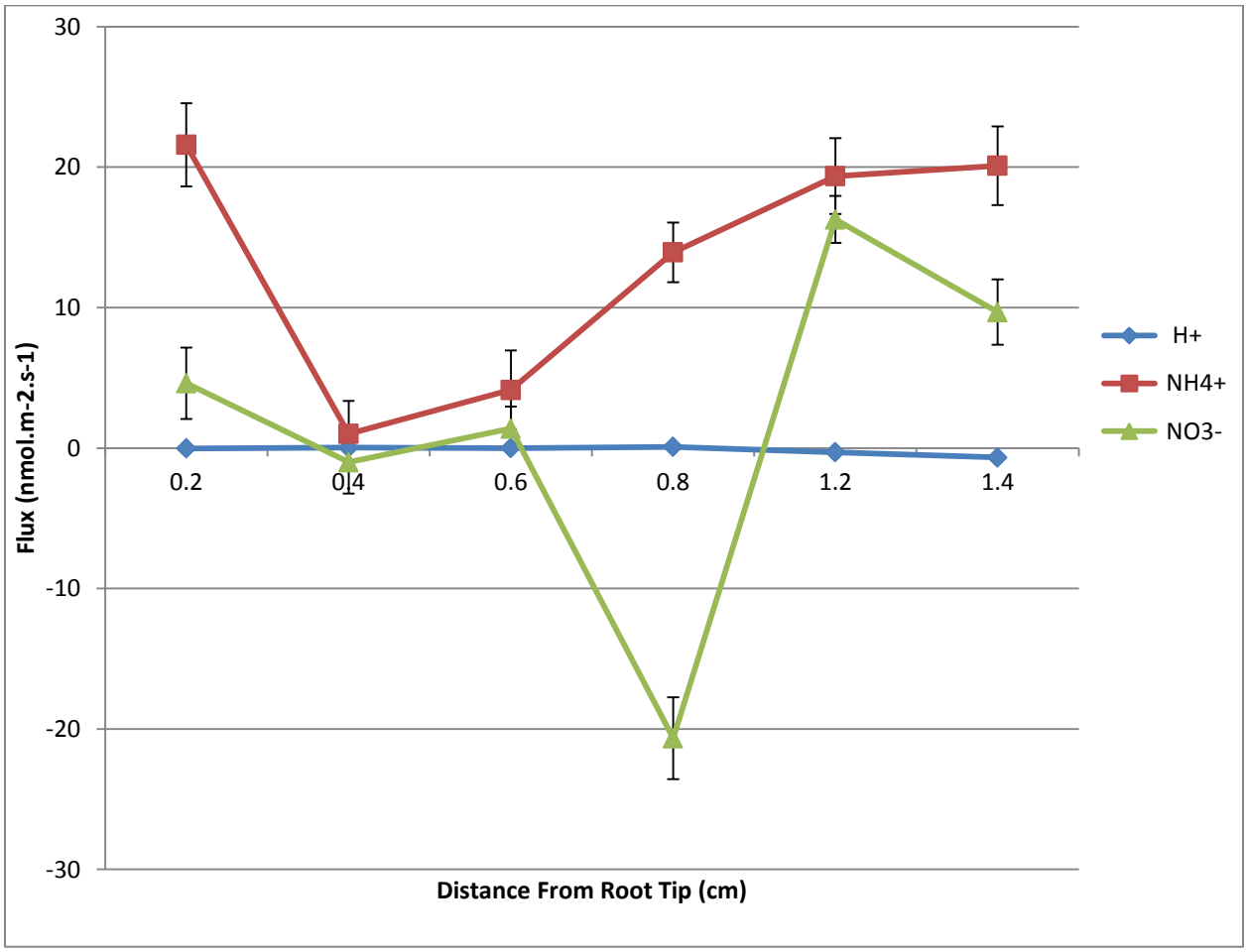

Figure 3.2. Mean H^+, NH_4^+, and NO_3^- net fluxes (with standard error) measured at intervals from the tip to 1.4 cm of three-week-old *P. trichocarpa* seedling roots. Prior to flux analysis, seedlings were nutrient starved for 12 hours, then treated with 1500µM NH_4NO_3 for five hours.

3.3.2 H^+ Flux: Seedling Roots

N treatment had a significant ($P \leq 0.1$) effect on proton flux, and the N treatment * position term was nearly significant ($P=0.1104$); therefore, data were reanalyzed by comparing H^+ fluxes among root positions, separately for each N treatment with a one-way ANOVA. In all treatments at most root positions, the net flux was generally near-zero or slightly negative

(Figure 3.3). In the 1000 µM treatment, however, proton net efflux at 1.4 cm was significantly greater ($P \leq 0.05$) than at 0.2 cm, 0.4 cm, and 0.6 cm.

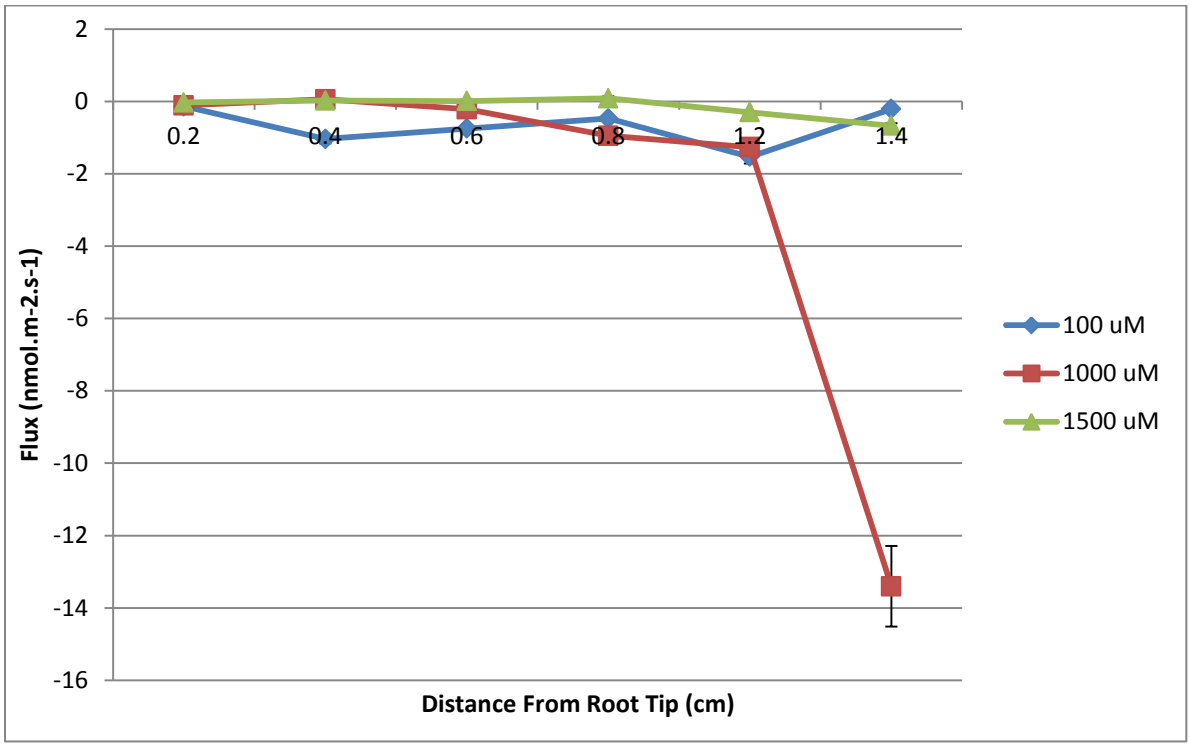

Figure 3.3. Mean H^+ net flux (with standard error) measured at intervals from the tip to 1.4 cm of three-week-old *P. trichocarpa* roots. Prior to flux analysis, seedlings were nutrient starved for 12 hours then treated with 100 µM, 1000µM, or 1500 µM NH_4NO_3 for five hours. Negative values indicate net efflux.

3.3.3 NH_4^+ Flux: Seedling Roots

NH_4^+ fluxes were significantly higher in the 1500 µM and 1000 µM treatments than the 100 µM ($P \leq 0.0001$). The mean net uptake rates observed in 1500 µM and 1000 µM treatments were not significantly different from each other; however, mean net NH_4^+ efflux was observed in the 100 µM treatment ($P \leq 0.05$) (Figure 3.4). Across all treatments, low net uptake ($P \leq 0.05$) was observed at the 0.6 cm position. There was net uptake of NH_4^+ in the 100 µM treatment and no significant differences among root positions. 1000 µM treatment fluxes were all positive, with highest net NH_4^+ uptake at 0.4 cm, 0.8 cm, 1.2 cm and 1.4 cm. None of these values were significantly different, likely due to the large standard deviations. Net flux differed significantly among root positions ($P=0.035$) in the 1500 µM treatment. Net NH_4^+ uptake at 0.4 cm and 0.6

cm was lower than at 0.2 cm, 1.2 cm, and 1.4 cm, and net uptake at 0.8 cm was not significantly different from any other root position.

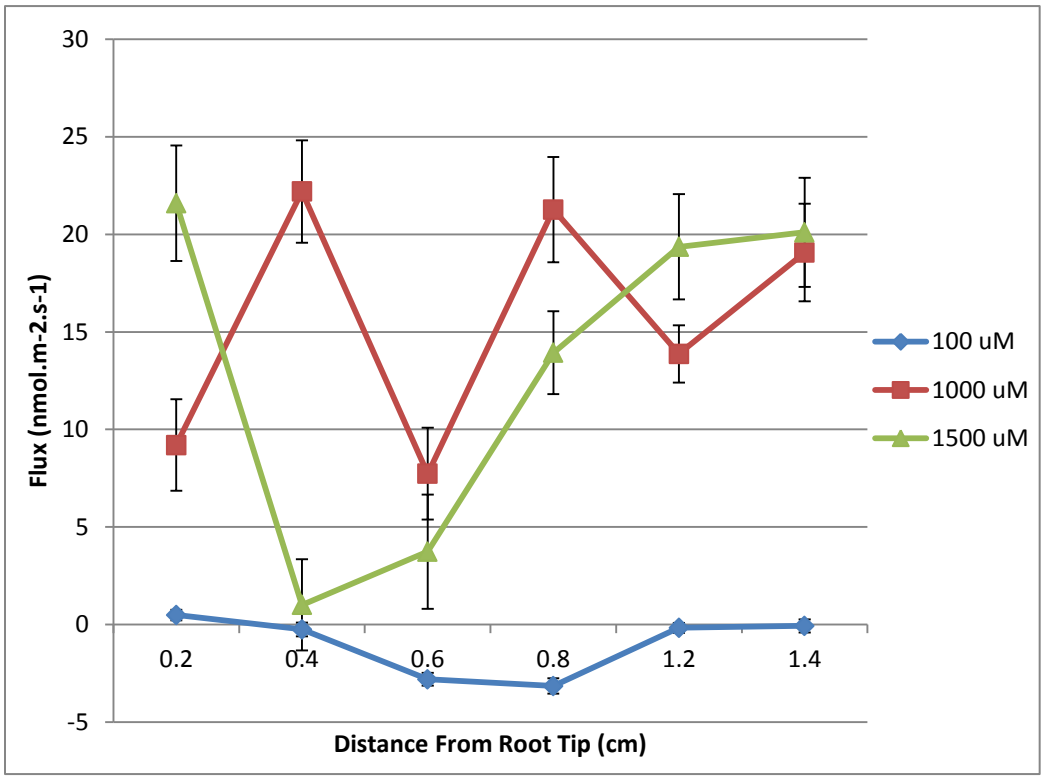

Figure 3.4. Mean NH_4^+ net flux (with standard error) measured at intervals from the tip to 1.4 cm of three-week-old *P. trichocarpa* roots. Prior to flux analysis, seedlings were nutrient starved for 12 hours then treated with 100 µM, 1000µM, or 1500 µM NH_4NO_3 for five hours.

3.3.4 NO_3^- Flux: Seedling Roots

The effects of N treatment and root position on NO_3^- flux were significant (P=0.014 and P=0.006 respectively), as was their interaction (P=0.071). The difference in average flux between the 100 µM and 1500 µM treatments was not significant, and net uptake in both the high and low N treatments was lower than in the 1000 µM treatment (Figure 3.5). On average, net uptake at 0.8 cm was lower ($P \leq 0.05$) than at 0.2 cm, 0.6 cm, 1.2 cm, and 1.4 cm, There were no significant differences in net flux in the first 1.4 cm of root in the 100 µM treatment. Net NO_3^- uptake was observed at all root positions in the 1000 µM treatment. Uptake at 0.2 cm and 0.8 cm was lower than at 1.4 cm ($P \leq 0.05$). In the 1500 µM treatments, there was significant net efflux of NO_3^- ($P \leq 0.05$) at 0.8 cm compared to the measurements at 0.2 cm, 1.2 cm, and 1.4 cm.

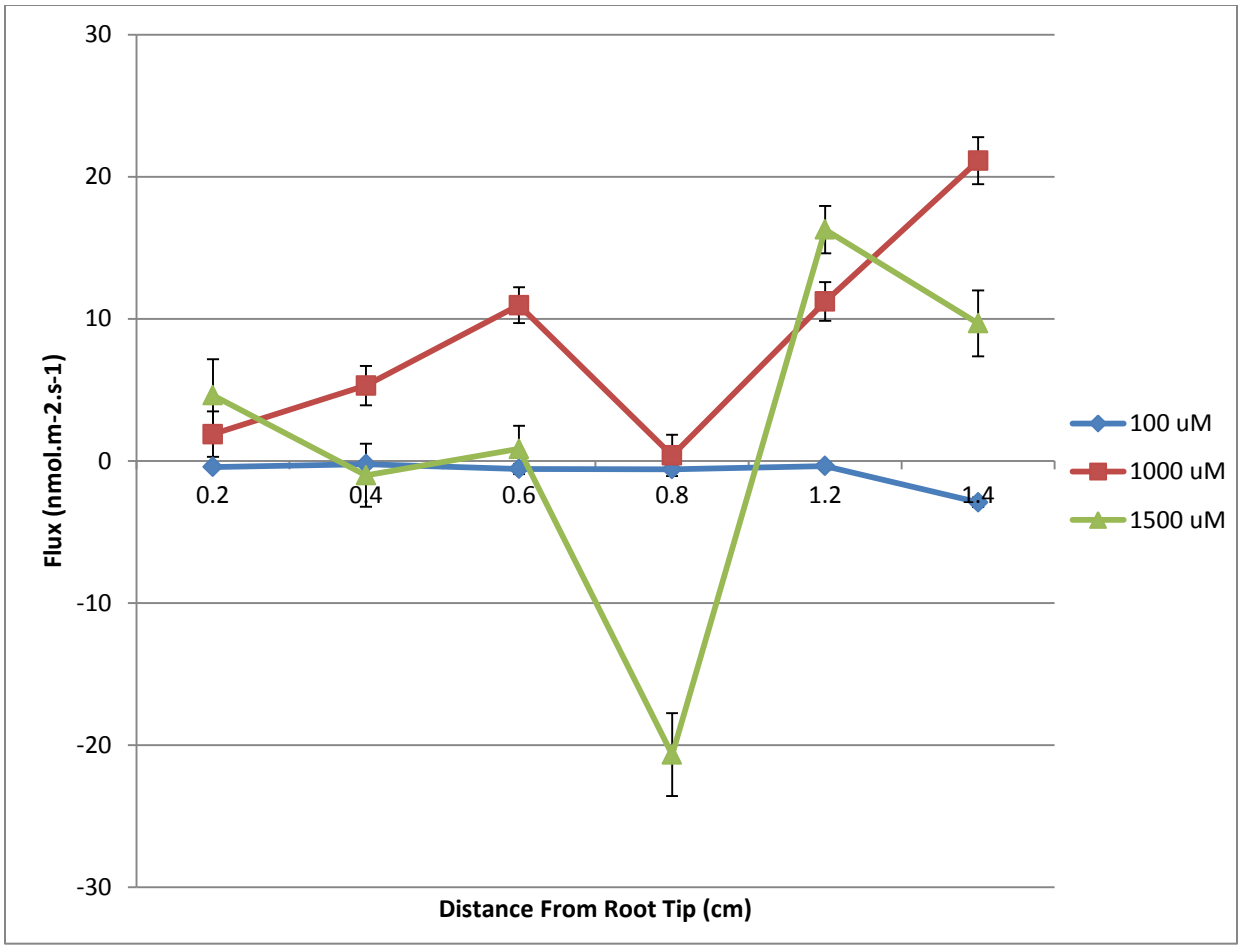

Figure 3.5. Mean NO_3^- net flux (with standard error) measured from the tip to 1.4 cm of three-week-old *P. trichocarpa* roots. Prior to flux analysis, seedlings were nutrient starved for 12 hours then treated with 100 µM, 1000µM, or 1500 µM NH_4NO_3 for five hours.

3.4 Discussion

I have generated ion flux profiles for the first 1.4 cm of three-week-old *P. trichocarpa* seedlings. These ion flux profiles illustrate the activity of the NRTs and AMTs responsible for the uptake of NH_4^+ and NO_3^- from the soil environment. Correlation of these ion flux profiles with gene expression of candidate NRTs and AMTs will aid in the identification of NRTs and AMTs responsible for the uptake of these ions from the soil environment. Based on the fluxes observed here, I would expect to see increased expression of NRTs in the regions beyond 1.0 cm from the root tip when treated with 1000 µM or 1500 µM NH_4NO_3, as well possibly at the 0.6 cm region when treated with 1000 µM NH_4NO_3. I would expect to see increased expression of AMTs in the regions beyond 0.8 cm in both the 1000 µM and 1500 µM treatments, as well as the

root tip in the 1500 µM treatment and the 0.4 cm region of the 1000 µM treatment. Unfortunately I was largely unable to measure the expression of my candidate transporters to validate these hypotheses.

My data suggest that *P. trichocarpa* prefers NH_4^+ over NO_3^- as net uptake of NH_4^+ was greater than NO_3^-, on average. This is in contrast to the results of Woolfolk and Friend (2003), who showed *Populus deltoides* grew best when the NH_4^+: NO_3^- ratio was 20:80, but not when NO_3^- was the sole source of N. Rennenberg *et al.* (2010) also stated that NO_3^- was the most important form of N to poplar. It seems likely, then, that *P. trichocarpa* prefers NO_3^- when the ratio of NH_4^+: NO_3^- favours NO_3^-. My seedlings may have experienced repressed NO_3^- uptake as a consequence of the presence of NH_4^+. It has been shown that the presence of NH_4^+ strongly inhibits the flux of NO_3^- (Lee and Drew 1989). This generally occurs only when a plant is induced for NO_3^- uptake and has high internal NO_3^- (Aslam *et al.* 1994, 1997). This was likely the case in my study, especially in the 1000 µM and 1500 µM treatments.

3.4.1 Proton Flux: Seedling Roots

Proton flux can be a proxy for the reliability of other ion flux measurements, as a sudden or strong proton efflux can indicate stresses such as nutritional deficiencies, pH stress, or other environmental stresses (Hinsinger *et al.* 2003, Kennedy and Gonsalves 1987). It is worth noting, however, that strong mechanical stress, such as the excision of shoot from roots, may not necessarily be shown in proton, NH_4^+, or NO_3^- fluxes, as demonstrated in *Pseudotsuga menziesii*, *Glycine max*, *Cucurbita pepo*, and *Pisum sativum* by Hawkins *et al.* (2012). The near-zero proton fluxes measured in all seedlings suggest that the plants were not under stress. In my 1000 µM NH_4NO_3 treatment, I observed a zone of proton efflux at the 1.4 cm region that may continue further along the root than I measured. Proton efflux may be a requirement to maintain an acidic environment for cell wall expansion in the root elongation zone (Bloom *et al.* 2002), and as such, I may have identified the beginning of the zone of elongation.

My proton flux data resembles the findings of Taylor and Bloom (1998) and Plassard *et al.* (1999), who demonstrated low proton efflux near the root tip, increasing from 3.5-60 mm and 3-20 mm, respectively, in maize. While I only observed an increase in proton efflux with distance from the root tip in one treatment, this could be due to the fact that I did not measure far enough along the root to detect the zones of maximal proton efflux in the other treatments. While

the high proton efflux at 1.4 cm in 1000 µM NH_4NO_3 suggests that the zone of efflux may be just behind 1.4 cm from the root tip, this contrasts with results from conifers (Hawkins *et al.* 2008), which show strong proton efflux near the root tip that declines up to 80 mm. My proton flux data also contrast with large proton efflux observed in *Eucalyptus nitens* (Garnett *et al.* 2001). Different species' roots grow at different rates, which could explain the variation in the location of the zone of elongation, and therefore zones of maximal efflux. As a fast growing species, it might be expected that *P. trichocarpa*'s root proton efflux profile would more closely resemble that of fast-growing cereal crop species than slow growing conifers.

Proton fluxes are often strongly influenced by NH_4^+ and NO_3^- fluxes (Garnett *et al.* 2001, 2003, Hawkins *et al.* 2008, Sorgona *et al.* 2010), which I did not observe in the current study. Rather, my results are in agreement with Garnett *et al.* (2001), who observed no significant patterns of proton efflux along *E. nitens* roots. Hawkins *et al.* (2010) demonstrated a correlation of proton flux with NH_4^+ and NO_3^- fluxes in lodgepole pine, but a lack of correlation between proton flux and NH_4^+ and NO_3^- fluxes in soybean. It is clear, then, that correlation of proton flux with NH_4^+ and NO_3^- fluxes is not a general rule, though the correlation is often observed.

3.4.2 NH_4^+ and NO_3^- Fluxes: Seedling Roots

Very low net NH_4^+ and NO_3^- fluxes were observed in the 100 µM NH_4NO_3 treatment. Since the iHATS is induced at low ion concentrations and operates at low rates (Glass *et al.* 2002), the low fluxes observed could simply be due to the operation of the iHATS. It is also possible that, since the MIFE system measures net flux, the influx is nearly equal to efflux, resulting in a net flux close to zero. Britto and Kronzucker (2006) demonstrate a relatively large influx relative to efflux at lower external ion concentrations that decreases to the point where, at high external ion concentrations, the influx is only slightly more than the efflux. This supports the suggestion that low rates of N-uptake in the 100 µM NH_4NO_3 treatment were due to the operation of the iHATS. At higher external concentrations, I observed much higher net uptake. Since the LATS operates at high rates and exhibits a linear response to increasing N-concentration (Glass *et al.* 2001), one could expect that high external ion concentrations would result in higher total fluxes.

My N-flux data from the 1000 µM and 1500 µM treatments suggest that the maximal influx zones may be further along the root than the 1.4 cm position, as fluxes were rising at this

position. In *Oryza sativa* subsp. *japonica*, transporter gene transcripts were in extremely low abundance in root tips (Kyndt *et al.* 2012), suggesting lower uptake at the root tip. It is worthwhile to note that the Hoagland's solution used by Kyndt *et al.* (2012) is N-rich and therefore expression of the iHATS, such as NRT2s and members of AMT1, would not have been stimulated. Also, since some transporters are constitutively expressed, mediated through a secondary protein, or otherwise post-transcriptionally regulated, low expression of transporter transcripts does not necessitate low flux. In fact, despite low transcript abundance of all NRT2s and NAR2s (a secondary protein often required for iHATS function), *O. sativa* roots can maintain a high NO_3^- influx (Cai *et al.* 2008). Similarly, lack of correlation between transporter transcript expression and N-uptake was also observed in barley (Vidmar *et al.* 2000).

Hawkins *et al.* (2008) demonstrated, in *Pseudotsuga menziesii* and *Pinus contorta*, that the zones of maximal uptake for both NH_4^+ and NO_3^- can be as far as 2-3 cm from the tip, and finally decline to near-zero around the 4 cm region. Their conclusions, however, were based on developmental zones rather than distance from tip. The highest fluxes observed by Hawkins *et al.* (2008) were in the white zone with low to no flux in the tan/brown zone. The current study did not measure past the white zone and this is likely why I did not see a decline to near-zero flux. In rice, the highest NO_3^- uptake was 5-20 mm from the tip (Colmer and Bloom 1998), while in barley, NO_3^- uptake increased from the tip to 60 mm (Henriksen *et al.* 1992). In maize, the lowest NO_3^- uptake was at the root tip, and increased from 5-50 mm (Taylor and Bloom 1998). NH_4^+ uptake in rice was maximal at the root tip and decreased to a minimum at 40-60 mm (Colmer and Bloom 1998) while in barley it was highest 10-20 mm from the tip (Henriksen *et al.* 1992). Maize had high NH_4^+ uptake at the root tip, with a decline from 5-10 mm, then an increase from 10-60 mm (Taylor and Bloom 1998). The NH_4^+ flux in my 1500 µM NH_4NO_3 treatment was similar to maize, with a maximal uptake value near the very tip of the root, followed by a steep decline, then an increase in net uptake further along the root (but over a much smaller distance). The high influx near the tip could be due to a high concentration of influx transporters active at the root tip, followed by either a high number of efflux transporters to prevent the toxic effects of NH_4^+ accumulation (Kronzucker *et al.* 1996), or a decrease in influx transporter expression for other reasons. Reinhardt and Rost (1995) note that different ion flux profiles between species are likely due to differences in root development. While flux measurements further along *P. trichocarpa* roots would be valuable, the root system of the

seedlings analyzed in my study were highly branched, and as such the morphology of the root system did not allow for measurement of fluxes over long distances.

The pH of the solution has a large effect on which form of N is taken up. Increased NH_4^+ and NO_3^- uptake was observed as pH increased from 4 to 7 in soybean, whereas a switch from NO_3^- uptake at pH 7 to near zero or net efflux at pH 4 was observed in Douglas-fir (Hawkins *et al.* 2010). The preference for NO_3^- observed by Woolfolk and Friend (2003) was observed at pH 5, the inhibition of NO_3^- uptake by NH_4^+ observed by Lee and Drew (1989) was observed at pH 6.0, and my study was performed at pH 7.0. The pH used in the current study is likely too high to observe the preference for NO_3^- as observed by Woolfolk and Friend (2003); however, the NO_3^- uptake inhibition by NH_4^+ may have been a factor influencing the observed fluxes. As *P. trichocarpa*'s flux profile resembles that of cereal crop species, I likely would have observed higher NH_4^+ and NO_3^- uptake than observed in either of Woolfolk and Friend's (2003) or Lee and Drew's (1989) experiments.

Many studies report nutrient regimens that span days or weeks, with maximal uptake occurring many days after initial treatment (Hawkins *et al.* 2008, Taylor and Bloom 1998, Colmer and Bloom 1998, Henriksen *et al.* 1992). My study only used a 12 hour nutrient starvation period and five hour treatment period because maximal N transporter gene expression has been shown to occur within two to six hours of treatment (Glass *et al.* 2001, Li *et al.* 2007, Huang *et al.* 1999, Sonoda *et al.* 2003). As the original goal of my study was to correlate the gene expression profile with the ion flux profile, and a number of the N transporter genes are post-transcriptionally regulated (Okamoto *et al.* 2006), days of treatment may have led to a homogenization of many of the gene expression levels. Given the short period of N treatment, I may not have elicited maximum influx rates for *P. trichocarpa*, as these could have occurred days after my measurements were taken. *P. trichocarpa* may obtain its NH_4^+ and NO_3^- from sources other than directly from the soil, such as mycorrhizal symbionts, but the ions must pass through the plant's membrane. As such, I have provided important insight into the locations of high NH_4^+ and NO_3^- uptake along the root, indicating locations of high NRT and AMT expression, as well as a very sensitive study of the flux profile in the first 1.4 cm of root in three-week-old *P. trichocarpa* seedlings.

3.4.3 Cuttings vs. Seedlings

As cuttings are often used in molecular studies of *Populus* spp. (Couturier *et al*. 2007, Selle *et al*. 2005, Frost *et al*. 2012) and I hoped to create a N transporter gene expression profile in cutting roots, my initial ion flux analyses of *P. trichocarpa* used cuttings. However, extensive N-efflux was observed at most root positions in cuttings, particularly in the 1500 μM treatments. In contrast, net N-uptake was observed at similar root positions in seedlings grown and treated with nearly identical conditions. Because of this, I determined the best plant material in which to correlate ion flux profiles with gene expression profiles were poplar seedlings. I propose that the difference between cuttings and seedlings could come from the different nutritional requirements of the two types of plant. A cutting has developed vascular tissue, emerging leaf tissue for photosynthesis, bark and woody tissue containing vegetative storage proteins, and root development that differs greatly from that of a seedling, thus it might be expected that the N-uptake activity would differ. It is plausible that the N demand of a cutting is less than that of a rapidly growing seedling that germinated from a small seed with few resources. The observed differences may also result from different root growth rates and anatomy between cuttings and seedlings. The extensive efflux in cuttings and influx in seedlings was measured at multiple times over multiple years (data not shown). As such, this difference is likely real and, to the best of my knowledge, my study is the first to report on this difference in N-uptake activity between cuttings and seedlings. The reason for this efflux could be a soil-enrichment strategy employed by adventitious roots to attract symbionts; however, further research is needed to determine the cause and extent of this difference between cuttings and seedlings.

4 Gene Expression Analysis

4.1 Introduction

In Chapter 3 I determined the flux profile for three-week-old *P. trichocarpa* seedlings with the intent of correlating it with an expression profile of candidate N-transporter protein genes in the same root region. Functional characterization of N-transporter protein genes is important in understanding N-nutrition of plants as it provides insight into uptake capabilities and thus proper fertilization procedures. N-transport is performed by two groups of N-transporters. NRTs are responsible for NO_3^- transport, while AMTs are responsible for NH_4^+ transport. Both the NRTs and AMTs are subject to regulation by glutamine as well as diurnal regulations (Glass *et al*. 2002). The NRTs can be further divided into NRT1 and NRT2 families, while the AMTs can be divided into AMT1 and AMT2 families. Each of these transporter families was investigated in the current study and each is responsible for a different task.

The NRT2 family is responsible for the high affinity transport system (HATS) of NO_3^- (Glass 2009). The HATS is composed of saturable transporters that take up NO_3^- at low rates and are expressed under NO_3^- limiting conditions. The HATS has inducible members (iHATS), which are expressed when NO_3^- concentrations are low, as well as constitutive members (cHATS), which are not N-inducible (Okamoto *et al.* 2006). The first NRT2 gene was identified in *Aspergillus nidulans* (Johnstone *et al.* 1990, Unkles *et al.* 1991). Since then a large number of NRT2 genes have been functionally characterized. For example, AtNRT2-1 is responsible for the HATS in the roots of *Arabidopsis thaliana* (Remans *et al.* 2006, Miller *et al.* 2007), and OsNRT2-1 is responsible for the HATS in the roots of *Oryza sativa* (Feng *et al.* 2011).

The NRT1 family is responsible for the low affinity transport system (LATS). The LATS is composed of non-saturable transporter proteins that take up NO_3^- at higher rates than the HATS and are expressed under NO_3^- sufficient conditions (Glass 2009). An exception to this trend is AtNRT1-1 which is able to perform both low affinity transport and high affinity transport based on the phosphorylation status of the amino acid T101 (Plett *et al.* 2010). Like the HATS, the LATS also has inducible members (iLATS) as well as constitutive members (cLATS) (Okamoto *et al.* 2006). An example of iLATS is AtNRT1-1 from *A. thaliana* (Glass 2009), while an example of cLATS is AtNRT1-2 from *A. thaliana* (Huang *et al.* 1999).

The AMT1 family has members responsible for HATS or LATS activity. The first AMT1 members were identified in yeast and *A. thaliana* (Sohlenkamp *et al.* 2002). Since then, many more AMT1s have been identified in various organisms. For example, AMT1-2 in a *Populus tremula* x *alba* hybrid shows HATS activity in the roots (Couturier *et al.* 2007), and AtAMT1-2 shows LATS activity in the roots (Neuhauser *et al.* 2007). AtAMT1-1 (Engineer and Kranz 2007) and LjAMT1-1 (D'Apuzzo *et al.* 2004) have been shown to have HATS activity in roots under N-limiting conditions; however, AtAMT1-1 also showed expression in leaves during N-sufficient conditions (Engineer and Kranz 2007).

The AMT2 family is more cryptic and less well characterized. Expression profiles are often used for members of this family in order to elucidate possible functions. Examples of AMT2 proteins include OsAMT2-2 from *O. sativa*, which is constitutively expressed at the same level throughout the plant, with some up-regulation upon NH_4^+ resupply after starvation (Li and Shi 2006). AtAMT2-1 is the only AMT2 in *A. thaliana* and is expressed in the roots, but does not contribute to NH_4^+ uptake (Neuhauser *et al.* 2009, Sohlenkamp *et al.* 2002, Yuan *et al.* 2007). OsAMT2-1 is constitutively expressed in roots and shoots of *O. sativa* regardless of N supply (Suenaga *et al.* 2003).

Determining the *in vivo* function of ion transport proteins in plants can be challenging. Heterologous expression in yeast or *Xenopus* has been used to demonstrate putative functions of transport proteins (Doddema and Telkamp 1979, Huang *et al.* 1999, Tong *et al.* 2005, Guether *et al.* 2009, Ho *et al*. 2009); however, a xylem loading NO_3^- transporter and a root uptake NO_3^- transporter could have very similar activities when expressed in *Xenopus* or yeast. Identifying the function within the plant is imperative when providing the functional characterization of a gene. Knock-down or overexpressing mutants can be used to obtain *in vivo* functional data (Li *et al.* 2010); however, expression profiles supplemented with ion flux data and comprehensive phylogenies can also indicate functional characteristics of transporter proteins and be performed in less time.

Expression profiles are powerful tools for identifying putative functions for candidate genes. From the phylogenies created in Chapter 2, candidate sequences from *P. trichocarpa* N transporters can be obtained and an expression profile generated. The initial goal was to correlate expression levels of these candidate genes with the ion flux data from Chapter 3, similar to

studies done in spruce (Alber *et al*. 2012), *O. sativa* (Takayanagi *et al*. 2011), and *A. thaliana* (Okamoto *et al*. 2003); however, limited plant material for RNA extractions led to insufficient template from the vast majority of the root sections. Instead, RNA from young bark, young wood, young leaves, mature leaves, dormant bud, and select root sections was used to generate a whole-plant expression profile with the objective to identify in which regions of the plant the expression of the candidate genes was highest. My hypothesis was that my candidate N transporters would have highest levels of expression in the root, similar to AMT1-1, AMT1-2, AMT1-3, AMT1-5, and AMT2-1 in *A. thaliana* (Yuan *et al* 2007), NRT1-1 in *A. thaliana* (Okamoto *et al*. 2003), NRT2-1 and NRT2-2 in *O. sativa* (Takayanagi *et al*. 2011), and support and expand upon data previously reported for AMTs in poplar (Couturier *et al*. 2007).

4.2 Methods and Materials

4.2.1 RNA Extraction and RT-qPCR

In preparation for RNA extraction, seedlings underwent an overnight preparation process similar to the preparation for flux analysis. Seedlings were removed from pots and soil was gently cleaned off. A small circular piece of Styrofoam was then placed on the stem, just above the roots, and the seedlings were then placed in a 10 L bucket of 100 µM NH_4NO_3, 1000 µM NH_4NO_3, or 1500 µM NH_4NO_3 treatment solution. A bubbler was placed in the buckets to aerate the solutions and lights were positioned above the buckets and adjusted to give the same light conditions as the seedlings being prepared for flux analysis.

Root tips were harvested from the seedlings the next day at noon. This was done by removing the seedlings from the solution one at a time and laying them on a glass plate. The first 0.5 cm section (labelled 0-0.5 cm) was removed by hand with a razor blade from each seedling root and placed in a tube in N_{2L}. The next 0.5 cm section of each root (labelled 0.5-1.0 cm) was also collected and placed in a separate tube in N_{2L}. The remainder of the root (labelled 1.0+ cm) was then removed and placed in another separate tube in N_{2L}. Root tips from the same section and treatment were pooled together to ensure enough material for an RNA extraction.

Root sections were ground by mortar and pestle in N_{2L}. 0.5g of frozen material was mixed with 5 mL of warmed 2X CTAB (hexadecyl trimethyl-ammonium bromide) (with 1% β-mercapthoethanol added just before use) and placed in a 65°C water bath for 10 minutes. 5 mL $CHCl_3$:IAA (Iso-Amyl Alcohol) 24:1 was added to each tube, vortexed (all vortexing was for ~2

sec), then spun at 4000 rpm for 10 minutes at room temperature in an Eppendorf 5810 R centrifuge. Supernatant was transferred to new tubes and 5 mL $CHCl_3$:IAA 24:1 was added, vortexed, and spun at 4000 rpm for 10 minutes at room temperature in an Eppendorf 5810 R centrifuge. Supernatant was transferred to new tubes, 5 mL phenol:$CHCl_3$:IAA 25:24:1 was added, vortexed, and spun at 4000 rpm for 10 minutes at room temperature in an Eppendorf 5810 R centrifuge. The resulting mixture was extracted twice more with $CHCl_3$:IAA 24:1 as described above. Supernatant was transferred into new tubes and ¾ volume isopropanol was added, mixed by inversion, and incubated at room temperature for 10 minutes. Tubes were then spun at 4000 rpm for 10 minutes at 4°C in an Eppendorf 5810 R centrifuge. Supernatant was poured off and pellets were washed with -20°C EtOH and then dried for 10 minutes in the fume hood. Pellets were then resuspended in 1 mL DEPC-treated H_2O. 335 µL 8M LiCl was added to each tube, mixed by inversion, and then incubated overnight in a fridge at 4°C. The next morning, tubes were spun at 14800 rpm for 15 minutes at 4°C in an Eppendorf 5415 D centrifuge. Supernatant was pipetted off and pellets were resuspended by adding 500 µL TE and 500 µL phenol. Tubes were vortexed then spun at 14800 rpm for 10 minutes at room temperature in an Eppendorf 5415 D centrifuge. The upper layer was transferred to new tubes, 65 µL 3M NaOAc and 850 µL -20°C 100% EtOH were added, then tubes were incubated in a -80°C freezer for 10 minutes. Tubes were then spun at 14800 rpm for 15 minutes at 4°C in an Eppendorf 5415 D centrifuge. Supernatant was pipetted off, pellets were washed with -20°C 70% EtOH, dried for 10 minutes in the fume hood, then resuspended in 100 µL DEPC-treated H_2O. Each sample was quantified using a Nanodrop Spec and run through gel electrophoresis to ensure success of the extraction.

Unfortunately, the RNA extraction met with limited success, and RNA was only obtained from the 1.0+ cm section of the 100 and 1000 µM NH_4NO_3 treatments. RNA from dormant buds, young bark, young wood, young leaves, and mature leaves was provided by Cuong Lee and Annette Alber for expression profiling. Mature leaf, young leaf, young wood, and young bark RNA came from Nisqually 1 clones growing in a field location at the University of Victoria and was extracted by Annette Alber (Ehlting lab). Dormant bud tissue came from the same Nisqually 1 clones growing at the University of Victoria and was extracted by Cuong Le (Ehlting lab). The plants supplying these tissues were grown in N-sufficient conditions (>1000 µM NH_4NO_3).

DNase Digest was performed on the extracted RNA using Ambion's Recombinant DNase I (rDNase I), catalog #AM2235. The protocol was supplied with the Ambion rDNase I. 10X DNase I Buffer (4 mL 1M pH 7.5 Tris-HCl, 1 mL 1M NaCl, 600 µL 1M $MgCl_2$, 4.4 mL DEPC H_2O) was added to a 1X RNA sample. 2 µL DNase I was added to a 100 µL mixture and incubated for 30 minutes at 37°C. After incubation, termination mix (10 µL 100 mM EDTA) was added, as well as 55 µL Phenol:$CHCl_3$:Iso-Amyl Alcohol (25:24:1). The mixture was spun at 14800 rpm for 10 minutes at room temperature. Supernatant was transferred to a new tube and 55 µL of $CHCl_3$:IAA (24:1) was added and the mixture was again spun at 14800 rpm for 10 minutes at room temperature. Supernatant was transferred to a new tube and 5 µL NaOAc (3M, pH 4.5) and 60 µL isopropanol were added. The mixture was incubated for 10 minutes on ice then spun at 14800 rpm for 15 minutes. Supernatant was poured off and the pellet was dried then resuspended in 50 µL of DEPC H_2O.

cDNA synthesis was carried out using Bio Rad's iScript cDNA Synthesis Kit catalog #170-8890. The protocol was supplied with the kit. 4 µL of 5x iScript Reaction Mix and 1 µL of iScript Reverse Transcriptase were mixed with 1 µg of RNA from the DNase Digest. DEPC H_2O was used to bring the final volume to 20 µL. The mixture was incubated for five minutes at 25°C, 30 minutes at 42°C, five minutes at 85°C, then kept in the fridge at 4°C.

Ubiquitin was used as the internal reference gene (with minimal expression level differences across the treatment/section types). Candidate genes (PtNRT2-6, PtAMT1-4, PtNRT1-2, PtNRT1-N, PtAMT1-1, PtNRT2-X, PtAMT1-2, PtNRT1-P, PtAMT4-1, and PtAMT4-4) were selected from the phylogenies presented earlier. Candidates were selected based on homology to previously functionally characterized genes, any existing data indicating expression in roots, and *in silico* subcellular expression predictions. Initial primer design for these candidate genes was performed by hand. After initial RT-PCR and gel electrophoresis showed relatively strong secondary product for all designed primers, primers for these candidate genes were then designed using Primer3Plus (Rozen 2000). Gradient PCR, from 55°C to 60°C, was performed using pooled cDNA, followed by gel electrophoresis, to test the quality of the primers selected. After Gradient PCR and gel electrophoresis had identified primers with singular products, qPCR was performed using pooled cDNA and a standard curve was generated. Primer sets that yielded acceptable standard curves and melt curves were then run in additional

qPCR reactions for all RNA samples individually to measure expression levels. Primers used were as follows: PtNRT2-6 forward [5'-TGCTGGAGCAACTTTTG-3'], reverse [5'-GCAGCTGTGGACAAACTTGA-3'], PtAMT1-1 forward [5'-TTACCCGAACAAACCGAATC-3'], reverse [5'-ACCCATCCGATAATCACCAA-3'].

Real Time qPCR was performed based on MIQE Guidelines (Bustin 2009). Master mix was created using SsoFast EvaGreen Supermix (Bio-Rad catalogue #172-5202). The qPCR reaction was run in two plates. In the PCR program, there was a one minute enzyme activation temperature of 95°C, followed by 39 cycles of 95°C (30 sec), 60°C (30 sec), 72°C (30 sec). A melt curve was then generated from 60°C to 95°C. For each RNA sample, three technical replicates (that is qPCR analyses) were performed. Expression values were calculated by determining the difference in Ct values between the gene of interest and ubiquitin, then calculating the fold change. Expression value means for each transporter gene were compared among tissues by pairwise t-tests with $P \leq 0.05$ with the *P* value adjusted to 0.007 using Bonferroni's adjustment (Uitenbroek 1997) for seven means.

4.3 Results

4.3.1 Candidate Gene Selection and qPCR Optimization

Initial gene selection was based on the phylogeny and *in silico* expression profiles presented in chapter 2. In general, genes were selected based on phylogenetic relationship to characterized transporters from other species, and based on expression patterns that suggest functions in root uptake. Based on these criteria, the genes selected for this study were PtAMT1-1, PtAMT1-2, PtAMT1-4, PtAMT4-1, PtAMT4-4, PtNRT1-2, PtNRT1-N, PtNRT1-P, PtNRT2-6, and PtNRT2-X.

PtAMT1-1, PtAMT1-2, and PtAMT1-4 were selected as they share subgroups with characterized *A. thaliana* AMT1s (AtAMT1-1 in I*E*ia, AtAMT1-2 in I*E*ii, and AtAMT1-4 in I*E*ib, respectively). As well, PtAMT1-1, PtAMT1-2, and PtAMT1-4 are already identified as putative NH_4^+ transporter proteins (Couturier *et al*. 2007), are predicted to be localized to the endomembrane system (endoplasmic reticulum), and come from the three separate subgroups of I*E* (I*E*ia, I*E*ii, and I*E*ib, respectively). In the case of PtAMT1-1 and PtAMT1-2, expression in root tissue has been observed (Couturier *et al*. 2007). PtAMT1-6 was not chosen as it was shown

to have highest expression in leaf tissues, with lower expression in fruit and petiole tissues (Couturier *et al*. 2007), and does not share a clade with any functionally characterized AMTs.

Within the AMT2 family, PtAMT4-1 and PtAMT4-4 were selected from group I*E*i because they are predicted to be localized to the endomembrane system. PtAMT4-1 and PtAMT4-4 were chosen over other PtAMT2s as my gene expression heatmap (Figure 2.2) shows PtAMT4-1 and PtAMT4-4 have higher expression in seedlings than other PtAMT2s. Group IV*E* contains AtAMT2-1 from *A. thaliana*, which is not responsible for NH_4^+ uptake from the soil (Wirth *et al*. 2007); therefore, no group IV members were considered.

Among the multiple NRT1 family members, PtNRT1-2 was selected as it is in supergroup 2 with functionally characterized NRT1s from *Arabidopsis*, namely AtNRT1-1, AtNRT1-3, and AtNRT1-4. PtNRT1-N and PtNRT1-P were selected as they are in supergroup 1 with AtNRT1-2 and are predicted to be localized to the golgi. In addition, my heatmap (Figure 2.2) suggests PtNRT1-N has highest expression in root tissues.

PtNRT2-6 and PtNRT2-X were selected over other PtNRT2s because, in addition to the fact that they share clades with characterized AtNRT2s (group I*E*ii and II*E*, respectively), they were the only PtNRT2s with available expression data. PtNRT2-6 was an especially good candidate as it has high expression in root tissue (Figure 2.2).

Primers were designed manually initially, but this yielded unspecific additional PCR products in most cases. After a second round of primer design, now using primer design software, strong secondary products were still observed for PtAMT1-4, PtAMT4-1, PtNRT1-P, and PtNRT2-X (not shown). After optimizing PCR conditions, single PCR products of the expected size were observed after gel electrophoresis for PtNRT2-6, PtNRT1-2, PtNRT1-N, PtAMT1-1, PtAMT1-2, and PtAMT4-4. Quantitative PCR (qPCR) was performed using pooled cDNA and a standard curve was generated. Only two primer sets (for PtNRT2-6 and PtAMT1-1) yielded acceptable standard curves and produced melting curves indicating that single products were obtained (Figure 4.1). For this reason, expression profiles were only analyzed for PtNRT2-6 and PtAMT1-1.

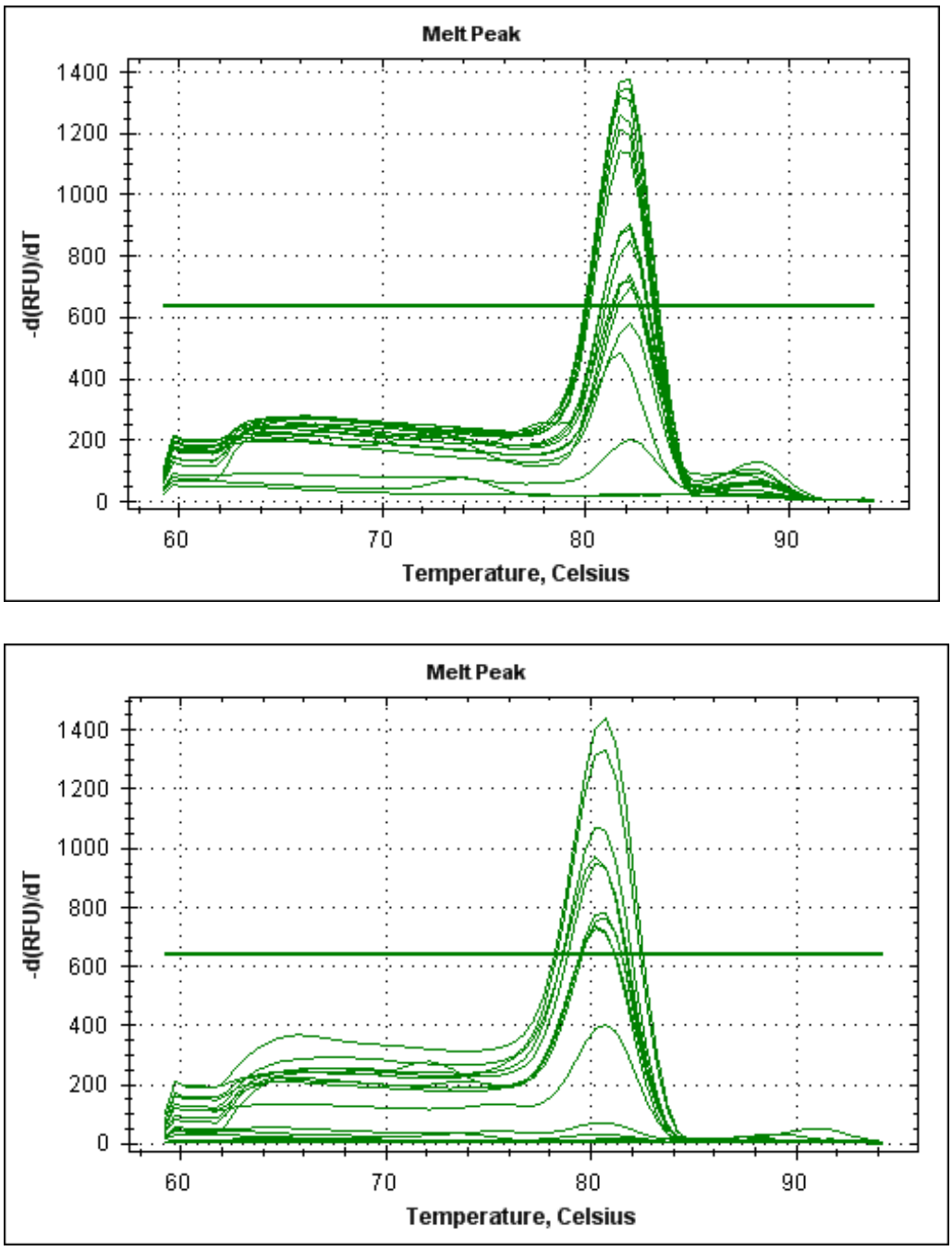

Figure 4.1. Melt curve analysis of PtAMT1-1 and PtNRT2-6 (top and bottom, respectively). Gradient PCR was performed with pooled cDNA showing singular products for each primer set. Each graph represents a different annealing temperature used in the amplification.

As a reference, the ubiquitin (UBQ) gene was chosen as it had been previously shown to be constitutively expressed, even under varying N-regimens (Couturier *et al*. 2007). The UBQ primer sets amplified a single product of the expected size. Raw expression values varied little,

from 21.6 to 24.7 Ct in the samples analyzed (Table 4.1), indicating constitutive expression levels. Thus, UBQ appears suitable for normalization across the samples tested here.

Table 4.1 Ct values for UBQ indicating that it is a suitable internal reference gene.

Sample	UBQ Ct
Mature Leaves	21.89
Young Leaves	21.58
Young Wood	21.74
Young Bark	22.05
Dormant Bud	23.46
100 µM (1.0+ cm)	24.66
1000 µM (1.0+ cm)	23.54

4.3.2 Expression Profiling of PtNRT2-6 and PtAMT1-1

For root tissues, there was only sufficient plant material for a single RNA extraction per treatment; however, each sample consisted of pooled tissue from 280 seedlings. For all other tissues, each RNA extraction was performed from pooled tissue from 18 *P. trichocarpa* (Nis-1) clones. Three technical replicates, i.e. independent qPCR reactions, were performed per sample. Mean expression of each transporter family was compared among tissues using t statistics.

PtAMT1-1 had highest levels of expression in the 1.0+ cm section of roots treated with 100 µM and 1000 µM NH_4NO_3 (Figure 4.2). There was no significant difference in expression between the 100 µM and 1000 µM treatments in the 1.0+ cm section (P=0.63). There was also appreciable expression in the young wood and dormant bud, although this was less than half the magnitude of the expression measured in roots. There was also measureable expression in young bark and young leaves and virtually no expression in mature leaves. Together, these results suggest that PtAMT1-1 is predominantly root expressed.

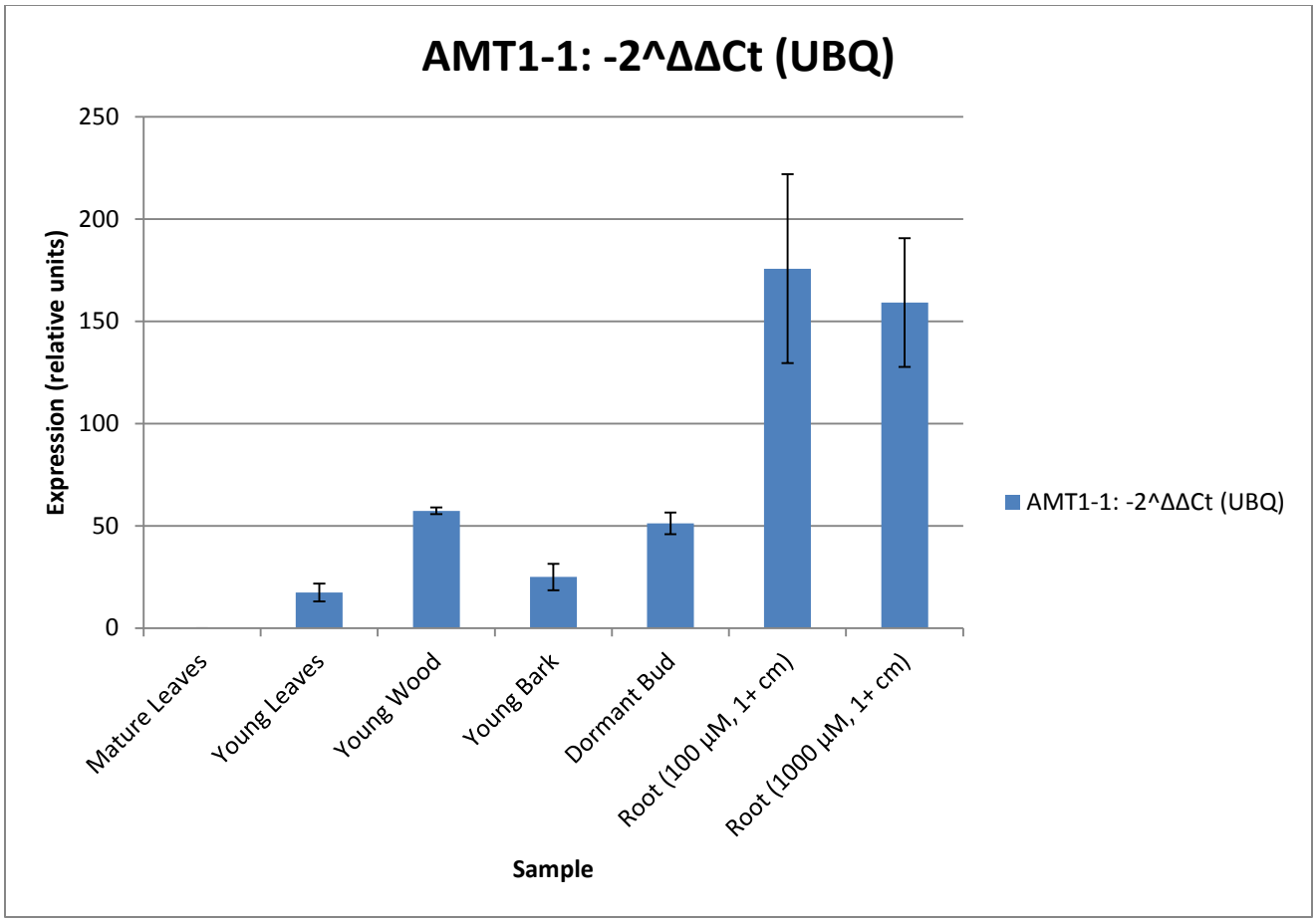

Figure 4.2. Expression profile of PtAMT1-1 in *P. trichocarpa* organs and tissues. Expression levels are normalized to ubiquitin. Error bars represent the standard deviation determined from three technical replicates (note that RNA was derived from pooled samples from 280 individuals for root samples, and from 18 individuals for the remaining samples).

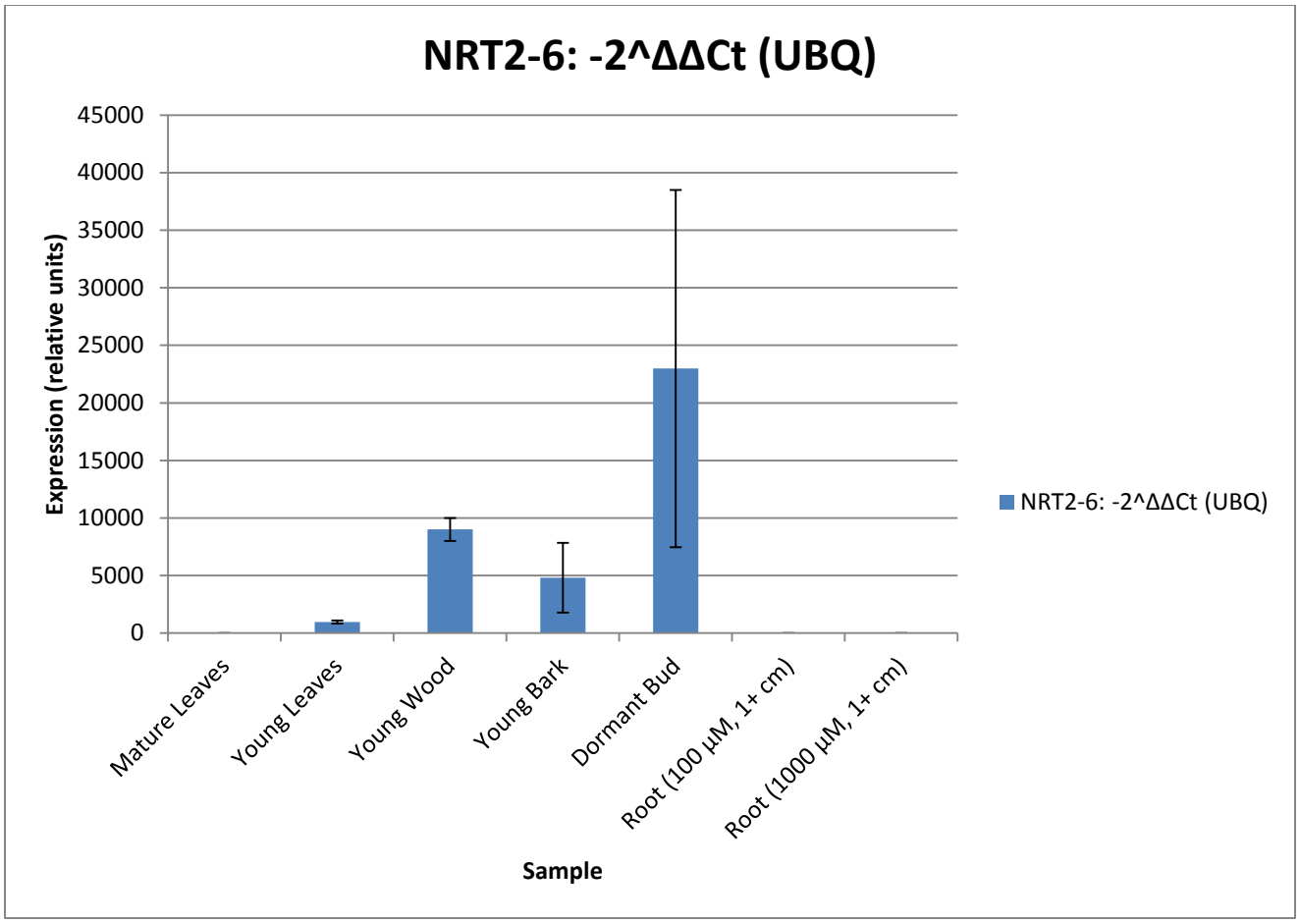

Figure 4.3. Expression profile of PtNRT2-6 in *P. trichocarpa* tissues. Expression is normalized to ubiquitin with standard deviation shown.

PtNRT2-6's expression was significantly higher in dormant buds than in both young and mature leaves and any root sections analyzed ($P \leq 0.005$) (Figure 4.3). The expression in the dormant bud was not significantly different from that in young wood ($P=0.19$) or young bark ($P=0.12$); however, this is likely due to the large standard deviations. It is interesting to note that PtNRT2-6 appears to be expressed only to very low levels in all root sections analyzed here.

4.4 Discussion

4.4.1 PtAMT1-1

The highest expression of PtAMT1-1 in the roots was under low N-supply, and as: i) the HATS operates under low N-availability ([N]≤1mM) (Glass *et al*. 2001, Siddiqi *et al*. 1990); ii) the iLATS would not have been stimulated by the 100 µM treatment; and iii) the cLATS shows a

linear response to increasing [N] which was not observed in my study; my data suggest that PtAMT1-1 is a high affinity NH_4^+ transporter. In support of my hypothesis, AMT1-1 from *A. thaliana* (Ninnemann *et al*. 1994) and tomato (Lauter *et al*. 1996) are both high affinity NH_4^+ transporters. To further support my conclusion, expression of PtAMT1-1 in roots would need to be measured under higher N-supply ($\geq$1.5 mM NH_4NO_3). I would predict that PtAMT1-1 expression would be negligible under this increased [N].

From the phylogeny presented in Chapter 1, I can see that PtAMT1-1 is most closely related to PtAMT1-3, which is supported in the work done by Couturier *et al.* (2007). I also observe that PtAMT1-1 shares a subgroup (I*E*ia) with AtAMT1-1, AtAMT1-3, and AtAMT1-5. Taken together with the expression profile, I can begin to identify likely characteristics of PtAMT1-1.

PtAMT1-3 (PtAMT1-1's closest relative) does not appear to be expressed in root, leaf, petiole, fruit, vegetative bud, or stamen tissues (Couturier *et al.* 2007), indicating that it may be responsible for a task very different from that of PtAMT1-1, or it could be an inactive duplicate. PtAMT1-1 has been shown to have highest expression in the petiole (Couturier *et al.* 2007). However, this was measured in 5.15 mM NH_4NO_3. As my data suggest that PtAMT1-1 is a high affinity transporter and displays a negligible expression in roots subject to N concentrations as low as 1.5 mM, the 5.15 mM NH_4NO_3 used by Couturier *et al.* (2007) would have repressed root expression of PtAMT1-1. Similar to my results, stimulation of PtAMT1-1 expression was observed in roots, and weakly in leaves, following N-starvation (Couturier *et al.* 2007). A similar reciprocal expression has been observed in AtAMT1-1 (Engineer and Kranz 2007) where N-sufficient conditions promote expression in leaf tissues, and N-starvation promotes expression in roots. Like the poplar AMT1-1 discussed, AtAMT1-3 is a high affinity AMT expressed in roots after N-starvation; however, the induction is not as strong as AtAMT1-1 (Gazzarini *et al*. 1999). Another high affinity AMT in the I*E*ia subgroup is AtAMT1-5, which has transcriptional up-regulation in N-starved rhizodermal and root hair cells (Yuan *et al*. 2007).

No variation in transcript abundance was observed in PtAMT1-1 after mycorrhizal inoculation (Couturier *et al.* 2007), suggesting that the expression levels I observed would not change drastically *in situ* upon mycorrhizal symbiosis. However, it is important to note that, as shown in Chapter 3, there is a dramatic difference in the flux profiles, and likely gene expression

patterns, between cuttings, as used by Couturier *et al.* (2007), and seedlings, as used in my experiment.

AtAMT1-1, AtAMT1-3 (Gazzarini *et al*. 1999), and AtAMT1-5 (Yuan *et al.* 2007) rescued MEP (Methylammonium Permease) deficient yeast, demonstrating transport capability. PtAMT1-1 was not able to rescue MEP deficiency in yeast strain 31019b (Couturier *et al*. 2007); however, it was suggested that this could be due to poor targeting to the yeast plasma membrane. It has been suggested that AtAMT1-1 may perform a role in either the transport of N from the roots to the shoots via the xylem, or the movement of NH_4^+ lost from cells during photorespiration into the mesophyll cells (Engineer *et al*. 2007). As AtAMT1-3 is more strongly regulated by diurnal cycles than by N-supply, it has been suggested that it may provide a physiological link between N and C metabolism in plants (Gazzarini *et al*. 1999). AtAMT1-5's transcriptional up-regulation in roots upon N-starvation, localization to the roots, and MEP deficient yeast complementation suggest it may be responsible for plant uptake of NH_4^+ from soil (Yuan *et al*. 2007). As there are no functionally characterized soil-to-plant AMTs in group I*E*ia, and PtAMT1-1 shows expression in tissues other than roots, PtAMT1-1 is not likely responsible for soil-to-plant uptake of NH_4^+. PtAMT1-1 is likely responsible for high affinity transport of NH_4^+ within the plant.

4.4.2 PtNRT2-6

My PtNRT2-6 expression data showed negligible expression levels in root tissue, indicating that it is not responsible for uptake of NO_3^- from the soil environment. PtNRT2-6 is, however, a member of the NRT2 family and should perform high affinity NO_3^- transport functions. As observed in Chapter 1, PtNRT2-6 is part of the large Group I*E*, and the gene most closely related to it is PtNRT2-7 (an uncharacterized sequence from *P. trichocarpa*). The next closest functionally characterized genes are AtNRT2-1, AtNRT2-2, and AtNRT2-4; however, AtNRT2-3 and AtNRT2-6 are also members of the I*E*ii subgroup.

AtNRT2-1 through 2-6 have shown high root:shoot expression, with all but AtNRT2-6 having at least twice the level of expression in roots compared to shoots. AtNRT2-7 shows a higher shoot:root expression (Okamoto *et al*. 2003). Okamoto *et al*. (2003) used a 1 mM NH_4NO_3 solution for three days following N-starvation in order to elicit expression profiles. As high affinity transporter expression can be down-regulated within 48 hours (Munos *et al*. 2004),

and ~1 mM NH_4NO_3 is the threshold at which the HATS is activated (Siddiqi *et al*. 1990), these may not be maximum expression values for AtNRT2-7.

The diversity of functions performed by the members of Group I*E*ii makes it difficult to identify a likely function of PtNRT2-6. Since PtNRT2-6 is most highly expressed in dormant buds, it is likely not similar in function to AtNRT2-1 nor AtNRT2-2, which are soil-to-plant uptake transporters. The functions of AtNRT2-1 and AtNRT2-2 were demonstrated when iHATS capability in an *atnrt2-1 atnrt2-2* double-knockout mutant was reduced to 27% of WT (Cerezo *et al*. 2001), leading to the conclusion that AtNRT2-1 and AtNRT2-2 comprise the majority of the iHATS in *A. thaliana*. In addition, a strong positive correlation between NO_3^- influx and AtNRT2-1 and AtNRT2-2 expression in roots was observed for three hours following N application (Okamoto *et al*. 2003). GFP tagging of AtNRT2-1 showed localization to the plasma membrane of root epidermal and cortical cells (Wirth *et al*. 2007).

It is possible that PtNRT2-6 shows differential expression based on vegetative stage, as seen for AtNRT2-3. AtNRT2-3 has higher expression in shoots than roots in 29-day-old plants, with highest expression in leaves of flowing plants (Orsel *et al*. 2002). However, in six-week-old plants, AtNRT2-3 has highest expression in roots (Okamoto *et al*. 2003), suggesting differential expression based on vegetative stage. An experiment set up like mine, but with plants harvested once at early vegetative stages and again at late stages, would determine if PtNRT2-6 shows this type of differential expression.

PtNRT2-6's function could be similar to that of AtNRT2-4, performing a role in the transport of NO_3^- from stored pools, such as vacuoles, to the cytoplasm (Orsel *et al*. 2004). While AtNRT2-4 was expressed prior to exposure to NO_3^-, suggesting it is a member of the cHATS (Glass *et al*. 2001), up-regulation upon exposure and subsequent down-regulation after 12 hours of exposure suggest that it is more likely a member of iHATS (Okamoto *et al*. 2003). To test if PtNRT2-6 is a member of the cHATS, like AtNRT2-6 and AtNRT2-7, dormant bud expression levels would need to be measured under different N-regimens. AtNRT2-6 and AtNRT2-7 were determined to be members of the cHATS as expression levels did not change in response to N-provision (Okamoto *et al*. 2003).

None of PtNRT2-6's relatives in I*E*ii have had expression measured in dormant buds. The heatmap in Chapter 2 did not include this tissue as I could find little to no work performed on it. My study has elucidated the need to include this important tissue in expression profiles.

5 Conclusions

My study has provided an in depth phylogenetic analysis of the four major NO_3^- and NH_4^+ transporter families in plants. While introducing a nomenclature system for the many clades within the families, I also provided a guide for likely functional characteristics of the genes contained within each clade. There has been no study to date analyzing all four N transporter families in an equal number of organisms, supplemented with *in silico* tissue profiling, subcellular localization predictions, and topology predictions. In addition, mine is one of the first studies to analyze the separate the clades of the NRT1/PTR family so intensively. While the goal of the phylogenetic analysis was to provide candidate transporter protein sequences for later studies, the extent of my analysis will be useful for anyone seeking to identify and characterize members from the NRT and AMT families.

I also conducted a N ion flux analysis of three-week-old *P. trichocarpa* seedlings. My initial goal was to correlate this with an expression profile of N transporters. While I was unable to make this correlation, I did provide an ion flux profile of the first 1.4 cm of root tips for NH_4^+, NO_3^-, and H^+ in three-week-old *P. trichocarpa* seedlings. I have potentially identified a region of high proton efflux (which may correlate to a zone of elongation), and have suggested the root growth habits of *P. trichocarpa* may be more similar to fast growing cereal crops than to slow growing conifers. One of the most unexpected results was the difference in ion flux between cuttings and seedlings, a result that has not been reported before.

Finally, I provided an expression profile of two previously identified candidate N transporter proteins that have not yet been biochemically functionally characterized, PtNRT2-6 and PtAMT1-1. My expression profile confirmed previously reported expressions by Couturier *et al*. (2007); however, it also included tissues not analyzed before and under N regimens not used by Couturier *et al*. (2007). My expression profiles suggest that while PtAMT1-1 is expressed in root tissues, it is likely not responsible for uptake from the soil environments. PtNRT2-6 will need further studying to explain its high expression in dormant bud tissue. The

surprising results obtained, for PtNRT2-6 in particular, highlight the need for more comprehensive expression profiles when characterizing NRTs and AMTs.

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Supplemental File 1. Sequences used in the current study.

AMT1:

Organism Name in Phylogeny Accession Number Sequence

Aureococcus anophagefferens AaAMT EGB04817
MNFTNEELEFLDARYAPASVAFALDTHWVLYCGVLVLLMQAGFAMLCAGSIRA
KNAQNILLKNLLDLCVGALSFWATGYAFAYGGPGDGSRGSRFVGSRHFFLSDGFEGAES
HGFKSWFFQFAFAATSATIVSGAVAERCALAAYAGYSAFLAGFVWPVVAHWVWSDAG
WLSPNRPSPLFGVGAVDFAGSGVVHMVGGGAAGIAVRVLGPRLGRFEDAASERGVDA
ALIATLRRNTPIRGHSMPLVVLGTFLLWIGWYGFNPGSTLALTRDAEQPETAARVAVTT
TLGAVAGGLASLLATYRLNGTYDVAEMCNGLLAGLASTTGSCAVVEPWAAVAVGAG
GAWSYAWGAAFLERRKVDDAVNATAVHFFAGAWGMLAPALFAAPSRMRAVYGSDA
RGLLYGGDGSLLGAQAVAFGAIALWVGATMGPFFLLFRRAGALRVSMDEEIDGLDDAH
HGRSAYEMDTFLDAELGKSDLDRISEVTDDANGDEIRRVDSADDLRRVHPGQGDAESA
S

Aquilegia coerulea AcAMT1-A AcoGoldSmith_v1.004576m
MVVSSWEESVTNSINTVYLLFSAYLVFIMQLGFAMLCAGSVRAKNAMNILLTNV
VDAAVGSISYYLFGFAFAFGVSSDSNPFIGSHFFALKDIPNETYDYSFFLYQWAFAIAVA
GITSGSIAERTQFSAYLVFSFFLTGFVYPIVAHWVWSSNGWLTASSSSELLFGSGAIDFAG
SGVVHLVGGIAGLWGAFVEGPRVGRFDAFGKPVRMRGHNATLVVLGTFLLWFGWFGF
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NGVLGGFVAITSGCAVVEPWAAIVCGFVAAWVLIGLNILALKLKFDDPLEATQLHGGCG
AWGLIFTGLFAKKEFVLQVYNSGQLDVPRPFGVLMGGGWGLIAAQVVAVLVIVGWVSI
TMGPLFYALHKLKILRISIDEELAGLDVSSHGGYAYVDHHEDDQPLRYADYARLKEGSR
A

Aquilegia coerulea AcAMT1-B AcoGoldSmith_v1.016082m
MATLSCSASDLGPLLGGAANATAAAAYICGQFSTVSTKLSDTTYAIDTTYLLFSA
YLVFAMQLDLLCFVRVLTNAVCCYLIYSAFLTGLVYPVVSHWFWSSDGWASPTRADNL
LFDSGVIDFAGSGVVHLVGGVAGLMGALIEGPRIGRFDHSGRSVALRGHSASLVVLGTF
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LVGHWNVTDVCNGLLGGFAAITSGCSVVEPWAAIVCGFVASGVLIGCNKLAEKYKYDD
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Arabidopsis lyrata AlAMT1-A 945158
MATSLSCSASDLIPLLSGGANATAAAAAAEFICGRFDTVAGKFTDAAYAIDNTYL
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VYPIVSHWFWSSDGWASPARSENLLFQSGVIDFAGSGVVHMVGGIAGLWGALIEGPRIG
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Arabidopsis lyrata AlAMT1-B 493556

MSCNATDLSVLLGPNATEAANYICGQLSVVDSKFIDAAFAIDTTYLLFSAYLVFS
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Arabidopsis lyrata AlAMT1-C 493564

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AYMYFDDDESHKAIQLRRVEPRSPSPSGAKTTPTPV

Arabidopsis lyrata AlAMT1-D 484193

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FAYMYHDDDESHKAIQLRRVEPRSPSPSGAKTIPTPV

Arabidopsis lyrata AlAMT1-E 925310

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Arabidopsis lyrata AlAMT1-F 479942

MSGAITCSAADLATLLGPNATAAADYICSQLGTVNNKFTDAAFAIDNTYLLFSAY
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Arabidopsis lyrata AlAMT1-G 930518

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Arabidopsis thaliana AtAMT1-1 At4g13510

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Arabidopsis thaliana AtAMT1-2 At1g64780

MDTATTTCSAVDLSALLSSSSNSTSSLAAATFLCSQISNISNKLSDTTYAVDNTYL
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Arabidopsis thaliana AtAMT1-3 At3g24300

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Arabidopsis thaliana AtAMT1-4 At4g28700

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Arabidopsis thaliana AtAMT1-5 At3g24290

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Brachypodium distachyon BdAMT1-A Bradi3g48950.1

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Brachypodium distachyon BdAMT1-B Bradi5g15360.1

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Cylindrotheca fusiformis CfAMT AAV70490

MAEFDNTFILEFCSGGNESSSDVQVLCQVASLANGTSASAGGLTEGINTFFLLFA
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Cylindrotheca fusiformis CfAMT1 AF360394

MAEFDNTFILDFCSGGNESSSDVQALCQVAGLANGTSASAAGLVEGINTFFLLFA
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Carica papaya CpAMT1-A evm.model.supercontig_87.55

MASINCVSSDLFPLLGNSSNAAAAADYICNQFSVVGNKFSDAGHAIDNTYLLFSA
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Carica papaya CpAMT1-B evm.model.supercontig_59.35

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Carica papaya CpAMT1-C evm.model.supercontig_756.4

MATSESVMSCSASELSPLFGANPNATAAAAFLCSRLSAVSDKLSETTYAVDNTY
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Chlamydomonas reinhardtii CrAMT1-A Cre03.g159250.t1.1

MSGDFGSEPLGSCSVETVTALLGYGLEQDSITALCQPEGGAGCTSTDNCMFQYL
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Chlamydomonas reinhardtii CrAMT1-B Cre06.g293050.t1.1

MDGTAKAEVALSLDVAFLLFSAYLVFGPMQLGFALLCAGAIRSKNSMNVLMKN
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WRYMRTSTWDTVLVCNCCLAGLVGITCSCSVVEPWAALICGFVAAFVFIGFEYVVLYK
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Chlamydomonas reinhardtii CrAMT1-C Cre13.g569850.t1.1

MADEMDPMTACITALTDAAMTTAQATALCGQFAFAADNSDLSDRLDQTNQGL
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Chlamydomonas reinhardtii CrAMT1-D Cre07.g355650.t1.2

MASPSVDMGGCLEEQYLEVLAALHSDAVAAATLCRVFSSRERTEEVAFGLNTVF
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Chlamydomonas reinhardtii CrAMT1-E Cre09.g400750.t1.1

MGCNPLQLAQVTALLGGDTATAATICAGTDVAQLGPNGAVTKWTVAELRGAQ
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Chlamydomonas reinhardtii CrAMT1-F Cre02.g111050.t1.2

MPLAELWRLTKLVPLACTVLLLSVRALAVDSGGLNDSADNSSRSLLQESGQASG
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Chlamydomonas reinhardtii CrAMT1-G Cre12.g531000.t1.1

MSSTPSATAIDHGATYSDLLIIQGAIVFFLQVGFVSLEVGYGRSKNVKNILLKNTV
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Cucumis sativus CsAMT1-A Cucsa.140600.1

MACSAADLHHLLGGSANATAVAEYICSRFESVSTKFVDTTYAVDNTYLLFSAYL
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SHGGLAYVYNDEEKF

Cucumis sativus CsAMT1-B Cucsa.194400.1

MAATDCSLTLAQLLGPNVTNSGAAASFICDQFTTSTNNFSDTKFAVDTVYLLFSA
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Cucumis sativus CsAMT1-C Cucsa.178210.1

MATLSCQSSDLVTLLGSSTTANNTAIAEFLCSRFTTIATTFSTTTYAVDNTYLLFS
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Cucumis sativus CsAMT1-E Cucsa.178240.1

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Dictyostelium discoideum DdAMT XP_642123

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Glycine max GmAMT1-B Glyma20g21030.1

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Glycine max GmAMT1-E Glyma10g31130.1

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Manihot esculenta MeAMT1-A cassava4.1_005829m

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Mimulus guttatus MgAMT1-F mgv1a005958m

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Medicago truncatula MtAMT1-A Medtr7g117370.1

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Medicago truncatula MtAMT1-B Medtr7g139110.1

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Medicago truncatula MtAMT1-C Medtr1g093290.1

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Medicago truncatula MtAMT1-D Medtr1g065600.1

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Oryza sativa OsAMT1-2 Os02g40710

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Oryza sativa OsAMT1-3 Os02g40730

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Physomitrella patens PpAMT1-A Pp1s33_11V6.1

MSTFGCSAEDVTTLQGFLGNTANAAGLSSFLCKKLDDVSSQLDATTLAVDNTYL
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TGVGRTAVTTTLSGCTAAVTTLFAKRLLHNHWSVLDVCNGLLGGFAAITAGCAVVAP
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YDGAGDRPHGLFMGGGGKLLAAQIIEILAIFGWVTVTMGPLFFLLKLFNLLRISPEDEMA
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Physomitrella patens PpAMT1-B Pp1s33_380V6.1

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IYGGNADRPFGLFMGGGGRLLAAQIVQILAITGWVTVTMGPLFLALHRFRLLRISSEDEI
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Physomitrella patens PpAMT1-C Pp1s33_381V6.1

MTTYGCAAGDLTILQGYLGASGNATGLSEFLCSKLDGIDARLGFTTLAVDNTYL
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Physomitrella patens PpAMT1-D Pp1s33_385V6.1

MTTYGCAEGDLATIQGFLGAAGNSTGLSEFLCTKLDGIDARLGFTALAVDNTYL
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Physomitrella patens PpAMT1-E Pp1s475_29V6.1

MSIFGCQDGDLATIQGFLGAVPNATGLSSFLCDKLNLIDGRLGSTKLAVDNTYLL
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Physomitrella patens PpAMT1-F Pp1s633_4V6.1

MTTFACQDGDMERIQGFLGAVSNATGLSIFLCDKLDNIDGRLGYTKLAVDNTYL
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Physomitrella patens PpAMT1-G Pp1s120_140V6.1

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Physomitrella patens PpAMT1-H Pp1s297_9V6.1

MAMPHRMIAESTSYVPSAYQNTGGVLPDWLNKGDNAWLLTASTLVGLQSMPG
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NGLFYGGNGGVQVLKQIVGALFIIGWNIVVTTLIIFAVGMLMPLRMSEEHLLVGDDAEH
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Prunus persica PrpAMT1-A ppa004613m

MAAISCSASDLQPLLGAAANATAAAQYICGRFDAVSNKFVDTAYAVDNTYLLFS

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NRPYGLLMGGGGKLLAAHLVQIVVIVGFVSLTMGTLFFLLHKLKLLRISSEEEMAGMDV
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Prunus persica PrpAMT1-B ppa015730m

MAAISCSASDLQPLLGAAANATAAAQYICGRFDAVSNKFVDTAYAVDNTYLLFS
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NRPYGLLMGGGGKLLAAHLVQIVVIVGFVSLTMGTLFFLLHKLKLLRISSEEEMAGMDV
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Prunus persica PrpAMT1-C ppa004542m

MATWATLDCSSAQLAQLLGPNNTAAADFICSQFAAVSSKLSDTAHAVDTTYLLF
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GFVAAIVLISCNKLAEKVKYDDPLEAAQLHGGCGAWGIIFTALFATKKYVNEVYGGKS
DRPYGLFMGGGGKMLGAHLIQIVVIIGWVSATMGPLFFVLHKLKLLRISAEDEMAGMD
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Prunus persica PrpAMT1-D ppa004450m

MGPLTCTASDLAPLLLTTTTTTLNATAIAEFLCSRFNTISIKFNDTTHAIDNTYLLF
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Prunus persica PrpAMT1-E ppa005341m

MAVSWEESVEYSINTIYLLFSAYLVFVMQLGFAMLCAGSVRAKNAMNIMLTNV
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Populus trichocarpa PtAMT1-1 POPTR_0010s07400

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Populus trichocarpa PtAMT1-2 POPTR_0019s04030

MACSASDLAPLLSTTVNSTEAATYLCSQFTSISSQLSDTSYAINNTYLLFSAYLVF
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Populus trichocarpa PtAMT1-3 POPTR_0008s17390

MASMNCSAGDLAQLLGPNVTNSTGAAAFICSQFQIAAGNFNATQFAVDNTYLLF
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Populus trichocarpa PtAMT1-4 POPTR_0002s25640

MAALTCSASDLQSLLGGAANATAAAEYICTRFVAVSDHFVDTAYAVDNTYLLFS
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Populus trichocarpa PtAMT1-5 POPTR_0002s25630

MASSPLSCSASDLYPLLGDGANATAAAEFFCGRFEAISNKFVDTGYAVDSTYLLF
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Populus trichocarpa PtAMT1-6 POPTR_0009s04980

MEVSWEQSVTDSINTIYLLFSAYLVFVMQLGFAMLCAGSVRAKNAMNIMLTNV
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Ricinus communis RcAMT1-A 30024.m001732

MASPLGCSAADLRPLLGGAANASAAAEYICGRFDAVSNKFVDTTYAVDNTYLLF
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Ricinus communis RcAMT1-B 29680.m001730

MASFTCSASELAPLLSTATNSTAAATYLCSQFTTIANQLSDTTYAVNNSYLLFSA
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Ricinus communis RcAMT1-C 29904.m003053

MATMACSANELAQLLGPNITSSLDAANFICSRFTASDDNFAATRYAVDNTYLLFS
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Ricinus communis RcAMT1-D 29681.m001335

MDASWERSVADAINTIYLLFSAYLVFMMQLGFAMLCAGSVRAKNAMNIMLTN
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Sorghum bicolor SbAMT1-A Sb06g022230.1

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Sorghum bicolor SbAMT1-B Sb04g026290.1

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GHSASLVVLGTFLLWFGWFGFNPGSFLTILKSYGPAGSIHGQWSAVGRTAVTTTLAGST
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Setaria italica SiAMT1-A SiPROV007786m

MSTCAADLAPLLGPAAANATDYLCSQFTDTASAVDATYLLFSAYLVFAMQLGF
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Setaria italica SiAMT1-B SiPROV035434m

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YAYHDDEDPSVRPKAVMSTQIANASSGEF

Selaginella moelendorfii SmAMT1-A 163770

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Selaginella moelendorfii SmAMT1-B 173475

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Thalassiosira pseudonana TpAMT XP_002287385

VISGVNSFYLIFAGALVFFMQVGFAMLCAGSIREKNVKNVLLWNLLDSAGGAFG
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Volvox carteri VcAMT1-A 61118 (e_gw1.22.94.1)

MHTLSLTQALCSQFASSSKLQDAIIGLNTLYLLLCGALVFVMHAGFAMLCAGAIR
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LVFEMGCALLLKLKVDDPLAAAPMHAAGGAWGVVFVGLLAKKQYICESYGKDCTEPG
SGVVPHGLFYGGGGRLLASQVIGVISIFAWVYGLLTLLFAVLNAINLLRISAQEEQAGLD
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Volvox carteri VcAMT1-B 75428 (estExt_Genewise1.C_300157)

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VEPWAALICGLMGGWVFDFVCWVFLKLRIDDPLSAAPMHAFCGAWGVFFAGLLAKRQ
YVCDSYGRDCDNTYYIPNGLLYGGDGRLLASQVIGIICIFAWVFGLMSILFAVMKVLKIL
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Volvox carteri VcAMT1-C 69712 (e_gw1.99.26.1)

MGASSFSEPLGKCDLTTLQSLQNYGLQEADINQLCAPPKGCQGFQDCLNVYLLA
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FFFQWSFCAATTTILSGAVAERCNFIAYLLYSFFLSSFVYPVVVHWVWGANGWLSVYNT
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Volvox carteri VcAMT1-D "84428 (estExt_Genewise1Plus.C_900018)

"

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Volvox carteri VcAMT1-E 77636 (estExt_Genewise1.C_760002)

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GFRRHRGWDLVGLCNGILCGFVAITACCHVVEPWAAILCGLVAGLWFDFLCWVLLKLK
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Volvox carteri VcAMT1-F 67734 (e_gw1.67.86.1)

MSNQGPLSTGGCTSEQFAEVVKALDGDSAAATALCQVFATSNRTEEIAFGLNTV
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VLEPWAALLCGGVAAVLFEAACEGLLKLRIDDVVSAGPMHGVCGAWGVLIVGLLAKK
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T

Volvox carteri VcAMT1-G 65690 (e_gw1.49.57.1)

MAVGSCDEVLFARVLALLGGDAATARSICGAPDVAILGADGAVTRWMVGQWR
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TG

Volvox carteri VcAMT1-H 41671 (gw1.19.140.1)

QVENLRNGVNQFYLLFGTALVFVMHGGFAMLAAGAIRSKNAVNILLQTLMDAC
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Volvox carteri VcAMT1-I 92451 (fgenesh4_pg.C_scaffold_26000055)

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Vitis vinifera VvAMT1-A GSVIVT01024748001

MEVSWEASVTDSINTVYLLFSAYLVFVMQLGFAMLCAGSVRAKNAMNIMLTNV
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Zea mays ZmAMT1-B GRMZM2G028736_P01

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AMT2:

Organism Name in Phylogeny Accession Number Sequence

Aquilegia coerulea AcAMT2-A AcoGoldSmith_v1.014184m
MSFPSNLLTNEGSPEWMNKGDNAWQLTAATLVGLQSIPGLVILYGSIVKKKWAV
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Aquilegia coerulea AcAMT2-B AcoGoldSmith_v1.024907m
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Aquilegia coerulea AcAMT2-C AcoGoldSmith_v1.017644m
MALSSPPFYLPGNLNTSDASPDWLNKGDNAWQLTAATMVGLQSVPGLVILYGSI
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Aquilegia coerulea AcAMT2-D AcoGoldSmith_v1.021027m

MAGLTALPPNLLTGDAAPEWMNKGDNMWQLTSATLVGLQSVPGLIILYGGGVK
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NTHKNEVVKQG

Aquilegia coerulea AcAMT2-E AcoGoldSmith_v1.019682m

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Aquilegia coerulea AcAMT2-F AcoGoldSmith_v1.023406m

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Aquilegia coerulea AcAMT2-G AcoGoldSmith_v1.025274m

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Acidithiobacillus caldus AdAMT NZ_ACVD01000080.1

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Arabidopsis lyrata AlAMT2-A 934547

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Arabidopsis thaliana AtAMT1-1 At4g13510

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Arabidopsis thaliana AtAMT1-2 At1g64780

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Arabidopsis thaliana AtAMT1-3 At3g24300

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Arabidopsis thaliana AtAMT1-4 At4g28700

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FGGDPNRPFGLLMGGGGRLLAAHVVQILVITGWVSVTMGTLFFILHKLKLLRIPAEDEIA
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Arabidopsis thaliana AtAMT1-5 At3g24290

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Arabidopsis thaliana AtAMT2-1 At2g38290

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Brachypodium distachyon BdAMT2-A Bradi1g08590.1

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Brachypodium distachyon BdAMT2-B Bradi2g56290.1

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Brachypodium distachyon BdAMT2-C Bradi2g56300.1

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Brachypodium distachyon BdAMT2-D Bradi3g45480.1

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Brachypodium distachyon BdAMT2-E Bradi1g02420.1

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Brachypodium distachyon BdAMT2-F Bradi2g22670.1

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Carica papaya CpAMT2-A evm.model.supercontig_437.2

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Carica papaya CpAMT2-B evm.model.supercontig_120.31

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FVIGWNIVSTTIILMIIRLFIPLRMGEEELAIGDDAAHGEEAYALWGDGERYDPKKHGSNF
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Carica papaya CpAMT2-C evm.model.supercontig_6.322

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Cucumis sativus CsAMT2-A Cucsa.162170.1

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Cucumis sativus CsAMT2-B Cucsa.044000.1

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Cucumis sativus CsAMT2-C Cucsa.176640.1

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Glycine max GmAMT2-A Glyma19g43380.1

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Glycine max GmAMT2-B Glyma02g16200.1

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Glycine max GmAMT2-C Glyma09g41810.1

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Glycine max GmAMT2-D Glyma07g18670.1

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Glycine max GmAMT2-E Glyma18g43540.1

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Glycine max GmAMT2-F Glyma02g04960.1

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Glycine max GmAMT2-G Glyma05g33010.1

MVSATLVGIQSMPGLVILYGSIVKKKWAVNSAFMALYAFAAVIICWVAWAYKM
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Glycine max GmAMT2-H Glyma01g30920.1

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Leptospirillium rubarum LsAMT2-1 DS180869

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Leptospirillium rubarum LSAMT2-2 EAY57703

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Manihot esculenta MeAMT2-A cassava4.1_032402m

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Manihot esculenta MeAMT2-B cassava4.1_027188m

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Manihot esculenta MeAMT2-C cassava4.1_022182m

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Manihot esculenta MeAMT2-D cassava4.1_006378m

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Manihot esculenta MeAMT2-E cassava4.1_029546m

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Manihot esculenta MeAMT2-F cassava4.1_006451m

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Manihot esculenta MeAMT2-G cassava4.1_006465m

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Mimulus guttatus MgAMT2-A mgv1a023654m

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Mimulus guttatus MgAMT2-B mgv1a005442m

MELPPNLRPDESSPDWMNKGDNAWQLTAATLVALQSMPGLVILYGGMVKQKW
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Mimulus guttatus MgAMT2-C mgv1a017684m

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Mimulus guttatus MgAMT2-D mgv1a018465m

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Mimulus guttatus MgAMT2-E mgv1a005294m

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Medicago truncatula MtAMT2-A Medtr7g140920.1

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Medicago truncatula MtAMT2-B Medtr4g144250.1

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Medicago truncatula MtAMT2-C Medtr7g075790.1

MAASPAYQAHLPTSPEWLNKGDNAWQMTAATLVGLQSMPGLVILYASIVKKK
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Medicago truncatula MtAMT2-D Medtr8g088950.1

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Oryza sativa OsAMT2-1 Os05g39240

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Oryza sativa OsAMT2-2 Os01g61550

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Oryza sativa OsAMT2-3 Os01g61510

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Oryza sativa OsAMT2-A LOC_Os03g53780.1

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Oryza sativa OsAMT2-B LOC_Os11g01410.1

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Oryza sativa OsAMT3-1 Os01g65000

MSGDAFNMSVAYQPSGMAVPEWLNKGDNAWQMISATLVGMQSVPGLVILYGS
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NIKAWMLFVPLWLTFSYTVGAFSLWGGGFLFHWGVMDYSGGYVIHLSSGVAGFTAAY
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ATSLLVWTCLDVIFFKKPSVIGAVQGMITGLVCITPGAGLVQGWAAIVMGILSGSIPWFT
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Oryza sativa OsAMT3-2 Os02g34580

MAAGAIPMAYQTTPSSPDWLNKGDNAWQMTSATLVGLQSMPGLVILYGSIVKK
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WITFSYTVCAFSLWGGGFLFQWGVIDYSGGYVIHLSSGIAGLTAAYWVGPRSASDRERF
PPNNILLVLAGAGLLWLGWTGFNGGDPYSANIDSSMAVLNTHICASTSLLVWTILDVFFF
GKPSVIGAVQGMITGLVCITPGAGLVQGWAAIVMGILSGSIPWYTMMVLHKKWSFMQR
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SGVSVGVTQNV

Oryza sativa OsAMT3-3 Os03g62200

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Oryza sativa OsAMT4-1 Os12g01420

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Physcomitrella patens PpAMT2-A Pp1s4_201V6.1

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Physcomitrella patens PpAMT2-B Pp1s12_395V6.1

MADALPTVPIAYNQTGGVTPAWLNKGDNAWQLTASTLVGVQSVPALVILYGSI
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FVPLWLTCSYTVGAFSLWGGGFLWQWGVIDYAGGFVIHLSSGIGGFVAAYWVGPRLTK
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Physcomitrella patens PpAMT2-C Pp1s15_321V6.1

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KDRERFPPNNVLLMLTGAGLLWMGWSGFNGGAPFSANLISGLAVLNTHICAATSLLTW
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Physcomitrella patens PpAMT2-D Pp1s30_275V6.1

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Physcomitrella patens PpAMT2-E Pp1s36_56V6.1

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Physcomitrella patens PpAMT2-F Pp1s57_114V6.1

MALTPPAPVTPEWLNKGDNAWQLTASTLVGIQTVPALVILYGSIVKKKWAVNSA
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Physcomitrella patens PpAMT2-G Pp1s109_32V6.1

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GGIGGTQFGKQITGALFVIAWNVVITCIILNVIKLVIPLRMTAEHLLVGDDAEHGEEACAL
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Physcomitrella patens PpAMT2-H Pp1s120_140V6.1

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Physcomitrella patens PpAMT2-I Pp1s240_51V6.1

MALPHRMAVESINPVPSAYMNTGEVLPDWLNKGDNAWQLTAVTFVGLQSMPG
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Physcomitrella patens PpAMT2-J Pp1s297_9V6.1

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Physcomitrella patens PpAMT2-K Pp1s352_2V6.1

MAVPSAYNNTGGVTPDWLNKGDNAWQLTAGTLVGLQSVPGLVILYGSIVKKKC
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GKQIAGAFFVIGWNVVVTSIIMVVIRLIAPLRMTEELLMIGDDAAHGEEAYALWGDGEK
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Prunus persica PrpAMT2-A ppa005235m

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Prunus persica PrpAMT2-B ppa027111m

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VVILNVVVTSLICVLIQFIVPLRMSDADMEIGDEAAHGEEAYAIWGQGEKLENSRYGYDI
ESSAKNRHAAGQIEMA

Prunus persica PrpAMT2-C ppa004749m

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GVYGGSGGMQILKQIVGALFIIGWNLVVTSIICLVLRCIVPLRMPEEQLLIGDDAVHGEEA
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Prunus persica PrpAMT2-D ppa004845m

MAIAGAYSEITPAVPDWLNKGDNAWQLTAATFVGLQSMPGLVILYASIVKKKW
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FSYTVGAFSLWGGGFLYHWGVIDYSGGYVIHLSSGIAGFTAAYWVGPRLKSDRERFPPN
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Prunus persica PrpAMT2-E ppa022420m

MTYSNYSGVLPVNLLPDEASPRWNNKGDNGWQLIATTMVGMQSVPGLVILYGS
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SMCRRLN

Populus trichocarpa PtAMT1-1 POPTR_0010s07400

MASMTCSAGDLAQLLGSNVTNSTGAADFICSQFNTAADNFSATQYAVDNTYLLF
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AVTTTLAGCTAALTTLFGKRILSGHWNVTDVCNGLLGGFAAITAGCSVVEPWAAIICGF
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Populus trichocarpa PtAMT1-2 POPTR_0019s04030

MACSASDLAPLLSTTVNSTEAATYLCSQFTSISSQLSDTSYAINNTYLLFSAYLVF
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Populus trichocarpa PtAMT1-3 POPTR_0008s17390

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Populus trichocarpa PtAMT1-4 POPTR_0002s25640

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Populus trichocarpa PtAMT1-5 POPTR_0002s25630

MASSPLSCSASDLYPLLGDGANATAAAEFFCGRFEAISNKFVDTGYAVDSTYLLF
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Populus trichocarpa PtAMT1-6 POPTR_0009s04980

MEVSWEQSVTDSINTIYLLFSAYLVFVMQLGFAMLCAGSVRAKNAMNIMLTNV
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MGPVFFALDKLKMLRISIDEEVAGLDISSHGGYAYTTHPEENHPRFYADYMPIQGRNHS

Populus trichocarpa PtAMT2-1 POPTR_0006s10370

MNASTAYEQVSPAVPSWLNKGDNAWQMTASTLVALQSMPGLVILYASIVKKK
WAVNSAFMALYAFAAVLICWVLLGYRMAFGDELLPFWGKGAPALGQKYLLTRARVPE
STHTLEDGTRETVEPWYPMASLVYFQFTFAAITLILLAGSVLGRMNIKAWMAFVPLWLI
FSYTVGAFSLWGGGFLYHWGVIDYSGGYVIHLSSGIAGLTAAYWVGPRLKSDRERFPPN
NVLLMLAGAGLLWMGWSGFNGGAPYAANIDASIAVLNTNVCAATSLLVWTSLDVVYF
GKPSVIGAVQGMMTGLVCITPGAGLVQSWAAIVMGILSGSIPWVSMMILHKKSALLQK
VDDTLGVFHTHAVAGLLGGLLTGLLAEPELCDLILPVNTRGAFYGGSGGVQFLKQVVA
ALFVIGWNVVSTTIILLFIRLFIPLRMPEEQLAIGDDAVHGEEAYALWGDGEKYDPTRHG
RNTLYGEETAQSPYVNGARGVTINL

Populus trichocarpa PtAMT2-2 POPTR_0016s12900

MDAPAYEQVSPAVPSWLNKGDNAWQMIASILVATQSMPGLVILYASIVKKKWA
VNSAFMALYAFAAVLICWVLLCYRMAFGDELLPFWGKGAPALGQKYLIAQARIPESTH

THEDGTRETVAPLYPMATLVYFQFTFAAITLILLAGSVLGRMNIKAWMAFVPLWLIFSY
TVGAFSLWGGGFLYHWGVIDYSGGYVIHLSSGIAGLTAAYWVGPRLKSDRERFPPNNV
LLMLAGAGLLWMGWSGFNGGAPYAANIDASMAMLNTNVCAATSLLVWTSLDVVYFG
KPSVIGAVQGMMTGLVCITPGAGLVQSWAAIVMGILSGSIPWVSMMILHKKFALLQKV
DDTLGVFHTHAVAGLLGGLLTGLLAEPELCDLILQVNTRGAFYGGNGGVQFLKQMVAA
LFVIGWNIVSTTLILLFIRLFIPLRMPEEQLAIGDDAVHGEEAYALWGDGEKYDPSKHGRI
TTLFGEETTQSPDVNGARGVTINL

Populus trichocarpa PtAMT3-1 POPTR_0001s31280

MAALPPNPVPVAYQGGSASVPDWLNKGDNSWQMISATLVGLQSMPGLVILYGS
IVKKKWAVNSAFMALYAFAAVVLCWVVWAYKMSFGDKLLPFWGKAGPALGQKFLIR
QAELPATTHFYDNGEVETAMIQPFYPMASMVWFQCVFAAITLILLAGSVLGRMSFKAW
MAFVPLWLTFSYTVGAFSLWGGGFLFHWGVMDYSGGYVIHLSSGIAGLTTAFWVGPRS
TKDRERFPPNNVLLMLAGAGLLWMGWAGFNGGDPYTANIDSSMAVLNTNICAATSLL
VWTWLDVIFFKKPSVIGAVQGMITGLVCITPGAGLVQGWAAIIMGILSGSVPWFTMMIV
HKRWTLIQKIDDTLGVFHTHAVAGLLGGVLTGLFAEPQLCALFLPVTNSRGGVYGGSG
GIQVLKQLVGAAFIIGWNVVVTSIICVVINLVIPLRMSDEELLIGDDAVHGEEAYALWGD
GEKYDSTKHGDTTEEFPMERKSSTQVL

Populus trichocarpa PtAMT4-1 POPTR_0002s04780

MNKGDNAWQLTAATLVGLQSVPGLVILYGSIVKKKWAVNSAFMALYAFASVL
VCWVGWGYQMSFGDKMIPFLGRPDVSLDQKFLLHQAFLGYLPNATMVYFQFVFAAITL
ILVAGALLGRMNFHAWMLFVPLWLTFSYTITAYSIWCPEGWLAKRGIIDYSGGYVIHLS
SGVAGFTAAYWVGPRTIKDRERFPPNNIILMLAGAGLLWMGWSGFNGGDPYTVSTDAS
LAVLNTHVCTATSLLTWLLLDILFFGKPSVIGATQGMITGLVCITPAAGVVQGWAAILM
GIMSGSIPWYTMMVLHKKLWLLKQVDDTMAVFHTHAVAGSLGGILTGFFAHPKLNRIF
YLVPDWQHYIGLAYGLQMGRASAGFKQMGIQLLGILFVVSLNVFVTSIICLLIRFVVPLR
LSDEELQTGDDAIHGEEAYALWGDGEKYESRHNSVYAQNTTLIM

Populus trichocarpa PtAMT4-2 POPTR_0018s01180

MSNDTAFPPNLLPDEASPEWFNKADNAWQLTAATLVGLQSIPGLMILYGGGVKK
KWAVNSAFMVLYAFACVMFCWVTWGYRMSFGSKLLPFWGEANVALDQKYLLDPAFL
GKFPNATMVYFQSVFAAITLILIAGAVLGRMNFYAWMIFVPLWLTFSYTFTAFSVWCPD
GFLAKMGLIDYSGGYVIHLSSGVAGYTAAYWVGPRLTKDRERFPPNNILLMLFGAGLL
WMGWTGFNGGDPYVVSTDASLAVLNTHLCTATSLLTWVALDIIFFRKASVIGAVQGMI
TGLVCITPAAGVVQGWAATIMGLCSGSIPWITMMVIHKNSELLQKVDDTMAVLHTHAI
AGSLGGILTGLFAEPKLNRLFFGSSGHYIGLVYGFDDKSRIGSGVRQMGVQFIGILFVVFV
NVLTTSIICILIRLVVPLRMSNEDLEIGDDAAHGEEAYAIWGNGDRQENSFYR

Populus trichocarpa PtAMT4-3 POPTR_0005s23750

MAEIPTNLLPDEASPEWMNKGDNAWQLTAATLVGLQSVPGLVILYGSIVKKKW
AVNSAFMALYAFAAVLVCWVGWGYHMSFGDKMLPFLGRPDISLDQKFLLDKAYVGY

LPSATLVYFQFVFAAITLILVAGALLGRMNFHAWMLFVPLWLTFSYTFTAYSLWCPGG
WLAKLGIIDYAGGYVIHLSSGVAGFTAAYWVGPRTNKDRERFPPNNILLMLAGAGLLW
MGWSGFNGGGPFAANTDASLAILNTHVCTATSLLTWLLLDIVFFGKPSVIGATQGMITG
LVCITPAAGVVQGWAAILMGILSGSIPWYSMMVLHKKIWLLKQVDDTMAVFHTHAVA
GSLGGILAGFFANPKLNRIFYMVKDWQHYIGLAYGLQNGRTAAGLKQMGVQLLGILFV
VVLNVFVTSAICLLIRLVVPLRLTDEELQTGDDAIHGEEAYALWGDGEKYESKHNSLHG
VEEFPQVVSKEVEMA

Populus trichocarpa PtAMT4-4 POPTR_0013s05980

MNKGDNAWQLTAATLVGLQSIPGLVILYGSIVKKKWAINSAFMVFYAFAMVLV
CWVGWGFRMSFGEKLVFFLGKPAVALDEKFLLGKAFLGYFPTATMVFFQGVFACITLIL
IAGCLLGRMNFRAWIMFVPLWLTFSYTITAFSIWCPDGWLAKLGVIDFSGGYVIHLSAG
VAGFTAAYWVGPRIDKDREMFPPNNIILMLAGAGLLWMGWSGFNGGGPFAVSTISSLA
VLNTHVCTATSLLTWLLLDTCFFGKPSVIGAVQGMITGLVCITPAAGVVQCWAAILMGI
VSGSVPWYTMMVLHKKVKFLRLVDDPIAIFHTHAIAGGLGGILTGFFAVPKLCRLFYMV
PDWEKYIGLGYGLQNGQTSAGLRQMGIQLGGILFVIFINISTTSMICWFVGLFVPLRLSDD
ELQIGDDAIHGEEAFALWNDEETFQNTKTNSAFESEDSSYMKSRSFGDVQMV

Populus trichocarpa PtAMT4-5 POPTR_0005s10810

MNFPQGLNPDEGSPEWMNKADSAWQLTATTMVCLQSVPGLVILYGSMVKKKW
AVNSAFMAFYAFAAVLVCWVLLAHQMSFGAKMSPLVGRPGSALSEKLLLGPSRRGLVP
VADFVFYQFAFAAITVILLAGSLLGRMNFYAWMLFVPLWLFFSYTVGASTIWGDGFLER
RIIDYAGGYVIHLSSGVAGFTAAYWVGPRHSHDRQNFPPNNIIHMLGGAGFLWLGWTG
FNGGSPFAAGLVASLAIFNTHLCTATSLLVWVSLDMLFYRKSSVIGAVQGMITGLVCITP
GAGIVEPWAALLMGVMSGSIPWYTMMVLHRRFAFFQSVDDTLAVFHTHAVAGLLGGI
LSGIFAKPALLKLMYPDTTYHTGLIYSFSGGRHADGFKQMGIQLLGAAFITAWNGGATS
LICILISRIVDLRMKEDDLEIGDDAVHGEEAYALWGDGERMPKPLRLHMHPRLPYFCRQ
RF

Ricinus communis RcAMT2-A 29883.m001970

MSTQWNLPSGLMPDDASPDWLSKADNAWQLTAATLVGLQSVPGLVILYGSIVK
KKWAVNSAFMALYAFAAVLVCWVGWGYRMAFGHDMLPFLGRPDVAMDQKYLLGIA
FLGKFPNATMIYFQFVFAAITLILVAGALLGRMNFHAWMLFVPLWLTFSYTITAYSIWCP
TGWLAKMGIIDYSGGYVIHLSSGVAGFTAAYWVGPRANKDRERFPPNNILLMLAGAGL
LWMGWTGFNGGDPYSVSVDASLAVLNTHVCTATSLLTWLLLDIIFFGKPSIIGATQGMIT
GLVCITPAAGVVQGWAAILMGLMSGSIPWYSMMVLHKKIWLLKQVDDTMAVFHTHA
VAGSLGGILTGFFAEPKLNRIFYLVDGWEHYIGLAYGLQTGRTTAGFKQMGIQLLGILFV
ILTNIFTTSVICFLIKLVIPLRLADDELQIGDDAIHGEEAYALWGDGEKYESKHNSVFEDY
PQAVPKGGGGGQVEMA

Ricinus communis RcAMT2-B 29848.m004664

MSNILVPIPSPAPAPLFDLPSGLAFDESTPPWMSKADNAWQLTAATFVGLQSIPGL

MILYGGGVKKKWAVNSAFMVLYAFACVLFCWVTWGYRMSFGTELVPFWGKANIALD
QKFLFDQAFFGKFPTATMVFFQSVFAAITLILIAGALLGRMNFYAWMMFVPLWLTFSYT
FVAFSIWCPSGFLFKNGLIDYSGGYVIHLSAGVSGFTAAYWVGPRLTKDRERFPPNNIIL
MLAGAGLLWMGWTGFNGGDPYAASVDASLAVLNTHVCTASSLLTWLLLDVVYFGKA
SVIGAVQGMITGLVCITPAAGVVQGWAAILMGICSGSIPWFTMMVVHKKSELLQKVDD
TMAVLHTHAIAGSLGGILTGLFAEPRLCYLFSGTYGQYIGLFYGFQMGQVHDGFRQIGIQ
LLGIIFVILVNVISTSIICLLIQLVVPLRMSDEDMEIGDEAVHGEEAYAIWGHGDRHENSW
RVNSANPETELPVTRRKNATGQVEMT

Ricinus communis RcAMT2-C 29826.m000743

MASPAPPNPVPIGYQGGSAAVPVWLNKGDNSWQMISATLVGLQSVPGLVILYGS
IVKKKWAVNSAFMALYAFAAVVICWVTWAYKMSFGDKLLPFWGKAGPALGQKFLIEQ
AALPATTHYYNNGEVETAMATPFYPMASMVWFQCVFAAITLILLGGSVLGRMNIKAW
MAFVPLWLTFSYTVGAFSLWGGGFLFHWGVIDYSGGYVIHLSSGIAGLTTAFWVGPRST
KDRERFPPNNVILMLAGAGLLWMGWAGFNGGDPYSANVDSSMAVLNTNICAATSLLV
WTWLDVIFFNKPSVIGAVQGMITGLVCITPGAGLVQGWAAIIMGILSGSVPWFTMMIVH
KRWTLLQKIDDTLGVFHTHAVAGLLGGVLTGLFAEPQLCLLFLPVTNSRGGVYGGSGG
VQILKQLVGGAFIIGWNIIITSVICVAINLVIPLRMSEEQLLIGDDAVHGEEAYALWGDGE
KYDSTKHGMYSDDTLHHKTPTGATQVV

Ricinus communis RcAMT2-D 29784.m000373

MNYTFQENFSLPSGLRPDESSPEWNSKADNAWQLTATTMVCLQSVPGLVILYGS
MVKKKWAVNSAFMAFYAFAAVLVCWVLWGHHMSFGTKISPLVGKPNVALPQHFVLS
RSKLGHVPMADYVLYQFAFAAITVILLAGSLLGRMNIYAWMLFVPLWLTFSYTVGAFSI
WGGGFLEKHIIDYAGGYVIHLSSGVAGFTAAYWVGSRHSHDRQHFPPNNIIHMLGGAGF
LWLGWTGFNGGSPFAAGLVASLAVVNTHLCTATSLLVWVSFDMIVYKKSSVIGAVQG
MITGLVCITPGAGIVEPWAAFLMGGMSGSVTWYTMMVLHRRSAFFQSVDDTLAVFHTH
AVAGLLGGILSGLFAKPSLLMMMYPQSTYGTGLFYSLTNGRHQDGLKQMVSQIEGAAF
VTAWNVVLTSLICILISRIVDLRLPQDHLEIGDDAVHGEEAYALWGDGERMPNLYRRLH
PKLPSWCGA

Ricinus communis RcAMT2-E 29601.m000429

MSEAYSNVTPAVPPWLNKGDNAWQMTASVLVATQSMPGLVILYASIVKKKWA
VNSAFMALYAFAAVLICWVLLCFRMAFGDELLPFWGKGAPALGQNYLTGRARIPESTH
KNEQGQSVTVSPYFPMATLVYFQFTFAAITLILLAGSVLARMNIKAWMAFVPLWLIFSY
TVGAFSLWGGGFLYQWGVIDYSGGYVIHLSSGIAGLTAAYWVGPRLKGDRERFPPNNV
LLMLAGAGLLWMGWSGFNGGAPYAAHIDASIAMLNTNISAATSLLVWTTLDVIFFGKP
SVIGAVQGMMTGLACVTPGAGLVQSWAAIVMGILAGSIPWVSMMVLHKKSTLLQKIDD
TLGVFHTHAVAGLLGGLLTGLLAEPELCALILPKKTRGAFYGGNGGVQFLKQMAGACF
VIAWNVTSTTIILLTIRLFIPLRMPEEQLVIGDDAVHGEEAYALWGDGEKYDPTKHGEEIA
PSPYGNGARGVTINL

Sorghum bicolor SbAMT2-A Sb01g008060.1

MATEAAPEWLDKGDNAWQLAAATLVGLQSVPGLVILYGSIVKKKWAVNSAFM
ALYAFAATFVCWCLWAFRMSFGDRLLPFVGRPDLAALDQSFLTEQGFAGAYPAATLLF
FQFVFAAITLILVAGSLLGRINFRAWMLFVPLWLTFSYTIGAFSLWSPNGFLFKAGVMDF
AGGYVIHLSSGIAGFTAAYWKKLISIDRQVGPRTAKDREAFPPNNILLTLAGAGLLWMG
WTGFNGGAPYAANIDASLAVVNTHFCTATSLLVWLCLDCFVFGRPSVIGAVQGMITGL
VCITPAAGLVQGWAAMLMGVVSGSVPWCTMMVLHKRCQFLKRVDDTLAVLHTHGVA
GSLGGILTGVLAEPRLSRLFFGDDPRYVGLVYALKDGRAAAGLRQVGMQLAGIAFVVA
LNVAVTSAVCLVVGLLVPLRLSEEQLAAGDDAIHGEDAYAVWGDGQMYEQSVHGDHL
YPMMSNPMASKADEMI

Sorghum bicolor SbAMT2-B Sb03g041140.1

MASLPFNVTMTLGYQPGTGIPPWLNKGDNAWQMVAATLVGLQSVPGLVILYGS
IVKKKWAVNSAFMALYAFAAVWLCWVIWGYQMSFGQRLVPFWGKAGHTLGQGFLLS
QAGLPATQHYYHDSDVVETFEITPFYPMASMVYFQCVFAAITLILLAGSLLGRMNFKAW
MLFVPLWLTFSYTIGAFSIWGGGFLFHWGVMDYSGGYVIHLSSGVAGFTAAYWVGPRL
TKDRERFPPNNVLLMLTGAGILWMGWAGFNGGDPYAANVDSSIAVLNTNICAATSLLV
WTCLDVIFFKKPSVIGAVQGMITGLVCITPGAGLVQGWAAILMGMISGSIPWFTMMVVH
KRSRLLQQVDDTLGVFHTHAVAGFLGGFTTGLFAHPDLCPMFLPVTNSRGAFYGNGMQ
LVKQVVGALFIISWNVVVTSLVCLVVRLVVPLRMPDDELAIGDDAVHGEEAYALWGDG
EKYDSTKHGWYSDNDTQHNKAPSGVTQNV

Sorghum bicolor SbAMT2-C Sb04g022390.1

MAAGAIPLAYQSSPSSPEWLNKGDNAWQMTSATLVGLQSMPGLVILYGSIVKKK
WAINSAFMALYAFAAVWICWVVWAYNMSFGDRLLPFWGKARPALGQSFLVAQSQLT
ATAVQYRRRDDGTTAEAAMLRPLYPAATMVYFQCMFASITVIILAGSLLARMNIKAWM
AFVPLWITFSYTVSAFSLWGGGFLFQWGVIDYSGGYVIHLSSGIAGLTAAYWVGPRSAS
DRERFPPNNILLVLAGAGLLWLGWTGFNGGDPYAANIDSSMAVLNTHICASTSLLMWT
LLDVFFFGKPSVIGAVQGMITGLVCITPGAGLVQGWAAIVMGILSGSIPWYTMMVLHKK
WSFMQRIDDTLGVFHTHAVAGLLGGTTTGLFAEPVLCNLFLSIQESRGAFYGGDGGSQF
GKQIAGALFVIAWNIVITSIICVLIGLVLPLRISDEQLLIGDDAVHGEEAYAIWAEAELNDV
TRHDEGRHSSVAVGVTQNV

Sorghum bicolor SbAMT2-D Sb01g001970.1

MASSGTMPLAYQTTAASPDWLNKGDNAWQLTAATLVGLQSFPGLVVLYGGVV
KKKWAVNSAFMALYAFAAVWICWVTWAYNMSFGDKLLPLWGKARPALNQGYLIGQ
ADLPATVHYFANGSTIETAAAEPLYPMATVVYFQCVFAAITLILVAGSLLGRMSFAAWM
LFVPLWLTFSYTVGAFSVWGGGFLFQWGVIDYCGGYVIHLSAGFAGFTAAYWVGPRA
QKDRERFPPNNILFTLTGAGLLWMGWAGFNGGGPYAANVVASMSVLNTNICTAMSLIV
WTCLDVIFFKKPSVVGAVQGMITGLVCITPAAGVVQGWAAIVMGVLAGSVPWYTMMI
LHKRSRLLKHVDDTLGVIHTHGVAGLLGGILTGLLADPTLCALFLPVTNSRGAFYGRAA

GGAQLGKQLAGALFIIGWNVVVTSIICVAINAVVPLRMTEDKLEVGDDAVHGEEAYAL
WGDGEVYDVTEHGPRGAAAVAPVSTTPN

Sorghum bicolor SbAMT2-E Sb09g023030.1

MAASGGAYAAQLPAVPEWLNKGDNAWQLTAATLVGIQSMPGLVVLYGSIVKK
KWAVNSAFMALYAYASSLLVWVLVGFRMAFGERLLPFWGKAGVALSQSYLIGRASLS
ATAHEGTPRTEPLYPEATLVLFQFEFAAITLVLLAGSVLGRMNIKAWMAFTPLWLIFSYT
VGAFSLWGGGFLYHWGVIDYSGGYVIHLSSGVAGFTAAYWVGPRLKSDRERFSPNNIL
LMIAGGGLLWMGWAGFNGGAPYAANIAASVAVLNTNVSAATSLLTWTCLDVIFFSKPS
VIGAVQGMMTGLVCITPGAGLVQTWAAVIMGVFAGSVPWFTMMILHKKSALLMKVDD
TLAVFHTHAVAGLLGGVLTGLLATPELLEIESPVPGLRGAFYGGGARQLGKQLAGAAFV
VAWNVVVTSLILLAIGLVVPLRMPDDQLMIGDDAAHGEEAYALWGDGEKFDATRHHD
AARGGGGGGMMDRDGSADQRMSGMGARGVTIQL

Sorghum bicolor SbAMT2-F Sb03g038840.1

MASPPEPGPYMPDLPAVPAWLNKGDNAWQLVAATFVGLQSMPGLVVLYGSIVK
KKWAVNSAFMALYAYASTLIVWVLVGFRMAFGERMLPFWAKAGPALTQDFLVRRAV
FPATAHYGRGGALETPRTEPYYAQASLVLFEFEFAAITLVLLAGSLLGRMNIRAWMAFT
PLWLLFSYTVGAFSLWGGGFLYQWGVIDYSGGYVIHLSSGIAGFTAAYWVGPRLKSDR
ERFSPNNILLMIAGGGLLWLGWAGFNGGAPYAPNITASVAVLNTNVSAATSLLTWTCLD
VIFFGKPSVIGAVQGMMTGLVCITPGAGLVHTWSAMLMGAFAGSVPWFTMMILHKKSS
LLMKVDDTLAVFHTHAVAGVLGGVLTGLLATPELCALDSPVPGARGVFYGGGIAQMG
KQLGGALFVTVWNLVVTSAILLCIGLFIPLRMPDDQLMIGDDAAHGEEAYALWGDGEK
FDVTRPDATRTGGASGAAVTEDTVEQRLTSMGARGVTIQL

Setaria italica SiAMT2-A SiPROV026536m

MATEAAPEWLDKGDNAWQLAAATLVGLQSVPGLVILYGSIVKKKWAVNSAFM
ALYAFAATFVCWCLWAFRMSFGDRLLPFVGRPDLAALDQAFLTQQGFAGAYPAATLLF
FQFVFAAITLILVAGSLLGRMNFRAWMLFVPLWLTFSYTIGAFSLWSPNGFLFKAGVMD
FAGGYVIHLSSGIAGFTAAYWLTIINGRRQVGPRTAKDREAFPPNNILLTLAGAGLLWM
GWTGFNGGAPYAANIDASVAVVNTHFCTATSLLVWLCLDCLVFGRPSVIGAVQGMITG
LVCITPAAGLVQGWAAMLMGVASGSVPWCTMMVLHRRSRLLKRVDDTLAVLHTHGV
AGSLGGVLTGVLAEPRLCRLFFGDDPRYVGLAYAVKDGRAAAGLRQVGVQVAGIAFV
AALNVGVTSAVCLVVRLLVPLRLGEEQLAAGDDAIHGEDAYAVWGDGETYEQSVHGN
QGYPMTANPVASKADEMI

Setaria italica SiAMT2-B SiPROV027263m

MSIDDPLLYNMTSGYLPGIGVPHWLNKGDNAWQMVAATLVGLQSMPGLVILYG
SIVKKKWAVNSAFMALYAFAAVWLCWVTWGYQMSFGEKLLPFWGKAGHALNQGSLL
AQAALPATEHHYHGGTDIETAAITPFYPQASMVYFQCVFAAITLILLAGSLLGRMNFKA
WMLFVPLWLTFSYTIGAFSIWGGGFLFHWGVMDYSGGYVIHLSSGVAGFTAAYWVGP
RSTKDRERFPPNNVLLMLTGAGILWMGWAGFNGGDPYSANVDSSLAVLNTNICAATSL

LVWTCLDVIFFKKPSVIGAVQGMITGLVCITPGAGLVQGWAAILMGIVSGSIPWFTMMV
VHKRSRLLQQVDDTLGVFHTHAVAGFLGGATTGLFAHPDLCPMFLPVTNSRGAFYGSG
IQLVKQVGGALFIISWNVVVTSLVCLVVRLVVPLRMPDDELAIGDDAVHGEEAYALWG
DGEKYDSTKHGWYSDNDTQHNKAPSGVTQDV

Setaria italica SiAMT2-C SiPROV007995m

MAASSAYAASLPAVPDWLNKGDNAWQLTAATLVGIQSMPGLVVLYGSIVKKK
WAVNSAFMALYAYASSLLVWVLVGFRMAFGERLLPFWGKAGVALSQGYLVRRASLS
ATAHGDTPRTEPFYPEATLVLFQFEFAAITLVLLAGSVLGRMNIKAWMAFTPLWLLFSY
TVGAFSLWGGGFLYHWGVIDYSGGYVIHLSSGVAGFTAAYWVGPRLKSDRERFSPNNI
LLMIAGGGLLWMGWAGFNGGAPYAANIAASVAVLNTNVSAATSLLTWTCLDVIFFGKP
SVIGAVQGMMTGLVCITPGAGLVQTWAAVIMGVFAGSVPWFTMMILHKKSALLMRVD
DTLAVFHTHAVAGFLGGILTGLLATPRLLEIESPVPGLRGAFYGGGIGQVGKQLAGAAF
VVAWNVVVTSLILLAIGMVMPLRMPDEQLMIGDDAAHGEEAYALWGDGEKFDATRHD
AARVGGGGGGMEREGSAEQRLSGMGARGVTIQL

Setaria italica SiAMT2-D SiPROV008039m

MSTSSGFPLAYQGSAASPDWLNKGDNAWQLTAATLVGLQSFPGLVVLYGGVVK
KKWAVNSAFMALYAFAAVWICWVTWAYNMSFGDKLIPIWGKARPALNQGFLIGQAAL
PATAHYRAGGATIETPAVEPFYPMATVVYFQCVFAAITLILVAGSLLGRMSFLAWMIFV
PLWLTFSYTIGAFSVWGGGFLFQWGVIDYCGGYVIHLSAGFAGFTAAYWVGPRAQKDR
ERFPPNNILFTLTGAGLLWMGWAGFNGGGPYAANSVASMSVVNTNICTAMSLIVWTCL
DVIFFGKPSVIGAVQGMITGLVCITPGAGVVQGWAALVMGVLAGSIPWYTMMKLHKRL
RFLKRVDDTLGVIHTHGVAGLLGGLLTGLLADPTLCNLFLPVTNSRGAFYGGAGGAQF
GKQLAGALFVIGWNVVVTSVICVAINAVVPLRMPEEKLEVGDDAVHGEEAYALWGDG
ELYDITKHGADETEHGGRAAVAPVSMTPN

Setaria italica SiAMT2-E SiPROV029939m

MASPPEPGPYMADLPAVPAWLNKGDNAWQLVAATFVGLQSMPGLVVLYGSIV
KKKWAVNSAFMALYAYASTLIVWVLVGFRMAFGERLLPFWAKAGPALTQDFLVRRAV
FPATAHYGRGGVLETPRTEPYYAEASLVLFEFEFAAITLVLLAGSLLGRMNIKAWMAFT
PLWLLFSYTVGAFSLWGGGFLYQWGVIDYSGGYVIHLSSGIAGFTAAYWVGPRLKSDR
DRFSPNNILLMIAGGGLLWLGWAGFNGGAPYAPNVTASVAVLNTNVSAATSLLTWTCL
DVIFFGKPSVIGAVQGMMTGLVCITPGAGLVHTWSAILMGMSAGSIPWFTMMILHKKSS
LLMKVDDTLAVFHTHAVAGVLGGVLTGLLATPELCALDSPIPGARGVFYGGGVVQIGK
QLGGALFITVWNLVVTSAILLCIGLFIPLRMPDDQLMIGDDAAHGEEAYALWGDGEKFD
VTRPETTRTGGASGAAREDTVEQRLTSMGARGVTIQL

Setaria italica SiAMT2-F SiPROV029613m

MGTPPQPGPYAPDLPAVPAWLNKGDNAWQLVAATFVGLQSMPGLVVLYVSIVK
KKWAVNSAFMALYAYASTLIVWVLLGFRMAFGDRLLPFWGKAGPALAEGFLVARASF
PATVRRGTGGALVAPRTEPPYYPEASLVLFEFELAAITLVLLAGSLLGRMNIRAWMAFT

PLWLLLSYTICAFSLWGGGFLYHWGVIDYSGGYVVHLSSGVAGFTAAYWVRRGSRRIL
LMIAGGGLLWLGWAGFNGGAPYAPNITASVAVLNTNVSAATSLLTWTCLDVIFFGKPS
VIGAVQGMMTGLVCVTAGAGPVHTWSAILMGVCAGSVPWFTMMILHKRSALLQKVD
DTLAVFHTHAVAGLLGGVLTGLLATPDLMALHSHVPGARGAFYGGGVAQVGKQLGGA
LFVVAWNVVVTTGILLGVGLFVPLRMPDDQLRIGDDDAHGEEAYALWGDGERFDVTR
NEAARTGAWGNGGREETVDHRLAGMGARGVTIQL

Selaginella moellendorfii SmAMT2-A 84585

MAARTTPITAVTPEWLEKGDNAWQLISATLVGMQSVPGLVILYGSIVKKKWAV
NSAFMALYAFAAVLICWVSFAYKMSFGHQLLPFWGKAGPALDQKFLLRQAHLSATEY
KFHNGTVETQMVQPFYPMATMVFFQFVFSAICLILIAGSLLGRMNIHAWMLFVPLWLTF
SYTVGAFSLWGGGFLFQWGVLDYSGGYVIHLSSGVAGFTAAYWVGPRLTKDRERFPPN
NVLLMLGGAGLLWMGWAGFNGGDPYAANIDASLAVLNTNICAAASLLVWTAFDTIFF
GKPSVIGAVQGMITGLVCITPGAGLVQGWAAICMGILSGSIPWYTMMVVHKRSPFLQKV
DDTLAVFHTHAVAGTLGGFLTGLFAQPTVTGMFSSVPGTHGAFYNHDIRGAMQVVKQL
GGALFIISWNLVMTSIICWVISKIVPLRMPEEHLMIGDDAAHGEEAYALWGDGEKYDSS
KHGLYNEAVEAGNRGSSRYNEPPVAV

Selaginella moellendorfii SmAMT2-B 93278

MKCSYLSSSSTPCWMDKGSNAWMMVAAILAGLATMPGLLLLYSGIARKKWAV
NTAFLTLYAFTASLICWVTICHNLAFGSHLLPFWGTPGPVLYTKFLLSRSHHPATHQDLD
FPSATMVAFQFGFAANSVAIVSSAVSARITFQAWAVFVPLWLIFSYTVGASSIWSGGFLS
RWGVLDFAGGYVVHLSAGVSGAVLAHWVGPRHPVDRARYPPNNVMLVLGGAGLVW
MGWIGFAGGSAFLSPQQASLAVVNTNIAAATSLLVWTSLDVLYHGQPSVLGAVQGLMT
GLVAISPAAGLVEAWASMCIGLCSGSLPWLTRLCHQKTTAKFCEEVDDTAGAVHTHGI
AALIGGLLTGFFAHPRLTALVSSVSGSKGVIFGNFQLVLKQLAAALLVILWNVAVTTLIC
VVVKRLMKLRMSDDQLRIGDDAVHGEEAYAVWEDGEKTTL

Selaginella moellendorfii SmAMT2-C 173475

MATVPATPAYALAATVPEWLNKGDNAWQLTAATLVGMQSVPGLVILYGSIVKK
KWAVNSAFMALYAFAAVLICWVGWAYRMAFGHKLLPFWGKADVALGQKYLMQQAS
IPSSGHYYKNGTVETAEITPFYPMATMVYFQFVFAAITVILIAGSLLGRMNFRAWMIFVP
LWLTFSYTVGAYSLWGGGFLFHWGVIDYSGGYVIHVSAGTAGFVAAYWVGPRLTKDR
ERFPPNNILLTLTGAGMLWLGWNGFNGGDPYAANIDASIAVLNTNICAATSLIVWTILDV
TFFNKPSVIGAVQGMITGLVCITPGAGVVQSWAAIVMGICSGSIPWFTMMVVHRRSTLL
QKVDDTLGVFHTHTVAGVLGGGLTGLLAEPVLTSYFVPVTGSRGGFYGGVGGGQFGRQ
IAGALFIIGWNIVATTIILLAIRLFVPLRMPDDELQVGDDAVHGEEAYALWGDGEKYEAS
RHGNDDIHHDGGNGRKVTVQV

Vitis vinifera VvAMT2-A GSVIVT01035812001

MADTSFPPNLLPDEASPEWMNKGDNAWQLTAATLVGLQTVPGLIILYGGAVKK
KWAVNSAFMAFYAFACVLICWVGWGYRMSFGTKLVPFWGRANVALDQVYLLDPAFI

GKFPQATMVFFQFVFAAITVVLIAGALLGRMNFYAWMLFVPLWLTFSYTFVAFSIWCPS
GFLAKAGIIDYSGGYVIHLSSGVAGFTAAYWVGPRLTKDRERFPPNNILLMMAGAGLL
WMGWTGFNGGDPYVVSVDASLAVLNTHVCTATSLLTWLILDIAVFGKASIIGAVQGMI
TGLVCITPAAGVVQGWAAIIMGIFSGSIPWFTMMVVHKKSELLQKVDDTMAVLHTHAI
AGSLGGILTGLFASPKLNRLFYGYGGFRQIGIQLLGIVFVLVFNVIATSLICLVVQLIVPLR
MSDEDMEIGDEAAHGEEAYAIWGQGDKLENSRYGSSVYGDVELPMPKPRGAGQGWGR
LATKYQAWDNVPTKGHQGQSLGGW

Vitis vinifera VvAMT2-B GSVIVT01022397001

MATMVWFQCVFAAITVILLAGSLLGRMNIRAWMMFVPLWLTFCYTVGAFSLW
GGGFLFHWGVMDYSGGYVIHLSSGIAGFTTAYWVGPRSTKDRERFPPNNVLLMLAGAG
LLWLGWAGFNGGDPYAANTDSSMAVLNTNICAATSLLVWTWLDVIFFKKPSVIGAVQG
MITGLVCITPAAGLVQGWAAIVMGILSGSVPWFTMMILHKRWTLLHHIDDTLGVFHTH
AVAGYLGGILTGIFAEPELCSLFLPVTNSRGAVYGGSGGIQVLKQLAGGAFIIGWNAVVT
SIICLVVRVVLPLRMPEEELLIGDDAVHGEEAYALWGDGEKYDSAKHGLYSDDTQHQM
PSSGTTQVV

Vitis vinifera VvAMT2-C GSVIVT01022402001

MATTVPIAYQGNTSASVPDWLNKGDNAWQMISATLVGLQGIPGLMILYGGLVK
KKWAVNSAFMTFYGFAAVILCWVSWAYRMSFGDQLLPFWGKAGAALGQKFLLKQAA
LPATTHHYKNGTVETAMITPFYPMASMVWFQGVFAAVAVILLAGAVLGRMNIRAWMV
FVPLWLTFSYTVGAFSLWGGGFLFHWGVMDYSGGYVIHVSSGIAGFTAAYWVGPRSKR
DRERFPPNNVLLMLAGAGLLWLGWAGFNGGDPYAANTDSSMAVLNTNICAATSLLVW
TWLDVIFFKKPSVIGAVQGMITGLVCITPAAGLVQGWAAILMGILSGSVPWFTMMILHK
RSTLLQHVDDTLGVLHTHAIAGYLGGILTGFFAEPELCSLFLPVTNSRGAVYGGSGGIQIL
KQIAGGAFIIAWNVVMTSIICIVVKLVVPLRMPEEELLIGDDAVHGEEAYALWGDGEKY
DSSKHGFYSDDTQHQRPYSGATDAV

Vitis vinifera VvAMT2-D GSVIVT01030330001

MATMVFFQFAFAAVTVILLAGSVLGRMSIKAWMAFVPLWITFSYSIGAFSIWGG
GFLFQWGIMDYSGGYVVHLASGAAGFTAAYWVGPRLQVDREQFPPNNLLLALAGAGIL
WMGWTGFNGGDPFAANVDSSLAVLNTHICATTSLLVWTFWDTFFFKKPSAIGAIQGMIT
GLVCITPGAGLVQGWAALIMGIASGSVPWYTMMCLSKKLPFLQKIDDTLGVFHTHAVA
GTLGGALTGLFAHPDLSALFIVVPNSRGAFYGGRGGVQFLKQLVGASFIIGWNVIVTSIIL
LVISKFIPLRMSEEELIIGDDAAHGEEAYALAGQGAREKSTYNNMQLQNASGFEL

Vitis vinifera VvAMT2-F GSVIVT01021796001

MELPSNLQPNEASPEWMNRADNAWQLTAATLVGMQSIPGLVILYGSMVKKKW
AVNSAFMALYAFAAVIICWVGWGYRMSFGEKLVFFLGKPGVALDADLLLGQAFLGMF
PTATMVFFQLVFAAITVILIGGALLGRMNFGAWMLFVPLWLTFSYTIGAYSVWCPDGW
LAKLGVIDFAGGYVIHLSSGVAGFTAAYWVGPRASGDRDSFPPNNMILMLGGAGLLW
MGWSGFNGGAPAVASLDASLAVLNTHVCAATSLMTWLILDTIFFGKPRVFGAIQGMIT

GLVCITPAAGVVQGWAAMLMGVFSGSIPWYTMMVLHNKLKFLTQVDDTMSIFHSHAI
AGSLGGILTGFFAMPKLCRLFYMVPDWEKYIGLAYALQEDRTSKGLRQMGIQLVGILFI
VCLNIVMTSFICLLIRTLVPLRLAEDELQIGDDAVHGEEGYALWGDGEIFENSKNNSVFD
MEEFVSVPSKSLDDV

Vitis vinifera VvAMT2-G GSVIVT01003136001

MKLPLNLIPDEASPEWMNKGDNAWQLTAATLVGLQSMPGLVILYGSIVKKKWA
VNSAFMAFYAFAMVLVCWVGWGYRMSFGEKLAPFIGKPNVALDQGYLLKPAFLGYFP
NATMIYFQFVFAAITLILIAGALLGRMNFRAWMLFVPLWLTFSYTVGAFSLWCPDGWLA
KLGTIDYSGGYVIHLSSGVAGFTAAYWVGPRASKDRERFPPNNILLMLAGAGLLWMGW
TGFNGGDPYAVSTDASLAVLNTHVCAATSLLTWLMLDIIFFGKPSVIGATQGMITGLVCI
TPAAGVVQGWAAIIMGVLSGSIPWYTMMVVHKNIWLLKQVDDTMAVFHTHAVAGSL
GGILTGFFAEPNLCRIFYLVPDYEHYIGLAYGFQTGRTTAGFRQMGVQIAGIVFVITLNVI
MTSLICLFIRLIVPLRLADDELQTGDDAVHGEEAYALWGDGEKFESKHNSAFGMEEFPS
VVPRTGGQV

Vitis vinifera VvAMT2-H GSVIVT01005492001

MVKKKWAVNSSFMALYAFAVVLICWVLWAHEMSFGERMCPILGKPNFALGQK
YLLERAKNWYIPTATYVFYQFAFAAITVILLGGSVLGRMNFYAWMSFVPLWLTFSYTIG
AFNIWGSGLLQNRIIDFSGGYVIHLSSGVAGFTAAYWVGPRLSHDRQHFPPNNIIHMLGG
AGFLWVGWTGFNGGSPFAANEITSLAILNTHICTATSLFVWLSMDMLVYKKSSAIGAVQ
GMITGLVCITPAAGIVEPWAAGLMGAMSGSIPWYTMMVLHRKSAFFQKVDDTLGAFHT
HAVAGTLGGLLSGILAKPSLLKLYYTETPYGPGLFYGLIQGRLMDSLKQMGFQILGAVF
VASWNVVVTSLICIFLSRFLNLRMDERDLEIGDDAAHGEEAYALWGDGERRPTHPHRRL
TIPSMCRHC

Zea mays ZmAMT2-A GRMZM2G338809_P02

MSSSSGTTMPLAYQTSASSPEWLNKGDNAWQLTAATLVGLQSFPGLVVLYGGV
VKKKWAVNSAFMALYAFAAVWICWVTWAYNMSFGDRLLPLWGKARPALSQGGLVG
QAGLPATAHHFASGALETPAAEPLYPMATVVYFQCVFAAITLVLVAGSLLGRMSFAAW
MLFVPLWLTFSYTVGAFSVWGGGFLFQWGVIDYCGGYVIHLSAGFAGFTAAYWVGPR
AQKDRERFPPNNILFTLTGAGLLWMGWAGFNGGGPYAANVVASMSVLNTNICTAMSL
LVWTCLDVVFFKKPSVVGAVQGMITGLVCITPAAGLVQGWAAMVMGVLAGSVPWYT
MMILHKRSRLLKHVDDTLGVIHTHGVAGLLGGLLTGLLADPTLCALFLPVTNSKGAFYG
DGAQLGKQLAGALFIIGWNVAVTSIICVAINAVVPLRMTQDKLEVGDDAVHGEEAYAL
WGDGELYDVTDHGPRAAAAVAPMSTPPN

Zea mays ZmAMT2-B GRMZM2G473697_P01

MATEAAPEWLDKGDNAWQLAAATLVGLQSVPGLVILYGSIVKKKWAVNSAFM
ALYAFAATFVCWCFWAFRMSFGDRLLPFVGRPDLAALDQAFLTQQGFAGAYPAATLLF
FQFVFAAITLILAAGSLLGRVNFRAWMLFVPLWLTFSYTIGAFSLWSPNGFLFKAGVMD
FAGGYVIHLSSGIAGFTAAYWVGPRTAKDREAFPPNNILLTLAGAGLVWMGWTGFNGG

APYAANIDASLAVVNTHLCAATSLLVWLCLDCLVFGRPSVIGAVQGMITGLVCITPAAG
LVQGWAAMLMGVASGSVPWCTMMVLHKRSRFLKRVDDTLAVLHTHGVAGSLGGVLT
GVLAEPRLSRLFFGDDPRYVGLVYAVKDGRTAAGLRQVGMQLAGIAFVAALNVAVTS
AVCLVVGLLVPLRLSEEQLAAGDDAIHGEDAYAVWGDGETYEQSVHGNHSYPMTSNP
MSKADEMI

Zea mays ZmAMT2-C GRMZM2G043193_P01

MAGGGAAYQSSSASPDWLNKGDNAWQMTSATLVGLQSMPGLVILYGSIVKKK
WAINSAFMALYAFAAVWLCWVVWAYNMSFGDRLLPFWGKARPALGQRFLVAQSQLT
ATAVRYRDGSLEAEMLHPFYPAATMVYFQCVFASITVIILAGSLLGRMDIKAWMAFVPL
WITFSYTVSAFSLWGGGFLFQWGVIDYSGGYVIHLSSGIAGLTAAYWVGPRSASDRERF
PPNNILLVLAGAGLLWLGWTGFNGGDPYSANIDSSMAVLNTHICASTSLLMWTLLDVFF
FGKPSVIGAVQGMITGLVCITPGAGLVQGWAAIVMGILSGSIPWYTMMVLHKKWSFMQ
RIDDTLGVFHTHAVAGLLGGATTGLFAEPVLCNLFLAIPDSRGAFYGGDGGSQFGKQIA
GALFVIGWNIVITSIICVLIGLVLPLRIPDAQLLIGDDAVHGEEAYAIWAEGELNDVTRQD
ESRHGSVAVGVTQNV

Zea mays ZmAMT2-D GRMZM2G080045_P01

MMAASGAYAAQLPAVPEWLNKGDNAWQLTAATLVGIQSMPGLVVLYGSIVKK
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SATAHGATPRTEPLYPEATLVLFQFEFAAITLVLLAGSVLGRMNIKAWMAFTPLWLLFS
YTVGAFSIWGGGFLYHWGVIDYSGGYVIHLSSGIAGFTAAYWVGPRLKSDRERFSPNNI
LLMIAGGGLLWMGWAGFNGGAPYAANIAASVAVLNTNVSAATSLLTWTCLDVIFFGKP
SVIGAVQGMMTGLVCITPGAGLVQTWAAVIMGVFAGSVPWFTMMILHKKVALLTRVD
DTLGVFHTHAVAGLLGGVLTGLLATPELLEIESPVPGLRGAFYGGGIRQVGKQLAGAAF
VVAWNVVVTSLILLAIGLLVPLRMPEDQLMIGDDAAHGEEAYALWGDGEKFDATRHD
AVRVAGVMDREGSAEQRLSGGVTIQL

Zea mays ZmAMT2-E GRMZM2G335218_P01

MSTTAYNMSSAYMPNPSIGIPDWLNKGDNAWQMVAATLVGLQSVPGLVILYGS
IVKKKWAVNSAFMALYAFAAVWLCWVMWGYQMSFGQKLLPFWGKAGHTLGQGFLL
SQAGLPATTHFFHGSGVVETGEITPLYPMASMVYFQCVFAAITLILLAGSLLGRMNFKA
WMLFVPLWLTFSYTIGAFSIWGGGFLFHWGVIDYSGGYVIHLSSGVAGFTAAYWVGPR
LTKDRERFPPNNVLLMLTGAGILWMGWAGFNGGDPYAANIDSSIAVVNTNICAATSLLV
WTCLDVIFFKKPSVIGAVQGMITGLVCITPGAGLVQGWAAIVMGMLSGSIPWCTMMVV
HKRSRLLQQVDDTLGVFHTHAVAGFLGGATTGLFAHPDLCPLFLPVTNSRGAFYGDGM
QFLRQVVGALFIISWNVVVTSLVCLVVRLVVPLRMPDDELAIGDDAVHGEEAYALWGD
GEKYDSTKHGWYSDNDTQHNKAPSGVTQNV

NRT1:

Organism Name in Phylogeny Accession Number Sequence

Aquilegia coerulata Aquca_01 Aquca_001_00177

MKRKHQSSEVFLQRVWFDPTLIDWVIRLIQLKPVNEKPIYSPYDVAKLLSSLPTC
WLLMYSSYMSVQKVITNDSWFNTNSFREEKKGMNKNKISSMEDMEDSRKEVLAQKGG
LRTIPFIIANESFQSVASVGILPNMILYMIYGYNMNIATGSSILSIWSSSQDFLSIFGAFISDA
YLGRFRVIVLGSILSSLGMTLLWLTAMISNAKPPPCNSSHTGCQNPTFAQLAFLVLSLGLI
SIGGGCIKPCSMAFGADQLVGEHKLKKNERLVQSYFNWYYAAAAISSVIALTVVVYIQD
QFGWKVGFGVPVILMLLSTAFFLGGSAIYVKMKGDKSLFIGLAQVLVAAIKNRHLPFPS
DNSDGLYWQKKDSNLGVPSNKQRFLNKACIIKNPEEDFDEDGLATKPWELCSVEQVET
LKTLINIIPIWSTGIFSYVAVNQSSLAVIQATSMDRHIISNFQIPAGSLSFFTALSAAIWVTF
YDRLVLPLVARYTGRPGGMSSKLRMGIGLIISCLTMALAAIVETIRRKIAIEEGLSDDPTT
VVSMSALWLIPQFSLLGFALVLNGVGQIEYYYSELPKSMSSMGMAVYTLGSAFAGLLSS
LVTIIVNKVTQSGGEISWLSTNLNKGHYDYQYGLISFLCFLNFVYYLFVCRGTCGPQKDV
RAQVSNEREDLKEALLSSKSRAFPSSSA

Aquilegia coerulata Aquca_02 Aquca_001_00383

MDMEISLESNELNQQSSSKQGGFKTMPFIIANEAFEKVASYGLTPNMTRYLMGG
YNMDVATVTTILAFFGAGTNFLPVAGAFVSDSFLGRFLTILLGCIASLLGMTLMWLTAMI
PQAKPPACDPLSKSCKSPSSAQLFLLYGSFVLMSIGAGGIRPCSLAFGADQFDKEGDPEN
KSVIQTFFNWYYASSSIAVLISFTVIVYIQDQLGWKVGFGVPAMFMFLSTLLFVLASSYY
VKAKPNKSLFSGFAQVTVATFRNRHIDLPPKLHEGVYHHLAGSNKVVPTELLRFLNKAC
VIQNKEQDLNTDGTATNPWSLCTVEQVEELKALLKVIPLWSANITIAINLNQQTFPYLQV
SSMDRHLISGFKIPAGSFAMFVIISLVIWITIYDRLILPQLVKLTGKPYGIGLKQRMGIGLV
LSCMAMAVSAIVESVRRRNAIKQGFADNPSGVLDMSAMWLVPQLCIGGVAEAFNAIGQ
TEFYYSQFPKSMSSIAACLFGLGMAVGSLLVGLIVNVVDDVTKRGGKESWVSSNLNKG
HYDYYYWFLVVLNIINFFYFLVCCWAYGPLENERTRRRQGDADEGRRQKASLGIEMEK
L

Aquilegia coerulata Aquca_03 Aquca_001_00384

METSLDPNMLTQQPSRKKGGFRTMPFIIANEAFERVASFGLLPNMTRYLMGGYH
MDVATGTYVLSIWSAATNFFPVVGAFISDSFLGRYRTIVVGCVTSLLGMILLWLTAMIPQ
AKPPPCEALSKSCKSSSTAQLAFLFASFVLMSIGAGGIRPCSLAFGADQWDKDGNPKSKN
VLQSFFNWYYVSATTSVLLAMTVIVYIQDHFGWKIGFGVPVVFQFMSGFLFLLASSFYIK
TKPNKSLFTGFAQVSVAAFRKRHIDLPKSKEACYHYIKGSKIVVPTDMLRCLNKACIIIN
KEKDVKTDGSATDPWSLCTVEQVEELKALLKVMPIWSTGIIIAVNISQQTFPYLQASSMD
RHITSNFQIPAGSFGMFTVLTLIIWIAVYDRLIIPQLAKLTGKPYGIGLKQRIGIGLALSCM
AMATSAIVENMRRKTAIRQGFADNPQGILNMSAMWLVPQHCLTGLAEAFNAIGQTEFY
YSQFPRSMSSIATSLFGLGMAVGSLLVSVIVKMVDDATKGEGKESWVSSNLNKGHYDY
YYWILTILSVMNFLYFLVCSWAYGPCEGERTKVPSEGDDEGMREEEPCSESRTVDSSA

Aquilegia coerulata Aquca_04 Aquca_001_00884

MEEAPGEFTQDGTVDLKGNPILRSKRGGWTACSFVVVYEVFERMAYFGISSNLV
LYLTNKLHQGTVASANNVTNWVGTVWLTPILGAYVADAHLGRYWTFLIASAIYLSGM

CLLTVTVSIPALRAPPCHEVNLADCKHASRLQLAVFYTALYILAIGTGGTKPNISTIGADQ
FDDFEPKEKTQKLSFFNWWTFSIFFGTLFANTFLVYIQDNVGWSLGYGLPTCGLAISILIF
LAGTPFYRHRVPTGSPFTRMSRVIVAAIRKSRIPVPNDPKELYELDAEEYAQNGKYRIDA
TPSLRFLNKAAVKTGSNDPWMLSSVTQVEETKQMIRMLPVLIATIVPSTMVAQVNTLFV
KQGTTLNRALNSFQIPPASLTAFVTLSMLISVVIYDRIFVRIMSKWTKNPRGITLLQRMG
MGFVFHILVMVTASLTEMRRLSVAKDHGLVENGGRVPLSILTLLPQFVLMGIADAFLAV
AQIEFFYDQAPESMKSLGTSYSTTSLGIGNFFSSFLLSTVSDITERKYHKGWILNNLNDSH
LDYYYAFFAVLNLVNLVFFVVVCRFYVYRAEVSDSMEVLKKKQEMLSLTNPNQGRNN
EIS

Aquilegia coerulata Aquca_05 Aquca_002_00334

MDEGRTSKGVGKSCILVIVVAGVERFAFKGVASNLVTYLTDVVKLSNSSAAKTV
NSWCGVTFMLPLLGAFLADSFFDRYSTILASSFLYVLGLVALTSTAFVWESIPSSKASCSF
LLLSLLIISLGQGGYNPCLQAFGAEQLHNDEELPLGKKDQISDVKKSSFFKWWYFGICTG
SLLGVSCMSYLQDTFGWGLGFTIPTIAMAISILPFSCGNQCYIHKEPKGGGNKRIQDLIQSI
KATASKMISGKITLSAKEVVELELEEKPLCNQKFEYTKSLTEESNNNVASDAKAILRLLPI
WAMLLMFAIIFQQPATFFTKQGMTMKRNIGKEFLIPPASLQSAINISIILLMPLYDKIVIPI
MRIITQDDKGINVMQRMGIGMFLSIIAMAIAAFVETKRLEISRRSDLPLSIFCLLPQYIILGI
SDVFTVVGMQEFFYTEVPNNMKTMGMALHLSVFGVGSFLSALLISVIEFITSDKDGKHS
WFSDDMSEAHLDMYYWFLALSSALSLMLFVHLCKNYSSKNAGLNQNCK

Aquilegia coerulata Aquca_06 Aquca_002_00461

MEKKDQQVHDVEKVDKQKINYRGVKAMPYILGNETFEKLGTIGTSSNMVVYLT
TVFNMKSVSATTLVAVFSGTANIAPLIGAFLSDAYFGRFKTLGFASISSLMGMFVITLTA
AISKLHPPHCGPEDIGHCIGPTIWQLAFLLCGFVFLIVGAGGIRPCNLPFGADQFNPNTEA
GKRGINSFFNWYFFTFTFAMMVAVTLIVYVQSNINWAIGFAIPTFLMFLAVALFFMGSRI
YVKVKPEGSPLTGVVQVFVAANKKRRLKLPESPHLSLFNYHPTDSINANLPYTDQFRFL
DKAAIITPEDGVNPDGSAVDPWRLCGMQQVEEVKCIMRILPIWVSGIVYYTTIVHTHTY
AVLQALQSDRHLGGNNFEVPAASYIVFSMIGLTIWIPIYDRLIVPTLRKFTGKEGGISLLER
VAIGFVLSVTTMLVSAIVETQRRNYALTRPTLGITSKGGAISSLPGLWLAPQLILAGLTEA
FGSIGQVEFYYKQFPENMRTIAGSFFYCTMAGANYLCGFLVSLIHRVTAKSPTGNWLPE
DLNKGRLDYFYYLFVALGILNFAYFLVCARWYRYKGTGGVAIELANESTPTEKQHIV

Aquilegia coerulata Aquca_07 Aquca_002_00462

MEKNDDDKKVHHDIEDHVDKQKINYRGVKAMPYIIGNETFEKLGTIGTSSNMVV
YLTTVFNMKSASATTLVNVFNGTTNFAPLIGAFLSDAYFGRYKTLGFASISSLTGMFVIM
LTAAITKLHPPHCGTKDTGHCIGPTTLQFAFLLLGFAFLVVGAGGIRPCNLAFGADQFNP
NTESGKRGINSFFNWYYFTFTFAMMVSVTLIVYVQSDINWAIGLAIPTFLMFLSCATYFV
GSRIYVKVKPEGSPLGRVVQVFVAAKKKRRLKLPENPHLSLFSYQPTGSINASLPYTDQF
RFLDKAAIITPEDSIKPDGSAVDPWRLCGMQQVEEVKCIMRVIPIWASGIIYYTAIVQMHT
YVVLQALQSDRRLGGSGFEVPAASYIVFAMVGLTFWIPIYDRIIVPTLRKFTGKEGGITLL
QRMGIGIVLSITTMLVSAVVEVRRRNYALTRPTLGIAKSGGAISSMPGLWLSPQLLLAGL

SEAFDSVGQIEFYYKQFPENMRSIAGSFFFLTMAGANYLSGFLVSLIHRVTANSPTGNWL
PDDLNKGRLDYFYYLFAALGILNFGYFLVCARWYRYKGTGGVTIELANESTPTEKHIV

Aquilegia coerulata Aquca_08 Aquca_002_00465

MKENNSSSTPSWLSCSFKCFPMSSSSSSSPVKEKQEKYDIVEETTTPKRKPGGWR
SMPYVLGNETFERLATIGLLANIMVYLLNEYHMDQVFATNVINIWSGTTNFGPLIGAYIS
DAHIGKFKTLAFASIASLLGMISLTLTAAIPQLRPPRCTKIQLQRDQCMGPTKGQLGILYM
SLGFLSIGAAGIRPCSLPFGVDQFDSTTDEGRKGIASFFNWYYFTFTIVIMIALTLIVYIQDS
LSWVWGLGIPTSLMFCSIILFFIGTRVYMYVPPGGSVFSGIGQVFAAAYKKRGLKLPSEE
ELPHVVYDPSVKGTTITSKLPLTHQFSFLTKAAVVLEGEVGEDGSRLDKWSICSVQQVEE
VKCLLRVIPIWASGIICFTSMSQQGTFTVSQALKMDRHLGPKFQIPAGSLGVISMLTLGL
WVPFYDQILVPRLRKITKHEGGITLLQRMGIGMVFSILSMVVAGFFEEKRRASAILHASP
DGIAPISVLWLSPQLILMGLAEAFSIIGQIEFYYKQFPEHMKSFANSLLFCTMAGANYLSS
TIVSIVHGNTGKDGNPDWLDKNINKGRVDYFYYLIAAMGVLNLVYFLIVASRYRYKGE
VPVEGEDTPIDIELSKAKHIDN

Aquilegia coerulata Aquca_09 Aquca_002_00466

METIVDQKDEGNDIEKGCANNIVKVESIKAGGWNAMPYIMGNETFEKLASMSLI
ANLVVYLRTQYNLDGIAAVTIFTVWHGTCNFAPLLGAFISDAYIGKFKTLIFGSLSSTLG
MVVLAITAALPHLRPHPCLNGIECEQAKPWQLSILMAGLGFLVLGAGGIRPCNIAFGVDQ
FDIRTEKGKKDVESFYNWYYLTFTLALLIALTVVVYIQNSISWAWGLALPATFMVLSVL
VFLAGSHLYVYVLPNGSVFGGMVKVVVAAFRKRHLTGLEYSLYEGQTEPGAETKMAH
TERFKCLDKAAVITDRDVFDDKGLPVNEWRLCSIKQVEQLKSLIGILPVWASGITCFIIMD
QQHTFGVQQAMQTDTHIRKFQVPPGSLGLTSMIALSIYIPIYEHVLLPFSRKVNKKGIML
GDRMKAGIVMSILCMLSAGLLEGKRRDSALKNGSFVAPMSFVWLLPQFAFSGLTEALM
GISLMEFFNSHLPANMRTVAGAFVFLNLAMAGYLNTCIVNSISSSRLHWLGGRDLNKNR
LDYYYFTIGGLAVINFIYFMTFARRYVVNNDSMETVEAPLETTSNKDNKVTHDER

Aquilegia coerulata Aquca_10 Aquca_002_00485

MEEGHQLERWEGYVDWKHRPAMRGHHGGMVAASFVLVVEILENLAFLANASN
LVIYLSKFMHISPSKSANTVTNFMGTAFLLALLGGFLSDAFLTTYNMYLISAVIEFFGLV
MLTVQAHLPLLKPPPCERVGTENICQEVSGGKALMLFGGLYLIALGVGGIKGSLATHGA
EQLDDNTPQGRKQRSTFFNYFVFCLSFGALIAVTLVVWIEDNVGWQWGLGISTATIFLSI
PVFLAGSAKYRNKIPSGSPLTTIAKVLASALLNSCITRSPSNAVASMVTSPAYPTQTTEQE
EMDKAELTIQTHTQDFKFLDRAIVSKPIHPVLGCTKEQVEEVKIVCRILPIFLCTVMLNCC
LAQLSTFSVQQADTMDTKLGSMKVPPASLPVFPVIFIMILAPLYDHVIIPFARKVTRTEM
GISHLQRIGIGLILSIIAMVVAALVEIKRKRVASHAGLLDSDKPLPITFFWVALQYLFLGSA
DLFTLAGLLEFFFTEAPASVRSLATALSWASLAMGYYLSSVLVSIVNSVTDTSQHAPWLS
GKNINHYHLERFYWLMCVLSGLNFLHYLFWAKRYNYRSTRSDIK

Aquilegia coerulata Aquca_11 Aquca_002_01145

MSGEKMEGNQTSSNVQRRKGGLRTMPFIFANEVSEKLAVVGFSANMVSYLTEE

LHLPLTKAANTLTNFGGTASLTPLIGAFIADSFAGRFWTITVASIIYLIGMISLTASAVLPS
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WKFFNWYYFGMGVSILVAVTVIVYVQDNVGWGWGLGIPTIAMFLSIITFALGYRLYQN
MDPVGSPFTRLIQVIVAASKKRKLPMVSDPNLLYENEELDAGISTTGKLLHSKQFSFLDK
AAIITDEDDPKSPNLWRLNTVHRVEELKSVIRMGPIWAAGIVLITAYVQQGTFSLRQAKT
MNRHLTKSFEIPAGSMTVFTMVFMLSTITLYDRLLIRIARHYTGLDRGITFIQRMGIGFAIS
ILATLVSGFVETKRRNAAIAYGLVDKPHSIIPISVFWLVPQYGLHGIAEAFMSIGHLEFFY
DQAPESMRSTGAALFWTSIAVGNYFSTFLVSIIHKYTAKPGRTDWLDSNLNKGKLEYFY
WLITALQTINLVYYLICARFYTMKPIQLRQKEEEPEGVELAQRV

Aquilegia coerulata Aquca_12 Aquca_002_01344

MDSQEEVRLLLEGRFVENGITEYTGDGSVDINGKPVLKNNTGNWKACPFILGTE
CCERLAYYGISTNLVTYLTNKLHEGNANAARNVTTWQGTCYLTPLIGAFLADAYWGRY
WTIAVFSTIYFIGMGTLTLSATVPSLRPPPCVDSICPSASFSQYAIFIVGLYMIALGTGGIKP
CVSSFGADQFDDTDSKERVRKGSFFNWFYFSINIGALISSSFLVWVQDNLGWGLGFGIPT
VFMALAIGSFLSGTPLYRFQKPGGSPLTRMCQVLSASFSKWNVEVPHDSSLLYEVPDGV
SAIAGSRKLEHSDELKCLDKAAVISDNEVKTGDFSNPWRLCTVTQVEELKILIRMFPIWA
TGIVFSAVYAQISTMFVEQGMTMDTKIGSFTIPPASLSTFDVVSVIVWVPLYDSILVPIAR
KFTGKERGFSALQRMGIGLFISIFAMATAAIVEIRRLQIARDLDLVHQDVSVPMTILWQIP
QYFLVGAAEIFTFIGQLEFFYDQSPDAMRSLCSALSLLTTALGNYLSSLILTIVTILTTKGG
KPGWIPDNLNEGRLDNYFWLLAGLSFLNMLVYVLCAAKYKSKKAS

Aquilegia coerulata Aquca_13 Aquca_003_00185

MKREGEVEEQKWVLDSSLDHKGKLPVRASTGAWKAALFIVVIEFSERLSYFGLS
ANLIIYLTKVLHFNLKNAAESVNYWAGVTTMMPLLGGFLADGYVGRFYMVLLSSFIYV
MGLCLLTMTQLIPSLKACHMEKCDKPEKLHEVVFFIAIYLVSLATGGHKPSLESFGADQF
DDNHPEERKKKMSFFNWWNSALCGGLLLGVTVIIYIQDYVSWAASYIILTVVICITIILFY
LGKPVYRYRVPKGSPLTPLLQVLVAAIAKRNLPYPSDTAQLNHVSYHSDNDQRIRLCHT
NKLRAAILEDVKDEEKGSSDQLRNPWRLSTVSQVEELKLVLNMIPIWCSTLVFGLSIAQI
GTFFIKQGVTMNRKLGNHFEIPPASIFSLTAIGMILSISMYDKVLEPKVRKVRGKERGITIL
ERIGIGMGIAMIAMFIAAGIERKRLGIAWRDIAQGGNGVGTISVFWLAPQFIVGAVGDGF
ALVGLQEFFYGQVPDSMRSLGIALYLSVLGIADIISGLLITLVDDLTSTGGGTSWFGKDLN
HSRLDKFYCLIGVISIVNLCVFVYLANRYTYKNVEKGVISVNSDGVEIEENEQ

Aquilegia coerulata Aquca_14 Aquca_003_00240

MEENKVEFGTGYKSLEQCDKRKGGFRASMFLFVLVALENMGFVANMASMVLY
FLLVMHFDLAGSANTLTNLMGSIYLLSVFGGFISDTYLTRFNTCLIFGTIEVLALGMFTIQ
AHIHKLQPEACSNSPCVKGGKALMFYSSLCLLALGAGAMRGAIPALGGDQFDQKDEKG
KKSLSSFFNWLLLSTTLGSTIGVTVIVWISMNKGWDLGFLIITLATFLGFVVLAIGKPFFHI
ETPGDSPIIRVIQVIVVAIRNRRLSLPDNHDELYDISEDATINDDKIQHTNQFRSLDKAAIL
RPDSSTGPWKVCTVTQVEEVKILTRMLPILASTIIVNTCLAQLQTFSVQQGNIMDLHLGSF
KIPPASIPVIPLLFMAVLLPFYELIFVPLARKITNHASGITQLQRVGVGLFLAAVSMGIAGII

EVKRRHQAIKDPTKPISLFWLSFQYGIFGIADMFTLIGLLEFYYKEASSGMRSLATSFTYL
SMSIGYFLSSIFVDLINSITKRTTKSKQGWLQGQDLNKSNLNLFYWFLAILSCLNLLNYLY
WSSWYKYKTDTTDYELKEKAVNGSTPFLKVGGTQAAAVSKQNGVSPART

Aquilegia coerulata Aquca_15 Aquca_003_00374

MGDIIDVYTKDGTINHCKEPTDKRKTGTWKACPFILGNEFCERLAYYGMSTNLV
NYLQHRYNMGTASAANAVLLWSGTCYITPLVGAFLADAYFGRYWIIAVFSMIYVFGMA
MLTSTASFPWIKPSCDIKGICNPKTFQTDLMFIALYLIALGTGGIKPCVSSFGADQFDDTD
EDEKKKKSSYFNWFYVSINIGALIASSVLVYVQTNVGWGIGFGIPAIAMAIAVVSFFSGR
KFYRLQKPGGSPLTRIAQVIVASFRKFNVKVPADPNSLYGITEGENIIEGSRKLNHTEGLR
FFDKAAVTELEEDVKGPVKPWRLCSVTQVEELKCIVRLLPIWVTGIIFSAVYGQMSTMF
VLQGNTMDPHLGKGFKIPSASLSIFDTISVIIWVLVYNYLIVPVARKFTKRETGFTQLQRI
GIGLLISILAMMVAGGVEVFRLHLVRENNYFDLKYVPMSILWQIPQYFLIGLAEVFTFVG
QMQFFYDEAPDAMRSMCSALSLTTVALGNYLSSALVTIVTQVTTRNGKLGWIPDNLNR
GHLDYFYWLLTILSVVNFLAYLVNAKCYTYKKTAGTVSS

Aquilegia coerulata Aquca_16 Aquca_004_00046

MATKELPFSGEYMHDEEAPTKCVGQKKGGWTTFPFVTVSLLGLSIAVAGWMTN
LIVYLIQKFNIKNIHATEIYNVVNGCTCFFPIVGAIIADSFVGNFFVILVSSILSLLGLVLLTL
TATLDSLRPRDCKGDLETCEAPSQFQLAILFSAITLVSIGSGGTRFTLATMGADQFDKTK
DQGTFFNWFFFTFYLATVIGITAIVYIEDNVSWGVGYILCLAINAIGLTIFICGKRYYRHIK
PCGSPFTSLARVIVATIRKKKMVLSSESKDYYYGRIDETMFNAIIGPTSSFRFLNRAAMKT
EGDAQQEGKLTESWSLCTVQHVEDFKSLIKIFPLWSTSIFLSTPIAIQMSLMVLQALTMD
RHVGPHFSIPSSSFLVFTLLFTAISLSIFDRLLFPMWKKLTRRPMTPLLRLGIGHVLNIVGM
AGSALVESRRLHVVRTHNLTHQPNSAAPMSALWLVAPLAIVGVGEAFHFPGQVALYYQ
EFPTSLKSTATAMISLVIAVAFYLSTALINLTQKITGWLPDNINEGRIDNVFWMLVILGVI
NFGYYITCAMLYKYNNVENAEQISETVTEA

Aquilegia coerulata Aquca_17 Aquca_004_00048

MATKELPAYGDEYMHDEEEPTKCVGQRRGGWTTFPFITVSALGLSIAAAGWTTN
LIVYLIQKFNIKSIHATEISNVVNGCTSFFPIVGAIIADSYVGNFFVILGSSILSLLGLVLLTL
TATLDSLRPKDCKEHLETCEASSQFQLAILFSAITLVSIGMGGTRFTLATMGADQFDKRK
DQGTFFNWYFFTFYLATIIGITAIVYVEDNVSWGLGYILCLAINAIGLAIFIFGKRYYRHIK
PHGSPFTSIARVIVATIRKKKVLLSSESKDYYYGDIKGTFSPAVLGPTSRFRFLNRAAMKV
EGDAQQQGKLSESWSLCTVQQVEDFKSLIKISPLWSSSIFLHTPIAIQMGLMVLQALAMD
RHIGSHFSIPSSSFLVFTLLATAIALSVFDRFLFPVWKKLTHRSMTPLVRIGIGHILNIIGMA
CSALVESRRLHVVRTHNLTHQPSSVTPMSALCTATAMISLVIAVAFYLSTALIDLFQRITG
WLPDNINEGRIDNVFWMLVIIGVINFGYYSTCAMLYKYNNIVEDSEQKSETAVTDA

Aquilegia coerulata Aquca_18 Aquca_004_00285

MGTQAIAPEEDIYTKDGTTDYQNNPANKSKTGTWKACPFILGNECCERLAYYGM
GTNLVNYLKVQLNQHNVTAINNVTNWSGTCYITPLLGAFLADAYLGRYWTIAIFSIIYIM

GMTLLTLSASVPGLRPSCDANGVCHPKTIQSVVTFIALYTIALGTGGIKPCVSSFGADQFD
DTDEDEKKHKSSFFNWFYFMINIGALIAASVLVYIQTHVGWGWGFGIPAAAMAIAVVSF
FSGTRLYRNQKPGGSPLTRICQVIIASFRKIHVKVPADKSLLYETADEESVVQGSRKLDH
TKTLSFFDKAAVETDLDNSKGVVNPWMLSTVTQVEELKSILRLLPIWATGIIFATVYGQ
MNTLFVVQGGSMDAHMGPNFEIPSASLSIFDTISVIFWVPVYDRLIVPFARKFTGHKHGF
TQLQRMGIGLFISIFAMLVAGILEVVRLGIVRRNNYYDLKQVPVSIFWQIPQYFIIGLAEVF
TFIGQLEFFYEQAPNAMRSLCSALSLTTVALGNYLSSLLVTIVTDVTTRNGKLGWIPDNL
NRGHVHYFFFLLAALSVVNLIVYIFIARWYTYKKAVGTLR

Aquilegia coerulata Aquca_19 Aquca_004_00286

MGTQAVVSEEDIYSNDGTTDYKNNPANKNKTGTWKACPYILGNECCERLAYYG
MATNLVNYLKVQLNQHNVTAINNVSNWSGTCYITPLLGAFLADAYLGRYWTIAIFSIIY
AMGMTLLTLSASVPGIRPSCDAEGVCHPKTIQSVVAFIALYTIALGTGGIKPCVSAFGAD
QFDDTDEDEKKHKSSFFNWFYFTINIGALVASSVLVYIQTHVGWAWGFGIPAAAMAIAV
VSFFSGTQLYRNQKPGGSPITRICQVIIVSFRKFHVKVPTDKSLLYETADEESVVQGSRKL
DHTETLSFFDKAAVEMDFDNRKGMVNPWTLCTVTQVEELKSVIRLLPVWATGIIFATVY
GQMGTLFVVQGGSMDPHMGPKFEIPSASLSIFDTLSVLFWVPVYDRLIVPFARKFTGHK
NGFTQLQRIGIGLFISIFAMIVAGILEVVRLDIVRRHNYYDLKQIPMSIFWQVPQYFIIGCA
EVFANIGQLEFFYEQAPDAMRSLCSALSLITAALGSYLSTLLVTVVTDVTTRGGKPGWIP
DNLNRGHVHYFFFLLAVLSMMNLIVFVFIARWYTYKKAVGNLR

Aquilegia coerulata Aquca_20 Aquca_005_00171

MDSKDYTKDGSVDLRGRPVLASTTGKWKACSFLVGYEAFERMAFYGVASNLV
VYLTTQLHEDTVSSVRNVNNWSGSVWMTPILGAYIADTYMGRFWTFTISSLIYVMGMV
LLTLAVSLKSFKPTCSNGICNKATTSQIAFFYSSLYIIAIGAGGTKPNISTFGADQFDDFNP
QEKELKVSFFNWWMFSSFLGALIATLGLVYIQENVGWGLGYGIPTLGLLLSLVIFYYGSP
SYRHKPRKSKSPAKNIVRVPIVAFSNRNLELPSSPLELHEVEPQHYMITGKRRILHTPAFR
FLDKAAIKDANMEGTSSLHPCTVTQVEETKLVLGMFLIWLVSLIPSTIWAQVNTLFVKQ
GTTLDRLVGHNFQIPAASLGSFITLSMLISVPMYDRYFVPMMRRKTGNPRGITLLQRLGI
GCALQIISIVFAYAVEMRRMYVIREHGTVGAKDTVPMTIFWLMPQYVVMGIADVFNAIG
FLEFFYDQSPGDMQSLGTTFFTSGIGVGNFLNSFLVTMVDKITGRGGRKSWIGNNLNDS
HLDYYYGFLLGIAALNLGVFLWVSSKYTYKKETILDEGKGSCIQMEGKAIDNTPLALQV

Aquilegia coerulata Aquca_21 Aquca_008_00009

MDSSIISPPINVQQKDSFKGGWASSVYLIGAEILEQFAMLGATGNLITYLTDILHEP
TATAAKNVNIFNGAVTLSPILGAFVADAYFGRFKTALLSSLIYVMGLVMLILSAWMVPL
EFRPVPFFLSLYMIAIGNGGHKPCLQTFGADQFSENNLEEIKAKSAFFNWWYFGICFGAS
AGMLIIFYVQDYIGWVAGFVISAVAMAVGLVIFLLGKRSYRQHIPSGSPLTRIMQVFAGA
ICKHHLCVSKDNCTEWYEEGSDEGFGAQPSVQTLPRTSSFKFLDKAAILDDKDAMGVTE
NYWRLCTVTQVEEVKLLLHLVPIWLSCLMYAIVFAQGGTFFTKQGSTMDTSIGKSFYVS
PASLPVVIALTVLLFVPIYDKLLIPFARRFTGFQSGITMLQRIGFVMFLATIGMIISALVEST

RIGIAIQHGLQDQPNTTVPMSVWWLLPQYVISGVSNVFAVIGLQEFFYDQMPNEIRNVGS
AAQFSVFGVGSLLSGVIISVVQYVSSKMGNEWLVDNLNRSHLDYYYWLLAG

Aquilegia coerulata Aquca_22 Aquca_008_00178

MDIETNTRQNFKGESMSLVEDDSVDWKGKSCKLNKHGGMRAATFVLGLLAFEI
MAIAAVGNNLITYVFNDMHFSLSQSANIVTNFIGTVFLLSLVGGFLSDSYLGSFWTMLIF
GFIELSGFILLSVQAHLPQLRPPQCNMLSAGEHCLEAKGLKALIFFAALYLVALGSGCVK
PNIISHGADQFSKQDPRQSKKLSTYFNAAYFAFSVGELVALTVLVWVQTRSGMDVGFG
VSAAAMAMGLISLISGTLVYRNKPPRGSIFTPIAQVFVAAFAKRKQVRPSNPEMLHGTQ
AHTSHMITTSSNGSLLHTERFRFLDKACIKVMQDGTNNKENPWRLCTVSQVEQVKIIISV
VPIFACTIIFNTILAQLQTFSVQQGSLMNAQLTKKFQIPSASLQSIPYIMLIFLVPLYETVFV
PLARRITGKDSGISPLQRVGVGLFVATFSMVSAALVENKRRNSALESNEILSIFWIAPQFLI
FGLSEMFTAVGLIEFFYKQSLSGMQSFLTAMTYCSYSFGFYLSSLLVSLVNKITSNSSNN
GGGWLSDNDLNKDRLDLFYWVLAALSLINFLNYLFWSKWYTYNPSLLPTSYGEDRDH
QSFSSSKHIGAENVMP

Aquilegia coerulata Aquca_23 Aquca_009_00610

MANLGTSVNLMTYFYFHMHYDIPESADMVTHFMATSFLLSLVGALFTDAYRSK
GFMILALQAQIKSLHLPQCDMFESTIECEHVSGRKSIILFTGLYLVALGSGGLKAALPTLG
ADQFDENDLKEQRLVSSFFNFFLFSLCVGACIGDVFIVWLQNNEGWDVAFSISSSAILLG
LFILSLGYSKFRNRLPTGSPVTKILNVLVATFRNRNVDLPSNSEDLYEEKPVCHNNKSMF
DDHERLQHTTQFRFLDRAAIMPTVTTGRKLCTITQVEEVKILIRMLPIFASTILMNTCLAQ
LQTFSIQQGVTMDKKLGSLEISSASVPIIPMAFIVILTPLYDRVFVPFARRFTGLETGITHLQ
RVGIGLVLSIFSMTAAAIVEIKRKGIAGEYNLVHANPNISPLPMSVFFLGFQYFIFGIADLF
TFVGLLEFFYSQAPKGFRSLGIALVWCSMSMGYFLSSVLVNLINAATKNSTKSGGWLNG
NNINLNHLDLFYWALAVLSFLNFINYLYWAQSYKYKRVAIVIEH

Aquilegia coerulata Aquca_24 Aquca_009_00739

LIFFFLFHHHCLLFIKSYQSSTQKNPIKRLCCDKIMADIGVDTYTKDGTTNRKGKP
ADKKETGNWKACYFILGNELCERLAYYGMSTNLVNYLQLHYNMGNADAAKAVSVWS
GTCYITPLVGAFLADAYFGRYWVIFVFSILYALGMALLTLTAWIPGIKPSSCNANGICNP
KKFQTNLMFVALYLIAIGTGGIKPCVSSFGADQFDDSDEAEKKQKNSYFNWFYFSINVG
ALIASSVLVYIQMNVGWAIGFGIPAIAMGTAALAFVLGTWMYRFQKPGGSPLTRIAQVI
VASFRKCNVKVPADPNSLYETVEGEKTIEGSRKLKHTEGLRFFDKAAVTEQEEDIKGPV
KPWSLCSVTQVEEVKCIVRLLPIWVTGIVFSAVYGQMSTMFVLQGNTMDPHVVKGFKIP
SASLSIFDTISVLFWVLVYNWFIVPFARKFTKRETGFTQLQRMGIGLFISIFAMLAAGWVE
VRRLNLVRENNYYDLKFLPMTIFWQIPQYFLIGLAEVFTFVGQMQFFYDEAPDAMRSM
CSALSLTTVALGNYLSSLLVTIVTDVTTRNGKLGWIPDNLNRGHLDYFYWLLAILSFVNL
LAYLVIAKCYTYKKTKGSA

Aquilegia coerulata Aquca_25 Aquca_009_00847

MKQALNKTMTMSSQSVEVDEEKWVHDSSLDHHGRTPLRASTGVWKAALFIIAIE

FSERLTYFGIATNLINYLTKVIHQDLKTAAKSVNYWSGVTTMMPLLGGFLADAYFGRFF
MVLISSIIYLMGLSLLTMSELVPSLKPCEIVTCEKPKKLHAVFFFLGIYMISIATGGHKPSL
ESFGADQFDEDHSKERKQKMSYFNWWSTGLCCGLLLGVTVIVYIQDEVSWAAADIALT
VIMAISIIIFLSGKRFYRYRLPEGSPLTPMLHVLVAAITKRKLPHPSDPALLYEVPKSQKVH
MRLLCHTNKLSFLDKAAIIEDREKGSTDEQQSPWRLATVTRVEELKLVLNTFPIWFTTLA
FGLCVAQASTFFLKQGSTMNRKIWNGFEIPPASIYSLAAIGLIITVCIYDRILVPILRKRTG
NERGINILQRIGIGMVFSVLSMATAALVEKKRLGVVNKEILQGGHTGTVSMSVFWLVPQ
FMIIGIGDGFTLIGLQEYFYDQVPDNMRSLGIALYLSVIGVSNFVSSLLITIVDHLSSKGGN
KSWFGKDLNHSRLDKFYWLLAAINVVNLCAYIFIAKRYSYKSVQKRAVVAVSSDDDAV
AVMA

Aquilegia coerulata Aquca_26 Aquca_010_00307

MGICRDDNTQQIQPRKRGGNRAVLFVYAMQGLENMAFVSNAMSLVVYFYGYM
NFSLTKSATTLTNWMGTSFLLALLGGFLSDTYLSRFKTTVLFGCIEVVGYALLTVQAHFT
LLRPFPCKNVPPGNQCEAADNGQLALLFSGLYLVALGTGGVKGGLPSLGADQFDDKDP
KEKAQLSSYFNWLLFSLTIGAVFGVIFLVWISTNQGWDLAFGICAVAVFFAVLFLCMGK
SFYRNNNPSGSPITRILQVFVAAIRNRNLPIPVSTDELHELYDKESGMGTEILQRSDQFRFF
DRAAIVMNAQGTSSPNRTGSWHLCSVTQVEETKILIRMLPIIVSTIFMNTCLAQLQTFSVQ
QSLTMDTNLFGFRVPGASLPVIPLIIMAFLVPIYERFFVPIARKFTGIPTGIRHLQRIGVGLV
LSAISMAISGYMETRRKSVAIEHNMVDSMQPLPMSVFWLGFQYAVFGAADLFTLVGILE
FFYAESSEGMKALSTAISWSSLAFGYFLSSVVVEVVNNVSGGWLASNNLNRDKLNYFY
YLLAGLSVINFGFYLLCASWYRYKKVEDVKQDSNGDKGEVGMAKITG

Aquilegia coerulata Aquca_27 Aquca_012_00156

MMKSSSRQGGDKATIFILVMMGLENIGFITLMFTAVLYFYSVMHFDLSASSTTTT
NFAGTTLLLSLLGGFISDAYMTRLNTCLVFGVLELLGYTLMIIQSHYKKLQPDPCNDSKC
VKGGQALMLYTSIGLFALGAGAIRGCVPALGADQYDRKNPKEQKQLSRFFNWYMLCT
TLGATIGITIVVWVNTHKGWDKGFLISVICAFVGLLIIASGKPLYRVRVPGDSALSRILQV
LVVSIKNMKEQLPEDSNALYENHDQESVLNEEHILHTDQFRLLDKAAIIPAGYKLPAKW
RVCTVTQVEEVKILTRMMPIILSTILMNTCLAQLQTLSVQQGTLMDNHIGSFKFPAASIPV
IPLIFMNILLPIYEFIFVPAARKLTGHPNGITQLQRVGIGLVLSAISMSIGGIIEVKRKHEINH
HGKRLGLFWLSFQYGIFGIADMFTLTGLMDFFYSEAPAGMRSISTSFAYLSWSLGYFLST
ALVDATNSVTSKIGNSKMGWLEGRDMNKNHVERFYWFLAILSVLNFMNYLYWASWY
SYKKDAPINMNEENSLKAKSDHTEETGSDKTATPN

Aquilegia coerulata Aquca_28 Aquca_012_00158

MMQGEGEAASVTNGVLQQTRNPKQGGHRATIFIFLMLGLENIGFVANMVSLVL
YFLYVMRFDPSGSATTTTNYLGSVFMLTLVGGFISDTYMNRLNTCLISGALELLGYLLMI
IQAHYNKLQPKPCNKSSCVEGGEALMLYASMCLLAIGAGGVRGSVPALGADQFDQNNP
MERKYLARFFNWLLLSITIGASLGVTIVVWVSTNKGWDKGFLISMLCAFVGLIIIASGKSF
YRVRIPGDSSLSRIFQENTNELYETRDQECGLGEVQILHTDQFRLLDKAAILAIGEKPRKW
GVCTVTQVEEVKILTRMMPILISTIIMNAAFAQLQTFSVQQGAIMNTKIGTFEVPPASIPVI

PLVCMSILIPIYEFFFVPVIRKVTGHPNGITHLQRVGVGLVLSVISMGIAAIVEVKRKHEIL
HNGNRISLFWLGIQFFIFGIADMFTLVGLMEFFYSEAPTGMRSLSTSFSWLSLSFGYFLSSI
FVELTNLVTSKITKSKRGWLEGRDMNNNHLELFFWFLAILSALNFANYLYWAS

Aquilegia coerulata Aquca_29 Aquca_012_00159

MACQCQAGSEKGYIRLLLRAPRKPSSFLFSDHGENDAPAGGTVAAFQPVKNSKK
GGSRASLFIYLAMGFGNIGFVANMTSMVLYFYFVMHFDLPGSATTTTNYLGSVFMLTL
VGGFISDTYMNRLNTFLSFAVLELLGYVLMIIQSHYKKLQPEPCINDSRCVKGGEALML
YASLCLLAIGAGGLRGSAPALGADQFDRKNPMERKYLARFFNWLLLSTTIGASIGVTIVV
WVSMNKGWDKGFIISMFCAFAGFIVITSGKPFYRIRVPGESSLSRIFQVLVVMVKNRKEQ
LREGTNELYEIQDKEAGLSEVQIPRTDQFRLLDKAAILRIGVKPKKWGVCTVTQVEEVKI
LTRMTPIIISTIIMNTCLAQLQTVSVQQGTFMNTYIRSFEVPSASIPVIPLVFMSILIPIYEFAF
VPLIRKVTGHPNGITHLQRVGVGLVLSVISMGIAGIVEVKRKHEILNNGHRISIFWLGIQY
AIFGIADMFTLVGLMDFFYSEAPAGMRSLATSFSLLSLSFGYFLSSIFVEVTNSVTSKITKS
KMGWLEGRDMNKNHVELFYWFLAALSVLNFVNYLYWAKWYIYKKDDP

Aquilegia coerulata Aquca_30 Aquca_012_00162

MEDSKVQQYWKPGQGGFRATIFVYVLIAFENMGFVANMSSLVLYFLFVMHFGV
SGSSNTLTNFLGSTFMLALIGGFISDTYLSRLHTCLIFGVVEVLALVIITIQAHYPSLHPDPL
CPSNCLKGSHAFMFYTSLALYALGAGGMRGALPALGGEQFDPKDPKEKKALTSYFNWL
LFSLTLGASFGVTVIVKLGMDHGWDVAFFICMLACVVGFIVLAIGKPFYRVKPPGDSPIL
RIIQVIVAAFRNRKLKLPEETEELYEINDKESSEDYEKLAITKQFRLLSKAAILSKDSAPGP
WEVCTVTQVEEVKILIRMLPIIGSTIIMNTCLAQLQTFSVQQGQAMNRFLGTFEVPAPSVP
VILLLFMAILIPVYEFVFIPVARKFTHHPAGITQLQRVGVGLVLSAVSMSIAALVEVKRRN
QDIKYHSTNSISLFWLSFQFAIFGIADMFTLVGLMEFFYKEAPSGMKSLSTSFTFLSLSIGY
FLSSVLVSIINSVTAKYIKLRMGWLEAQNLNENHLDLFYWFLAILSCINFANYLYWASW
YKYKAENSDSELSDKMALVGSSFHKEESNE

Aquilegia coerulata Aquca_31 Aquca_013_00656

MEAVHQESNLQAGSSSIEPINMTVQDANERQNDEHTRDGSTDCLGRPADKGKTG
GWKSGLLLLVNQGLGALAFVAVEVNLVLFSTRVLKQTNAEAANTFSQWMGTVSFFSLI
GAFLSDSYLGRYMTCVIFQVIFLLGLIMLSTVSYFSLLTPHGCGKVGFLCDSQSKLDMAV
FYMSIYLIALGNGGYEPSLATLGADQFDEEDENEKRSKVSFFSYFYIALNLGSMLSETVL
AYMQNLGKWVLGFWISTACGFIGLAVFLSGSLRYRHFKPCGNPISRFSQVIVASFKKMK
LEIPPNGEGLHESHANAGATSGARKIHHTNDFRFLDRAAVISPEDMVIMTTRSDGFDPWS
VCTVTQVEEVKCVLRLIPIWLCTIFYFLGFIQMLSLFVEQGAAMYTKINSFHIPPASMTVF
DIVSISAFIVIYDNLIRPYYTKVTKHTPRGPSELQRMGIGFAFSIGAMIAAGLVEQQRLKY
AKEGAEELSSLHLFWQIPQYIILGISEAFMYVAQLEFFAAQIPDALKSLGVGLSMSSTAIG
SYLTSILLSAVMVITTRNGSPGWIPPNLNDGHMDRFFFLSAGITTINLLMFVYCAKRYKSI
SLEKRDGTEEAQPPPPQTLP

Aquilegia coerulata Aquca_32 Aquca_013_00823

MALPQTKGTADNILSDAWDYKGHPAEKSKTGGWTSAARILGVELNERLTTLGIA
VNLVTYLTGTMHLGSAVSANAVTNFLGTSFMLCLLGGFVADTFLGRYLTISLFATVQAI
GVTILTISTAVPALQPPKCTPNTPCDEANSLQLTVLYIALYLTALGTGGLKSSVSGLGSDQ
FDESDQHEKKQMTNFFNWFFFISLGSLAAVTVLVYIQDNLGRKWGYGICAFAIFLGLIIF
LSGTRKYRFKKLVGSPLTQIAMVFLAAWRKRHMDLPSDSSILYNNVDEDSIKGQKGKK
QKLPHSKQFRFLDKAAIKYADMESDSPVVLDRTWLSTLTDVEEVKMVIRMLPIWATTIM
FWTVYAQMTTFSVSQATTMNRDIGSFQIPAGSLTVFFVASILLTVPVYDRVIVPICRRGL
GNPQGLTPLQRIGVGLVLSILAMVAAAIIELKRLHAAESNGLTNDPTAVIPLSVFWLIPQF
FLVGAGEAFAYIGQLDFFLRECPKGMKTMSTGLFLSTLSLGFFFSSILVSIVHAITGNKKP
WLSDNINQGKLHYFYWLLAALSVINFGLYLICARWYVYKETRFAEEGIELEEAEPCSHA

Aquilegia coerulata Aquca_33 Aquca_014_00065

MFSNRGDGAVVSGESVAPLLGDTEFNEEVEFVEGVVNYKGYPVIRSKYGGWRS
ASFIIGVEVAERFAYYGISSNLITYLTGPLHQSTAKAAENVNVWSGVASMLPLIGAFVAD
SYLGRYRTILFSSLLYVLALGLLTLSAVLPFPSSPDCPDNENNSSCSSPSILQVIFFFFSLYL
VAVAQSGHKPCVQAFGADQFDERDPVESKSKSSFFNWWYFGLCAGTAVTLFVLNYIQD
NLNWGLGFGIPCLSMAVALVVFLLGTSTYRYNFREDEKSPFVRIAQVFVAAAKNRRTTT
SSLLALEETKTTSDHQFKFLDKALTSESVNSVDLGKDWEVCSVSQVEDAKMVLRLVPIW
ATCLLYAIVFAQSSTFFTKQGSTMDRSMGSSFKIPAATLQTFISLSIVLFMPIYDRIFVPVA
RSITGKPSGITMLQRIGCGMFLSVISMVVAALTETQRLKIAQDSGLVDIPTATVPMSVWL
LAPQYILFGISDVFTMVGLQEFFYDQVPSGLKSLGLALYLSIFGIGNFLSSFLISVIEMATS
GAGQDSWFSNNLNRAHLDYFYWLLAGLSAFELAAYLYFAKSYRYRGSTI

Aquilegia coerulata Aquca_34 Aquca_016_00272

MEAIALELNNLTPKVDCVSKESIEDEGKLNSLTLSTTKKYSGGWKSASLLLVNQG
LATLAFFGVGVNLVLFLTRVLQYDNAEAANNVSKWTGTVYLFSLVGAFLSDSYWGRY
LTCIIFQIIFLVGLVLLSLSSWLFLIKPNGCGDATTKCMPTSDLGVGIFYISIYLIALGYGGY
QPTIATFGADQFNEADPMQRHSKAVFFCYFYFALNVGSLFSNTILVFFEDRGQWIIGFWA
SAVSAALGIVLFCVGTYGYRYLKPCGNPLTRVAQVFVATFKKWNVTVPDDTSKLFEVE
GSESAIKGSRKILHSEEIRFLDKAATVTEKDFHGPRNHNPWRLCTVTQVQEVKCIMKML
PIWLCTIIYSVVFTQMASLFVEQGDVMNCQFGKFRLPAASMSAFDIISVLLFTFIYRQLLIP
VTGKLTGNPKGLTELQRMGIGLVIGMLAMVAAGITEIERRKYAIPGHETSTLSVFWQIPQ
YTLVGASEVFMYVGQLDFFNTQAPDGLKSFGSSLCMASISLGNYASSMLVNMVMSITT
KGNRPGWIPINLNSGHMESFYFLISGLAAIDFVIYLFCAKWYKCISLENEEGDKVEDNLD
DILRRV

Aquilegia coerulata Aquca_35 Aquca_017_00783

MEEARSEFTQDGTVDLKGNPVLRSKRGGWKACSFVVVYEVFERMAYYGISSNL
VIYLTNKLHQGTVTSSNNVTNWVGTIWMTPVLGAYVADAHLGRYWTFVIASFIYLSGM
CLLTVTVSIPALRAPPCHQADVADCKQASTLQLAVFYTGLYILAIGTGGTKPNISTIGADQ
FDDFEPKEKKQKLSFFNWWMFSIFFGTLFANTFLVYIQDNVGWSVGYGLPTAGLAVSII

FLAGTPFYRHRVPAGSAFIKMSRVIVAALRKWNVPEPSDPKELYELDLVEYAKNGKYRI
DSTPSLRILNKAAVKTNSKDPWMLCSVTEVEETKQMLRMIPILIATFVPSVMIAQINTLFI
KQGTTLNRNINSFKIPPASLVGFVTLSMLISVVLYDRFFVKITRKWTKNPRGVTLLQRMG
IGMVVHIIIMVTASLTEMKRLSVAKDHGLVENGGQLPLSIFIILPQFVLMGIADAFLEVAK
IEFFYDQAPESMKSLGTSYSMTTLGIGNFLSSLLLSTVSHITKRHHHKGWIQNNLNASHL
DYYYAFFAVLNILNFIFFLVVSRFYIYRAEVSDSIEVLKENQELLKLKDKKEMLMVN

Aquilegia coerulata Aquca_36 Aquca_020_00135

VKSSFTTFWEFKRYKWLVLSFSNLFGSLYMSRCSSLTLCYPFFLSQEEKLGWAVA
DAVDYRGLPADRSKTGGWVRAAQILGIEICERLSTMGIAVNLVTYLTGTMHLPSATSAN
IVTDFMGTSFLLCLLGGFLADSFLGRYKTIAIFTVVQILGTGLLAISTKLPQLHPTPCENTA
SETCKQANGIQMGILYMSLYLIALGTGGLKSSVSGFGTDQFDDKDEKEKTQMAFFFNRF
LFFISMGTLTAVTVLVYIQDEVGRSWAYGICSVSMFIAVIIFLSGTKRYRYKKGSGSPIVQ
IFQVLAASIEKRKLNMPSNIGLLYEDFPQATRIHHTEQFCCLDKAAIIVEGDFEKNGSSSP
NPWKLCSVTKIEEVKMMIRLLPIWATTIIFWTTYAQMITFSVEQATTMNRKIGNFQIPAG
SLTVFFVGAILLTLAVYDRLIMPFWKRWRGKPGFTNMQRMSIGLVMSAIGMAAAALAE
RRRLSVAKTVDANTSTLPISVFLLIPQFFLVGSGEAFIYTGQLDFFITQSPKGMKTMSTGL
FLTTLSLGFFVSSFLVSVVKKVTGNNGGQD

Aquilegia coerulata Aquca_37 Aquca_020_00136

MEEKLGWSVSDAVDYKGFPADRSKTGGWVRAAQILAIEICERLSTMGIAVNLVV
YLTGTMHLPSATSANIVTDFMGTSFLLCLLGGFIADSFLGRYKTIAIFALVQAVGIGILAV
SSKLPQMHPPPCKIGTSEICRKANGFQMGILYLSLYLIAVGTGGLKSSVSGFGTDQFDVK
DEKEKTQMTYFFNRFMVCISGGALFAVTVLVYIQDEVGRSWGYGICSGVTFLAVFVFLS
GTKKYRYKKGSGSPLVQIFQVVVASVKKRKLNMPANISSLYEDFPEGSRIHHSDQFHCL
DKAAIIAEGEFENNGSSSPNPWKLCSVTRIEEVKMMIRLLPIWATTIIFWTAYAQMITFSV
EQANTMERSIGKFLIPAGSLTGFFIGSILVVLAIYDRLIMPLWKRWKGKPGFTSLQRIAVG
LFLTTMGLGAAALCEEKRLSVAKNFDITTKTLPITVFLLIPQFFLVGAGEAFIYIGQLDFFI
TQSPKGMKTMSTGLFLTTIALGFFVSSFLVSIVKKVTGTQGWLANNINQGRLDFFYWLL
TALSLINFGAYLLCAMWFKPNNTESDLEMDTAVNGSSVEDKC

Aquilegia coerulata Aquca_38 Aquca_020_00233

MDGFPEKRKMKNQKGGLIAKPIIRKGGLKTMPFIIANETFEKVATYGLLANMIIY
LITGYNMDSATGANVLFIWSAVSNFTPILGAFLSDSYLGRFRVIALGSVASFLGGTLLWL
TTMLPEAKPTQRGEQATAVQLSMLFGAFALMSIGAGGIRPCSLAFGADQLDKEDNSPEN
ARVLQTFFNLYYASVGVSIMISVTAFVYIQDKLGFKVGFGIPAALMFLAAVFFLFGSPLY
VKVKANKSLFTGFIQTAVVAFKNKHLAFPPNNTDGWYHHRKGSKFVSPTDKLRWLNK
ACIIRNPDKYLNRDGFASEPWKLCRVEQVEELKALVKVMPLWSTGIMIAVTISQHSFPVL
QARTMDRKVTPSFEIPAASYGAFAILTLTIWVGIYDRILVPLLARLTGNPRGIGLKLRMGI
GLFLSCLAMAVSAIVESKRRETAIAQGLLEKGNALVNISAMWLVPQHCLTGLSEAFNAI
GQIEFYYSQFPKSMSSIGVALFALGMGFGNLLGSLIVEVVDKVSSRGGRDSWVASNLNK

GRYDYYYWLLTLLSVANLLYFIVCSYAYGNCEEQRSKVWDETEEVNEVDISKSKELPLI
VSV

Aquilegia coerulata Aquca_39 Aquca_020_00234

METIEDKDSMEVSSDQKDTTKLPSGPKGGLLTMPFIIANESFEKVASYGILPNMIF
YLAKGYRMSLADGTSVLQLWSAMTNFTPLLGAFLSDSYFGRFQVIVMGSLSSLLGVILL
WLTAMIPQAKPPRGESPDSGQLALLFGAFALISLGAGGIRPCSIAFGADQLTSNKNNPKN
ERILHSYFNFYYATIGLSTVTALTVIVYIQDHFGWKLGFGIPAILMVLSVLTFVLGYPLYI
KAKADKSLFTGLAQVIVVTFKNRSLAYPVDGRYHTSKDSKFAAPSKHLRFLNKACIIRD
PVSDINLDGSTSKPWDLCTIDQVEALKILVRVLPIWSTGIIIYMSLTQSTLTVLQARSMDR
HLTSNFQIPAGTFGIFTVITLTIWVAIYDRAIVPLLARFTGQPQGFSQLMRIGIGLVLSIMS
MIVAASVEIVRRRTAINEGLANNPRGVVGMSAFWLVPQFCIGGIAEGLNGVGQVEFFYS
QMPKKMTSLAMALFSLNNAFAGLLGSFLIKTVDKITKDGKKPSWVANNPNQGHYDYY
YWFLAILCTANFLYFLVCCWIFGPSEEVKTKVSDDHYEVEDDSSMQN

Aquilegia coerulata Aquca_40 Aquca_020_00238

MEKVVDEEKMEVFSIENDTTNVASKPKGGLVTMPFIIANESLEKVASVGLHPNMI
FYLMKGYHMSNASGTSILHLWQALSNFLPIVGAFLSDSYFGRFQVVALGSISSFLGVILL
WLTTMIPQAKPPTGEQPNSGQLALLFSSFLLMSIGAGGVRPCSIAFGADQFITKEENPNNE
RILQTYFNWYYASVGLSFVIAVTILVYIQDHFGWKLGFGIPVILMSLSILTFFLGSHLYVK
VNANNSLFNGLAQVMVVAFKNRSLPYPANCKYHCSKGSDIVLPSQNLRFLNKACIIKDP
ENDINPDGSTSKPWNLCTVEQVEALKSLIRILPIWSTGIISYLIITQFSFGSLQAKSMDRHLT
SNFQIPPASYGVFGIITLTLWASTYDRLVVPLLAKLTGHPRGITNQARMGIGLLLTVVAM
VIAALVENIRRSKAIAEGLADINGGIVGMSAFWLVPQYCVVGLADALQGVGQIEFFYSQ
LPKNMASLAMALCALNNAFAGLLGSFLVKTVDRITKHGGKQSWVASNPNKGHFDFFY
WLLAILCAANFLYYLLCCWAYGFSEDVKPSTSDDQEQIIIS

Aquilegia coerulata Aquca_41 Aquca_026_00275

MEEKQVEKVVEKKKGGARTLPFIFSNEICERLAVVGFAVNMMSYLTLELHLPLT
KSANILTNFAGTSILTTFAGAFIADAYAGRYWTIIWASFIYLLAMTSLTLSASLPGLRPPSC
KGNEVCKEANEAQLSLLYVSLLLSGIAGGGLRCCVVPFGADQFDESDPKNKAKSWNFF
NWYYIVMGLSILISVTVIVYIQENVGWGWGLGIPTVIWFFSIVLFIAGSKRYRILSPTGSPF
TRLFQVMVAAVKKRRLPKVSDPTLLYQDDELDASIIANGKLLHTKQLKVLDKAAMMIE
EDKLPSGQLNLWRVSTVHRVEELKSILRMGPIWASGLLLTAASANQGTFTIQQARSMDP
HLSSSFQIPPASMSVFTIVTMIITVVFYDRVFIPVARHFTGVDRGISYLHRMTIGFVISTIST
LVSGFVEVKRKNVAAAYGLIDSPNATIPISIFWLVPQYALYGIAEGFMSVGHLEYFFDQS
PESMRSSATAFYWTAIAAGNYLSSFMVTIIHKYTAGSDDSNWLPDYNINKGKLENFFW
MITGLQVINLIYYMMCVKYYTFKAVQIQYKKGEPEGGKELVDSV

Aquilegia coerulata Aquca_42 Aquca_027_00126

MPVSSDYKHDEEAPTTHVGSKQGGWITFPFITGLTIAASGWMTNLIVYLIEQFNV
KNIRATQISNIVNGSTNFFPIAGAIIADSYLGNFFVISVSSIISLLGLILFTLSATLDSLRPKAC

KQGLETCEAPSHFQLAILYSAITLASIGMGGTRFTIATLGANQFDKPKDQGAFFNWFFVA
LYMASITGITVIVYIEDNVSWGLGFGLCLVLNAIGLAVFVFGKQYYRHIKPDGSPFTSLA
RVIVATIRKMNIMVSSDNKDYYYGHTGETKLPVDQGPTSSFRFLNRAAMKTEGDTEQE
RELTESWNLCTVQQVEDLKTLLRIFPLWSTSIFLSTPIGIQSSLMVLQALSMDRHLGPHVK
IPAGSFLVATLLATAFSLSVIDQFFFPAWKKLTRQSMTPLQRIGVGHVLNIVGMAGSALV
ESRRLDVAKSHNLTHQLGSIVPMSAFWLVTPLVIVGIGEAFHFPGQVALYYKEFPTSLRS
TATAMISLLVAAGFYLSTALIDLIQKVTGWLPDNINEGRIDNVFWVLVVTGVINLGYYIT
CAMLYRYKNVENAEEKSETANDG

Aquilegia coerulata Aquca_43 Aquca_027_00398

MDSEEERLLVEDDLLQGASSIQGIDENRVLKNNNGGWRACPFILGTECCERLAY
YGIAKNLVTYLTQKLHEGNVSAARHVSTWQGTCYVAPLIGAVLADAYWGRYKTIAIFS
TIYFIGMGTLTLSASVPSFRPPACEGSICKQPNLAQRAILFTGLYVIALGTGGIKPCVSSFG
ADQFDDSNPVERMKRGSFFNWFYFSINIGALVSSILLVWIQDNLGWSLGFGIPTVFMGLA
IGSFFMGTPLYRFQKPGGSPLTRMCQVVVASFRKLNVEIPQDCSLLYELPDKSSAIKGSR
KLEHTDECKFLDKASVVSDLDFRSGNFHDPWRLCTVTQVEELKTLVRMFPIWATSIVFS
AVYSQMSTMFVEQGMMMDTNIGSFKIPPASLSSFDVISVIMWVPIYDRILVPMVRKFTG
KERGFSVLQRMGIGLFISILSMVAAASVEIKRLEVARALDLVDQKVAIPVSIFWQIPQFFL
VGAAEVFIFIGQLELFYDQSPDAIRTLCSALALLTTAFGNYLNSFILTIVTAVTTKGGKPG
WIPNNLNEGHLDYYFWLLACLSFLNMLLYVFFSTRYTYKRTS

Aquilegia coerulata Aquca_44 Aquca_032_00062

MVLAGSHSDGGENETVVDFKGKPFDKSRTGGWLAAGLILGTELAERICVNGISM
NLVTYLVGDLHISAAKSANIVTNFMGTLNLLALLGGFLADAKLGRYLTVAIFSVITAMG
VTLLTVATTIPSMKPPACSDYRRLHHGATTIPSIEANGGQLAMLYVALYTIALGGGGIKA
NVSGFGSDQFDVKDPKEEKAMIFFFNRFYFCISLGSLFAVTILVYIQDNVGRDYGYGISA
GAMAIAVIILLVGTPFYRYKKPKGSPLTIIWRVGYLAWMKRKLPYPSDSSMLNEYHNTK
APHTQRLRCLDKAAVIDDSEAKEIRTKSPWVVSTVTEIEEVKMVLKLIPIWSTCILFWTV
YSQMTTFSVEQATIMNRNIGSFVIPAGSLSFFLIVTILIFTSLNEKLFVPFARKITHNAKGLT
SLQRVAIGLIFSMAAMVAAAIVEKQRRVMEVHQHIKISVFWLVPQFFLVGAGEAFAYVG
QLEFFIREAPDKMKSMSTGLFLSTLSMGFFVSSLLVSLVDKVTKKGWIRNNLNKGRLEN
FYWLLAVLGVLNFLVFLAFAMKHQYKMEHYMSSNEENELKDWNGGSIEDIEKIQKVEE
MI

Aquilegia coerulata Aquca_45 Aquca_034_00294

MKEVEEKTIGLGVGIDDFTQDGTVDLKGQPILRSKGGRWKACSFIVGYEVFERM
AYYGIASNLVVYLTSRLHEGTVTSSNNVTNWVGTVWITPILGAYIADAHLGRYWTFVIS
AAIYLMGMCLLTMVVSIPALRPPSCAPGVEDFNCEKASTFQVGIFYCALYIIAVGTGGTK
PNISTMGADQFDEYEPKEKIQKLSFFNWWMFSIFFGTLFANTFLIYIQDKVGWTVGYVLP
TLGLGISILVFLVGTPFYRHKPPSGSPFTRMAKVLVAALKKWNVTVPNNPKDLHELGME
VYAKTGKSRIDNTPALRILDKAAVKSGTNDPWTLCPVTQVEETKQMIKMIPILMATTIPS
TMLAQTHTLFIKQGATLNRHIGPHFEIPPACLTAFVTIFMLISLVIYDKYFVPSIRRYTKNP

RGITLLQRMGIGLVIHIIIMVVACLAEMRRLKVAQENGKLGKNDIVPLTIFILLPQYALMG
IADTFVEVAKIEFFYDQAPQGMKSLGTSYFTTSLGVGNFLSSFLLTTVSLITKRNGHKGW
IQNNLNISRLDYYYGFYVVLTLINFIFFLVVAKYYVYNVDVDSERKSEKSTEMFVHKDK
TVD

Aquilegia coerulata Aquca_46 Aquca_039_00003

DEKVELVEGRVDWKGRPARKDKHGGMHISILVLAPFAFENMATFALSVNLITYF
TGVMHYNIADAANVLTNYLGTSYILTIAIAFLADTYIGRFKATTVSAFLEFLGLALLTIQA
HYSTLRPPPCNIFDPTSVCEKVSGGNVAFMFIGLYLVAIGSGGIKAALPAHGADQFDEKD
PKEFKQMSSYFNWFLLSVCLGGAVSLTFIVWVQTNKGWDQGFGISTIAMFLGLIVFVGG
LPRYRIHVIKGPNPLTQIFQVVYVASIRNRKLTLPENPEELYEIGCDNEAGVEEEFLPHQKSL
RFLDKAAIQISPVSQPEDVNPWKLCRVTQVENSKIILGLIPIFCCTIIMSTCLAQLQTFSIQQ
GVTMDTKISGSFHIPPASLPILPVGFMIILIPVYDRLLVPFLRKFTGIPTGITHLQRIGIGLVL
SSVSMGAAAIMEVKRKNVAESNNMLDAIPGLQPLPISVFWLSIQYFIFGIADMFTYVGLL
EFFYSEAPKGLKSLATCFLWTSMSLGYFFSTILVEWVNSATKNITKSKGWLAGNNMNR
NHVNLFYWLLSILSLINFFIYLFCTTRYKYRPVQVRDMKNKQQSLNRTDQ

Aquilegia coerulata Aquca_47 Aquca_044_00110

MASFDVSKEVKLKELRDVEGDDEKECTLDGTVDGRGRPALRGSTGTWVAGYIIL
VNQGLATLAFFGVGVNLVLFLTRVLQQNNADAANNVSKWTGTVYIFSLVGAFLSDSY
WGRYKTCAIFQGIFVMGLVSLSLTSYMFLVKPNGCGDEEHPCKKHTSLEIGLFYVSTYM
VALGNGGYQPNIATFGADQFDEEHPKEGHSKVAFFSYFYLALNLGSLFSNTVLGYFEDH
GLWTLGFWVSTGSAFIALVLFLIGTPRYRHFKPSGNPISRVSQVVVAATKKWTLKVPAG
SDVLYEVEGKECAIQGGRKMLHTRGFKFLDRAAYVTSDDFGQENKNHPSPWRLCTVTQ
VEEVKCILRLLPIWLCTILYSVVFTQMASLFVEQGAAMNTTVGHFRVPPAGMSAFDILSV
AFFVFLSRRVLDPIVSRIRNVKTKGLTELQRMGIGLIIAIMAMVSAGIVECYRLRFIQEDG
TSSLSIFWQVPQYALIGASEVFMYVGQLEFFNDQAPDGLKSFGSALCMTSISLGNYVSSL
LVSIVMKISTKDNMPGWIPGNLNRGHLDRFFFMLAALTAIDFVVYLAVARWYKSIKFEG
KCRVDEDSDESSDHSSNINELESFRV

Aquilegia coerulata Aquca_48 Aquca_074_00085

MVAASFVLVVEVLENLAYLANASNLVLYLSKFMHFSPSRSANIVTNFMGTAFLL
ALLGGFLSDAFFTTYQIYLISALIEFMGLLILTVQAKMPSLKPPSCDPINSSIPCQEVSDGK
AVMLFGGLYLIALGVGGIKGSLPAHGAEQFDESTIGGRKQRSTFFNYFVFCLSCGALVA
VTLVVWVEDNKGWQWGFGISTATILLSIPIFFAGSATYTNKKPTGSPLTTIAKVRMLKAT
QQNPRLIPLTKSILTVSLSWSNDVRFNAQVVIAATFSTCINRTPSNAVMSMNTSPTNPVQ
TPKEEEQQKVKEELELQTLTKGLKFLNKAAKNKPIHQALECTVQEVEEVKVIFRIFPIFAC
TIMLNCCLAQLSTFSVEQAASMDTKIGSLKVPPASLPVFPVVFIMILAPLYDHLIIPFTRKI
TKTEMGISHLQRIGIGLVLSIVAMAVAALVEVKRKRVATDSGLLDSNEPLPITFFWVALQ
YLFLGSADLFTLAGLLEFFFTEAPSRMRSLAMALSWASLAMGYYLSSVLVSIVNSVTGT
SRHKPWLSGSNLNQYHLERFYWLMCVLSALNFLHYIFWARRYSYRSTTIG

Arabidopsis lyrata Araly_01 313816

MSCLEIYNKDTMKKKEEEEEETRDGTVDYYGRPSIRSNSGQWVAGIVILLNQGL
ATLAFFGVGVNLVLFLTRVLQQNNADAANNVSKWTGTVYIFSLVGAFLSDSYWGRYKT
CAIFQVIFVIGLSSLSLSSYMFLIRPRGCGDEVTPCGSHSMMEITMFYFSIYLIALGYGGYQ
PNIATLGADQFDEEHPKEGYSKIAFFSYFYLALNLGSLFSNTILGYFEDEGMWALGFWAS
TGSAIIGLILFLVGTPRYRYFMPTGNPLSRFCQVLVAATKKSSVEAPLRGREEMYDGDSQ
GKNASENTGRRIVHTDEFKFLDKAAYITARDLDDKKQDAVNPWRLCPVTQVEEVKCIL
RLMPIWLCTIIYSVVFTQMASLFVEQGAAMNTSVSDFKIPPASMSSFDILSVALFIFLYRR
VLEPVANRFKKNGSKGITELHRMGIGLVIAVIAMIAAGIVECYRLKYADKSCTHCDGSSS
LSIFWQAPQYSLIGASEVFMYVGQLEFFNAQTPDGLKSFGSALCMMSMSMGNFVSSLLV
TMVVKISTEDHMPGWIPRNLNKGHLDRFYFLLAALTSIDLVVYIACAKWYKPIKLEGKD
EMQDMSDDDDDTESEEEREKDSKV

Arabidopsis lyrata Araly_02 316181

LVESKRLETAKVIDQPGATVPMSIWWLIPQYLLLGLADVYTLVGMQEFFYSQVP
TELRSIGLALYLSALGLGSLLSSLLISLIDLATGGDAGNSWFNSNLNRAHLDYFYWLLAR
KMTTASDIYLQEEYVTDAVDHRGFAAKRSNTGRWRAALFIIGVEVAERFAYYGIGSNLI
SYLTGPLGQSTAVAAANVNAWSGIATLLPVLGAFVADAFLGRYRTIIIATLIYVLGLAFL
TLSAFLIPNTTEVTSTPSFLNALFFFSLYLVAIGQSGHKPCVQAFGADQFDEKNQQENTD
RSSFFNWWYLSMCAGIALAILVVVYIQENVSWAVGFGIPCVFMVISLVLFVLGRRSYRY
SKRRQEEEINPFTRIGRVFFVAFKNQRLSSSELYKVELEANPSQESPEELSFLNKALLVPN
DSPEGEMACKSRDVDDATTLVRLIPVWLTTLAYAIPYAQYMTFFTKQGVTMERTIFPGL
EIPPASLQALISITIVLFVPIYDRVLVPIGRSITKDPCGITTLKRIGTGMVLATLTMVVAALV
ESKRLQTAKEYGLIDQPKTTLPMSILWLFPQYILLGLADVHTLVGMQEFFYSQVPTELRSI
GLALYLSALGVGSLINSLLISLIDLATGGDAGNSWFNSNLNKAHLDYFYWLVAVVSAVG
FFTFLFISRSYIYRRVD

Arabidopsis lyrata Araly_03 316182

MAITRSSANELENTTEGFLEIRENTSGGWKSARLIIGVEMAERFAYFGIASNLIMY
LTGPLGESTAAAAANVNAWTGTVSFLPLLGGFVADSFLGRFRTIVISSSLYILGLGLLSFS
TMIPYHRKDSNQLQVALFFCSLYLVAIGQGGYKPCIKVFGADQFDGNDLKEAKDKSSFF
NWLMFGNCISILTTRLVSTYIQENLSWSLGFGIPSVSMLLALFLFLLGTNSYRFSTEREGK
RNPFARISRVYMEALKNQRQPDLDIANANETLLLLAHQSSKQFRFLDRAAISCELAEIEE
AKAVLRLIPIWITCVVYTIVHAQAPTFFTKQGATMDRSISPGLLVPAATLQSFINLSIVVFI
PVYDRLLVPFARSFTQKPSGITMLQRIGTGIFLSILAMVVAALIETKRLQTTRDDLTIPMS
VWWLVPQYVILGVSDVFTMVGLQEFFYDQVPSELRSIGMALNLSIYGAGNFLSSFMISVI
DKITSQYGQTSWFDNDLNQAHLDYFYWLLASLSFIGFASYLWFAKSYACNRPNTF

Arabidopsis lyrata Araly_04 323231

MASSVTGDAETVISADSSTKRSGGGWITFPFMIVTLLGLTIAAWGWLLNLIVYLIE
EFNVKSIAAAQIANIVSGCICMVPAMAAIASDSFFGTIPVISVSAFISLMGVALLTLTASLD
SLRPRACETASSLCQSPSKTQLGVLYTAITLASIGTGGTRFTLATAGANQYEKTKDQGSF

FNWFFFTTYLAGAISATAIVYTEDNISWTLGFGLSVAANLFSFLVFISGKRFYKHDKPLGS
PFTSLLCVIFAAVRKRKAVVSTNEKDYHNESITMPTKSFRFFNRAALKQEDEVKPDGSIR
NPWRLCSVQQVEDFKAVIRIIPLALATIFLSTPIAMQLSLTVLQGLVMDRRLGPSFKIPAG
SLQVITLLSTCLFIIVNDRFLYPFYQKLTGKFLTPLQRVGIGHAFNILSMAVTAIVEAKRLK
IVQKGHFLGSSSVADMSVLWLFPPLVIVGIGEAFHFPGNVALCYQEFPESMRSTATSITSV
VIGICFYTSTALIDLIQRTTAWLPDDINHGRVDNVYWVLVIGGVLNLGYFLACSLVYRYR
NLKDDDHEQSANVSH

Arabidopsis lyrata Araly_05 323400

MKSRVILNHRDRRDKNNNNNNNYTQIDTMERKPLEVEPSTTAVNTYSAVDGGG
SDGVTSKVDDEQRKIVYRGWKVMPFIIGNETFEKLGIIGTLSNLLVYLTSVFNLKSYTAA
TIINAFSGTINFGTFIAAFLCDTYFGRYKTLSVAVIACFLGSFVILLTAAVPSLHPVACGNK
SSCEGPSVGQILFLLMGLGFLVVGAGGIRPCNLAFGADQFNPKTESGKKGINSFFNWYFF
TFTFAQIISLTAVVYIQSNVSWTIGLIIPVSLMFLACVIFFAGDKLYVKVKASGSPLAGIAR
VIAAAIKKRGLKPVKQPWVNLYNHIPPNYANTTLKYTDQFRFLDKAAIMTPEEKLNSDG
AASDPWKLCTLQQVEEVKCIVRVIPIWFASTIYYLAITIQMTYPVFQAIQSDRRLGSGGFR
IPAATYVVFLMTGMTVFIIFYDRVLVPSLRRVTGIETGISLLQRIGAGFTFAILSLLVSGFIE
ERRRTFALTKPTLGMAPRTGEISSMSALWLIPQLTLAGIAEAFAAIGQMEFYYKQFPENM
KSFAGSIFYVGAGVSSYLASFLISTVHRSTAHSPTGNWLAENLNEAKLDYFYFMLTGLM
VVNMAYFLLMAKWYRYKGGNDEIITEIETNEEETKQQQLQDKNSV

Arabidopsis lyrata Araly_06 324861

MEEDKDIYTQDGTLDIHKKPANKNKTGTWKACRFILGTECCERLAYYGMSTNL
VNYLEKQMNMETVTASNSVTNWSGTCYATPLIGAFIADAYLGRYWTIASFVVIYISGMT
LLTISASVPGLTPTCSGNSCHATASQTAVTFIALYLIALGTGGIKPCVSSFGADQFDDTDE
KEKESKSSFFNWFYFVINVGAMIASSVLVWIQMNVGWGWGLGVPTVAMGVAVVFFFA
GSKFYRLQKPGGSPLTRMLQVIVASCRKSKVKVPEDESLLYENQDAESSIIGSRKLEHTKI
LTFFDKAAVQTESDNKGAAKSSLWKLCTVTQVEELKALIRLLPIWATGIVFASVYSQMG
TVFVLQGNTLDQHMGPNFKIPSASLSLFDTLSVLFWAPVYDKLIVPFARKYTGHERGFT
QLQRIGIGLVISIFAMVSAGILEVARLNYVQTHNLYNEETIPMTIFWQVPQYFFVGCAEVF
TFVGQLEFFYDQAPDAMRSLCSALSLTTVAFGNYLSTFLVTLITNITRSGGRPGWIAKNL
NNGHLDYFFWLLAGLSFLNFLIFLWIAKWYTYKKTTGHAL

Arabidopsis lyrata Araly_07 332502

MSQTFEQMDEANRLSTWNGYVDWRNRPALRSRHGGMLAASFVLVVEVLENLA
FLANASNLVLYLSTKMGFSPSGAANAVTAFMGTAFFLALLGGFLADAFFTTFHIYLVSA
AIEFLGLVVLTVQAHEHSTEPWSRVVLFVGLYSVALGVGGIKGSLPPHGAEQFDEETPSG
RRQRSFFFNYFIFSLSCGALIAVTVVVWLEDNKGWSYGFGVSTAAILISVPVFLAGSRFY
HLKVPSGSPITTLFKVLTAAFYAKYKKRRTSRNVVTCHTRSDCNDNVTKQNCNRDDEFL
GSFLGEVVRERESIPRPLRCTEDQAKDVKIVIKILPIFMSTIMLNCCLAQLSTFSVQQAST
MNTKLGSFTVPPAALPVFPVVFMMILAPTYNHLLLPLARKTTKTETGITHLQRIGTGLVL
SIVAMAVAALVETKRKHVVVTCCSNNNSSSYSSSPLPITFLWVAIQYVFLGSADLFTLAG

MMEFFFTEAPSSMRSLATSLSWASLAMGYYLSSVLVSAVNFVTGLNHHNPWLLGKNLN
QYHLERFYWLMCVLSGINFLHYLFWASRYVVYRSNQG

Arabidopsis lyrata Araly_08 333097

MDNEKGTISDLTTRQRKPLGWKAMPYIIGNETLERLATFGLMANFMVYMVREY
HMDQVQAATLINTWSALTNFAPIIGAFISDSYAGKFNTIVFGSIAELLGMLMLTFTSLIPN
LQPPPCTADQITGKCIRYSNSQLYVLLSGLFLLSVGTGGIRSCSVPFSLDQFDDSTEEGRE
GSRSFFSWYYTTHTIVQLVSMTLVLYVQNNISWAIGFAIPTVLNLFALLLLFVGTRFYVF
VKPEGSVFSGIFKVLVAAYKKRNVRFPSGIDYYRPLLETDLQSNKLVLTDQFRFLNKAVI
VMNNDEAENEEWRICTVRQIEDMKSIISIIPIFVSSIIGFLAMNQQQTFTVSQALKMDLQFP
GTSYLIPPASITVISLLTIGIWLPFYETVLVRHIENITKQEGGISLLQKVGIGNILSISTMFISG
IVERKRRDLSLTGVNISVFWLTPQQVLMGFYQVFTIVGLTEFFNKQVPINMRSIGNSLLY
LGLSLASYLSSAMVSIVHSLTARGRRQSWLTDDIDTSKLDYFYYFIAALSTLNLIFFFWC
ARRYRYRNYSDEQR

Arabidopsis lyrata Araly_09 339434

MAIACNKLEGTFPLRPTESSMDKPTLRLSSGGWKSARLIIGVEMAEQFAFYGISSN
LITYLTGPLGESTAAAAANVNAWTGTVSFLPLLWGFIADSFLGRFRTIVIASSLYILGLGL
LSFSAMAPSNSKDPNQLQVILFFCSLYLIAIGQGGYKPCIKVFGADQFDGNDLKEAKAKS
SFFNWLMFGSCVSILTTRLVSSYIQEYLSWSLGFGIPSVSMLLALLLFLLGTKTYRFSATR
GGKKNPFARISRVFMVALKNRTQPDSYIANPNETLLIYQSSKQFRFLDKAAISCSFAEIEE
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FIPIYDRLLVPVARSFTHNPSGITMLQRIGTGIFLSILAMVVAALVERKRLQIAHDNVTILM
SVWWLVPQYVLYGVSDVFMVGLQEFFYDQVPSELRSVGMALNLSIYGVGNFLSSFMIS
VIDKVTSQSGQTSWFDNDLNHAHLDYFYWLLACLSSIGLVSYLWFAKSYLYNRLN

Arabidopsis lyrata Araly_10 342706

MENEMEDKFENWKGKEAISGKHGGIRAASIVCVVVMMENIVFIANGFNFVKYF
MGSMHYSPATAANMVTNFMGTSFLLTLFGGFIADSFLTHFTTFIIFCCIELMGLILLTFQA
HNPKLLPEKGKTPSTLQSTILFTGLYAMATGTGGIKASLPTHGGDQIDRRNPRLISRFFD
WLYFSICFGCLLAVTVVLLIEEKKGWKWSFNISVGILATALCIFTVGLPFYRFKRPNGSPL
KKIAIVIISAARNRNRSDLDEEMMRSLIPFDKNIGHNKLKWIDKAMLNKNISETEVEETRT
FLGLLPIFGSTIVMSCCVAQLSTFSAQQGMLMNKKLFHSFEIPVPSLNAIPLIFMLFSIPLY
EFFGKRISLGSNNRSSSFNLKRIGLGLALSSVSMAVAAIVEAKRKHEVVHNNFRISVLWL
VFQYLMLSVSDMLTLGGMLEFFYREAPSNMKSISTALGWCSTAFGFFVSTTLVEVTNAV
TGRLGHQWLGGEDLNKARLELFYVLLCVLNTLNLLNYIFWAKRY

Arabidopsis lyrata Araly_11 347652

MAGFVSHDAEAPISADSSTRRSGGRITFPFMIATEKEETICILKSYFLWCIHSVWPD
ISYVGMVTELDCLPDRRVQHEEHRSRPAAKILDIFSGFTFMFPAIGAIAADSFFGTIPVISV
SAFISLVTPSLRNKICQAPTNIQLGVLYTAITLGSVGAGGLRFTLATAGANQYEKTEDQG
SFFNCFFFTWYLAASISVTAIVYTEENISWSFGFGLCVAANLLGLMVFISGKRFYKHECM

TSLWEVPSQVYFASSFLHYLKEKLWFPPTRKTTTVNQRSRQQRVSALKQDDEVNADSTI
RNQWRLCSVKQVEDFKAVIRIIPLVLAIIFLSTPIAMQLGLTVLQGLVMDRRLGPHFKIPA
GSLQVITLLSTCLFLIVNDRFLYPFYQKLTGKFPTPIQRVGIGHVFNIISMAMTAIVEAKRL
KIVQNVNLLESSSVADMSVLWLFPPLVIVGIGEAFHFPGNVALCYQEFPESMRSPATSITS
VVIGICFYTSTALIDLIQRTTAWLPDDINHGRVDNVYWVLVIGGVLNLVYFLVCSWFYK
YRNLKNDDHEQDASVFLS

Arabidopsis lyrata Araly_12 348537

MADSTSIINKRTKGGWNAAVFIIVVEMAERFAFYGLASNLITFLTNELGQSTATA
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AVLALIFIQERVSWSLGFSIIAGSVVIAIVIFLIGIPKYRKQVPVGSPLTRVAQVIVAALKK
WRLSSTRHHYGLCYEEEDEHKSESTNSNQIYLLARTNQFRFLDKATIIDEIDHNKNRNPW
RLCTVNQVEEVKLILRLMPIWISLIMFCATLTQLNTFFLKQGSMMNRTIGDHFTIPPAAFQ
SIVGVTILILIPLYDRVFVPMIRKITNHHSGITSLQRIGVGLFVATFNMMICGLVEAKRLRV
ASDHGLIDSPKEVVPMSSLWLLPQYILVGIGDVFTIVGMQELFYDQMPETMRSIGAAIFIG
VVGVGSFVSTGIISTVQTISKSHGEEWLVNNLNKAHLDYYYWIIASLNAVSLCFYLFIAN
HFVYKKLQDKDDDVEGER

Arabidopsis lyrata Araly_13 351064

MAAMDPRDNGYVTPLNERERAENLEVGEVVEVQDDQSVVSLMSNDSDLQKKM
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NTPSSLGVAIFYLSVYLVAFGYGGHQPTLATFGADQLDDDKNSKAAFFSYFYFALNVGA
LFSNTILVYFEDKGLWTEGFLVSLGSAIVALVAFLAPTKQYRYVKPCGNPLPRVAQVFV
ATARKWSVDRPGDPHELYELEGPESAIKGSRKIFHSTKFVFLDRAAVITENDRDETRTNA
WRLCSVTQVEEAKCVMKLLPIWLCTIIYSVIFTQMASLFVEQGDVMNAYVGKFHIPAAS
MSVFDIISVFVSTGIYRHIIFPYVRPTELMRMGIGLIIGIMAMVAAGLTEIQRLRRVVPGQK
ESELTILWQIPQYVLVGASEVFMYVGQLEFFNGQAPDGLKNLGSSLCMASMALGNYVS
SLMVNIVMAITKRGENNPGWIPENLNEGHMDRFYFLIAALAAIDFVVYLVFAKWYQPIS
HDEDSIKGGSCGNLKKTVSELEQV

Arabidopsis lyrata Araly_14 472112

MEVEKTEKNITEDDESKIIYRGWKVMPFIIGNETFEKLGIVGSSSNLVIYLTTVFN
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RGIESFFNWYFFTFTFAQMVSLTLIVYVQSNVSWSIGLAIPAILMLLGCIIFFAGSKLYVK
VKASGSPIHSITRVIVVAIKKRRLKPVGSNELYNYIGKDFKNSKLGHTEQFRFLDKSAIQT
QDDKLNKDGSPVDPWKLCSLQQVEEVKCVIRVLPVWLPAALFYLAYIQQTTYTIFQSLQ
SDRHLGSGSFQIPAATYTVFLMLGMTIFIPIYDRVLVPLSRKYTGKDGGITQLQRVGAGM
FLCITSMMVSAIVEQYRRKVALTKPTLGFAPRKGAISSMSGMWLIPQLVLMGIADALAG

VGQMEFYYKQFPENMRSFAGSLYYCGIGLASYLGTFLLSAVHDTTEGFSGGSWLPEDLN
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Arabidopsis lyrata Araly_15 472494

MAISGAVDEAGTPLLAVTVDGSVDFRSKPAVRSSSGGWRSAGFIIGVEVAERFAY
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QFDEKEPEECKAKSSFFNWWYFGMCFGTLTTLWVLNYIQDNLSWALGFGIPCIAMVVA
LVVFLLGTCTYRFSIRREDRSPFVRIGNVYVAAVKNWSVSASAVAAAEERLGLVSRNSS
QQFSFLNKALVAKTGSCSIDELEEAKSVLRLAPIWLTCLVYAVVFAQSPTFFTKQGATM
ERSITPGYKISPATLQSFISLSIVIFIPIYDRVLIPIARSFTHKPGGITMLQRIGTGIFLSFLAMV
IAALVEMKRLKTAADYGLIDSPDATVPMSVWWLVPQYVLFGITDVFAMVGLQEFFYDQ
VPNELRSVGLALYLSIFGIGNFLSSFMISIIERATSQSGQVSWFANNLNQAHLDYFYWLLA
CLSFIGLASYLYVAKSYVSKRLNTS

Arabidopsis lyrata Araly_16 472495

MAIAEEEAALIEDSVSDSVDHRGLPAGKSSTGGWRSAWYIIGVEVGERFAYFGIG
SNLITYLTGPLGQSTATAAVNVNTWSGTASMLPVLGAFIADAYLGRYRTIVIASLIYILGL
GLLTLSSIFILMRLSEQRNDASARPLFWVNLLFFCSLYLVAIGQGGHKPCVQAFGADQFD
VEDPKERISRGSFFNWWFLSLSAGITLSIIVVVYVQDNVNWALGFGIPCLFMVMALALFL
LGRKTYRYPRRDHEEKKNAFARIGRVFLVAFKNRKLKLTHSGQLEDGSSEKCKGLLEFL
AKASLSGEGGLEPCNSRDVEDTMALVRLIPLWITSVVSTIPYAQYATFFTKQGVTVDRKI
LPGLEIPPASFQALIGLSIFISVPTYERVFLPLARLITKKPSGITMLQRIGAGMVLSSLNMVV
AALVEMKRLETAKEHGLVDRPDATIPMSIWWFVPQYLLLGMIDVFSLVGTQEFFYDQV
PTELRSIGLALSLSAMGLASFLSGFLIAVINWATGKNGGGSWFNTNLNRAHVDYFYWLL
AAFTAIGFLAFLFFSRLYVYRRVDQI

Arabidopsis lyrata Araly_17 474334

MENPPNETEAKQIQPNEGKKTKGGIITMPFIIANEAFEKVASYGLLPNMIMYLIRD
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LPQVKPSPCDPTAAGSHCGSATASQLALLYSAFALISIGSGGIRPCSLAFGADQLDNKEKP
KNERILESFFGWYYASSAVAVLIAFTGIVYIQEHLGWKIGFGIPAVLMLIAALLFILASPLY
VTRGVTKSLFTGLAQAVVAAYKKRKLSLPDHHDSFDCYYHMKDSEIKAPSQKLRFLNK
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TSMDRRLNRHGSSFQVPAGSFGMFTIIALALWVVLYDRAVIPLASKIRGRPFRLSVKLRM
GLGLFMSFLAMAISAMVESFRRKKALSQGYANDANAVVDISAMWLVPQYVLHGLAEA
LTAIGQTEFFYTEFPKSMSSIAASLFGLGMAVASLLASVVLNAVNELTSRNGKESWVSD
NINKGHYNYYYWVLAIMSFINVIYYVICSWSYGPLVDQVRNGRVNGVREEEELLDIVGK
GFEKEDLSPVIKTI

Arabidopsis lyrata Araly_18 475124

MNSNEDERIIILDVEESLLIQEEVKNVLTGLSSSAEDGSVDIYGNPPSKKKTGNWK

ACPFILGNECCERLAYYGIAKNLITYYTSELHESNVSAASDVMIWQGTCYITPLIGAVIAD
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LYLIALGTGGIKPCVSSFGADQFDDTDPRERVRKASFFNWFYFSINIGSFISSTLLVWVQE
NGGWGLGFLIPTVFMGASIASFFIGTPLYRFQKPGGSPITRVCQVLVAAYRKWYLNLPED
ISFLYETREKNSIIAGSRKIQHTDGYKKISVPFQCLDKAAIVSEDESKSGAFSNPWKLCTV
TQVEEVKILIRMFPIWASGIIYSVLYSQISTLFVQQGRAMNRVVLSFEIPPASFGVFDTLIV
LIAIPIYDRFIVPFVRRFTGIPKGLTDLQRMGIGLFICVLSIAAAAIVETVRLQLIQDTVSMSI
FWQVPQYILMGIAEVFFFIGRVEFFYDQSPDAMRSVCSALALLNTAVGSYLSSLILTLVA
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Arabidopsis lyrata Araly_19 475340

MAEINKQSNKWEQEVVSNEMNNWELAEEESVDWRGRPSNPNKHGGMRAALFV
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WTIIIFGFVELSGFILLSVQAHLPQLKPPKCNPLIDQACEEAKGFKAMIFFMALYLVALGS
GCVKPNMIAHGADQFSQSHPKQSKRLSSYFNAAYFAFSMGELIALTLLVWVQTHSGMD
VGFGVSAAAMTMGLISLVSGTMYFRNKRPRRSIFTPIAQVVVAAILKRKLVSPSDPRML
HGDHHVANDVVPSSTLPYTPRFRFLDKACIKIQDTNTKESPWRLCTVTQVEQVKTLISLV
PIFASTIVFNTILAQLQTFSVQQGSSMNNRLSNSFHIPPASLQAIPYMMLIFLVPLYDSFLV
PFARKLTGHNSGIPPLTRIGIGLFLSTFSMVSAAMLEKKRRDSSVLDGRILSIFWITPQFLIF
GVSEMFTAVGLIEFFYKQSAKGMESFLMALTYCSYSFGFYFSSVLVSVVNKITSTSVDSK
GWLGENDLNKDRLDLFYWLLAVLSLLNFLSYLFWSRWNIKSSRSNNTNVVGDMNI

Arabidopsis lyrata Araly_20 475979

MEEQSKNKISEEEKQLHGRPNRPKGGLITMPFIFGMNEICEKLAVVGFHANMISY
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IPTLRPPPCKGEEVCVVADTAQLTILYVALLLGALGSGGIRPCVVAFGADQFDESDPNQT
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LYRHLDPAGSPFTRLIQVGVAAFRKRKLRMVSDPSLLYFNDEIDAPISLGGKLTHTKHMS
FLDKAAIVTEQDNLKPGQIPNHWRLSTVHRVEELKSVIRMGPIGASGILLITAYAQQGTFS
LQQAKTMNRHLTNSFQIPAGSMSVFTTIAMLTTIVFYDRIFVKVARKFTGLERGITFLHR
MGIGFVISIIATLVAGFVEIKRKSVAIEHGLLDKPHTIVPISFLWLIPQYGLHGVAEAFMSI
GHLEFFYDQVPESMRSTATALFWMAISIGNYVSTLLVTLVHKFSAKPDGSNWLPDNNLN
RGRLEYFYWLITLLQAVNLVYYLWCAKIYTYKPVQVHHSKEESSPVKDELQLSNRSLV
DA

Arabidopsis lyrata Araly_21 480035

MQVEIEEKFEDWRGREAISGKHGGIKAAFIACVVETMENMVFLAYSTNFMMYFT
KSMNYSSPKAATMVTNFIGTSFLLTIFGGFVADSFLTRFASFVLFGFIELLGLILLTLQAHI
TKLQPQGGKKPSTLQSTVLFTGLYAIAIGVGGVKGSLPAHGGDQLGTRNQRLISGFFNW
YFFSVCLGGFLAVTLMVWIEENKGWSSSFNISTAVLASAIFIFVVGCPMYRFKRPAGSPL
TRIVNVFASATRNRNRFVTDAEVTQNHTSTDKSIHHNKFKFLNKAKLNNKISATQVEET
RTFLALLPIFASTIVMNCCVAQMGTFSVQQGMVTNRKLSRSFEIPVASLNAIPLLCMLSSL

ALFELFGKRIISNSERSSSFNLKRIGSGLALTSVSMAVASMVEVKRKHEAVHNNIKISVF
WLELQFVLLSFSDMLTVGGMLEFFFRESPASMRSMSTALGWCSTAMGFFLSSVLVEVV
NGITGWLRDDLNESRLELFYVVLCVLNTLNLFNYIFWAKRY

Arabidopsis lyrata Araly_22 482796

MEHKKIGAEFQDSCDDQQKWVLDSSLDSRGRVPLRARTGAWKAALFIIAIEFSER
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ATTIYLMGLVLLTMSWFIPGLKPCHEDVCNEPRKAHEIAFFIAIYLISIGTGGHKPSLESFG
ADQFDDDHIEERKMKMSFFNWWNVSLCAGILTAVTAVVYIEDRVGWGVAGIILTVVM
AISLVIFLIGKPFYRYRTPSGSPLTPILQVFVAAIAKRNLPYPSDPSLLHEVSKAEFTSGRLL
CHTQHLKFLDKAAIIEDSSPLALEKHSPWRLVTLTKVEETKLIINVIPIWLSTLAFGICATQ
GSTFFIKQAMTMDRHIAGFKLPPAAMFTLTALTLIISLTLYEKILVPILRSITQNQRGINILQ
RIGIGMVFSLITMIIAALVEKQRLDSTNNNNKPMSVTWLAPQFMVIGFADAFTLVGLQEY
FYHQVPDSMRSLGIALYLSVIGVASFLNNLLITAIDTLAEDFSGKSWFGKDLNSSRLDRF
YWFLAGVISANICVFVIVAKRCPFKSVQPSQGSADSSMSVA

Arabidopsis lyrata Araly_23 484127

MGSIEEEAKPLIEEGLILQEAKLYAEDGSVDFNGNPPLKEKTGNWKACPFILGNE
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WTIACFSGIYFIGMSALTLSAAVPALKPAECIGDFCPSATPAQYAMFFGGLYLIALGTGGI
KPCVSSFGADQFDDTDSRERVRKASFFNWFYFSINIGALVSSSLLVWIQENRGWGLGFGI
PTVFMGLAIASFFFGTPLYRFQKPGGSPITRISQVVVASFRKSSVKLPEDPMLLYETQDKN
SAIAGSRKIEHTDDCKYLDKAAVISEEESKSGDYSNSWRLCTVTQVEELKILIRMFPIWAS
GIIFSAVYAQMSTMFVQQGRAMNCKIGSFQLPPAALGTFDTASVIIWVPLYDRFIIPLARR
FTGVDKGFTEIQRMGIGLFVSVLCMAAAAIVEIIRLHMANDLGLVESGAPVPISVLWQIP
QYFILGAAEVFYFIGQLEFFYDQSPDAMRSLCSALSLLTTALGNYLSSLILTLVTYFTTRN
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Arabidopsis lyrata Araly_24 484951

MASVVSGGTEAQSSGDPRSKRGGWITFPFMIATLLGLSVTSFGWVMNLIVFLIEE
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WYFLTLYIGAITGATSIVYIQDNASWKLGFGLCAAANLISFIVFVSGKRYYKHDKPMGSP
FTSLIRVVVAATAKRKAMVSCKEEDYHRGLGKEARTSVAMPSKSFRFLNRAALKTEDD
VNKKDGSDINIWRLCSVQEVEDFKAILRVLPLWLSIIFVSTPMVMQTSLIVLQALVTDRG
LGPNFKVPAGSLQVIIIITACIVIIMNNWLVFPMYKKLTQKLLTPLQKVGIGQVLTILSMA
LSAVVEAKRLKTVENEHPMSVLWLFPPLVIVGIGEAFQFPANIELFYGEFPESLRNTATSL
TSVVIGISFYLSTALIDLIHRTTAWLPNDINHGRVDNVYWILVIGGILNFGYFLVCSWVYK
YRNLKCDDHEQDPKDVTT

Arabidopsis lyrata Araly_25 484953

MARSLSGDSEVQTSRDSSSNRGGWKTFPFMIATLLGLSIASFGWVMNLVVFLIDV

FNIKSIAATQISNIVNGCVSMLPVVAAILADSFFGNIPVISVSAFISLLGILLLTLITSFDYLR
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NLIRVVFAATAKRKAVISSREEDYHHGLGRESKTSAAMPSTSFRFFNRAALKTEDDSVN
NIWRLCSVQEVEDFKAVFRVLPLLLAIIFVSTPMVMQTSLIILQALVTDRGLGSHFKIPAG
SLQVIVIITACIVIVMNNFLVYPMYHKLTHTPLTPLQKVGIGHVFIILSMAISAVVEAKRLK
TVNNGHTITATSLTSVVIGISFYLSTALITLIQKTTKWLPNDINRGRVDNVYWLLVIVGVL
NFGYFLVCAWFYRYRDLKDDDQEQDPKDVTI

Arabidopsis lyrata Araly_26 485811

MEEKDVYTQDGTVDIHKNPANKEKTGNWKACRFILGNECCERLAYYGMGTNL
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LLTLSASVPGLKPGNCNADTCHPNSGQTAVFFVALYMIALGTGGIKPCVSSFGADQFDE
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TDNLKFFDKAAVEIQSDSIKDGEVNPWRLCSVTQVEELKSIISLLPVWATGIVFATVYSQ
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FTQLQRMGIGLVVSIFAMITAGVLEVVRLDYVKSHNAYDQKQIPMSIFWQIPQYLLIGCA
EVFTFIGQLEFFYDQAPDAMRSLCSALSLTTVALGNYLSTVLVTVVMKITKKNGKPGWI
PDNLNRGHLDYFFYLLETLSFLNFLVYLWISKRYKYKKAVGRAH

Arabidopsis lyrata Araly_27 488159

MVASEIKSPVSVPETPGSSSVHHRKQLSVFFIESDNRRLALGRGYTGGTTPVNIHG
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LGISQASSVLGGFLADAYLGRYWTIAIFTTMYLVVSLIGITLGASLKMFVPDQSNCGQLS
LLLGNCEPAKSWQMLYLYTVLYITGFGAAGIRPCVSSFGADQFDEKSKDYKTHLDRFFN
FFYLSVTLGAIIAFTLVVYVQMELGWGMAFGTLAVAMGISNALFFAGTPLYRHRLPGGS
PLTRVAQVLVAAFRKRNAAFTSSEFIGLYEVPGLKSAINGSRKIPHSDDFIWLDKAALQL
KEDGLEPSPWKLCTVTQVEEVKILIRLIPIPACTIMLSLVLTEYLTLSVQQAYTLNTHIQHL
KLPVTCMPVFPGLSIFLILSLYYSVFVPITRRITGNPHGASQLQRVGIGLAVSIISVAWAGL
FENYRRHYAIQHGFEFNFLTQMPDLTAYWLLIQYCLIGIAEVFCIVGLLEFLYEEAPDAM
KSIGSAYAALAGGLGCFAATILNNIVKAATRDSDGKSWLSQNINTGRFDCLYWLLTLLS
FLNFCVFLWSAHRYKYRAIESEEDKSRAFL

Arabidopsis lyrata Araly_28 488338

MAGGEKRRGLSKSCALLIVIAGIERYAFKGVASNLVTYLTDVVKMSNSRAATTV
NTWSGFTFMLPLFSAPFADSYWDRFFTILASSSLYFVGLVGLTFTAYAGSRSTTKTISLYF
LYTSLSLVALGLGVLNPSLQAFGADQLDHDLDQGHDHEPSSENKEVKSNRKTQFFQWW
YFGVCAGSLLGVTVMAYIQDTFGWVIGFAIPTASMLLLIFLFLCGCGVYVYADPDLKAK
PFQRILESIKERVCGRNKITLVNDHDLNAMELELQDQKPLCNCSNTEANTTTTTKSLPDD
HKSCKTGFSGLETVKLLLRLLPIWTMLLMFAVIFQQPATFFTKQGMTMKRNIGPNFKIPP
ATLQSTITLSIILLMPFYDKILIPIAKKLTKNEKGISVKERMGIGMFLSIIAIVIAALVERKRL

KISKMMKTTPNLDPLSILWLLPQYILLGISDIFTVVGMQEFFYSEVPVSMRTMGFALYTS
VFGVGSFVSAALISIIETYSSSRGGKHNWFADDMTEARLDNYYWLLAFTSAISFLMYIVI
CKHFKSRSDADDQCDTNC

Arabidopsis lyrata Araly_29 492707

MDQKVRQFEVCTQDGSVDRHGNPAIRANTGKWLTAILILVNQGLATLAFFGVG
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AGLVMLSLSTGALLLEPSGCGVEESPCKPHSTFKTVLFYLSVYLIALGYGGYQPNIATFG
ADQFDAEDSVEGHSKIAFFSYFYLALNLGSLFSNTVLGYFEDQGEWPLGFWASAGSAFA
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ILHTKGFRFLDRAAIVTPDDEAEKVESGSKYDSWRLCSVTQVEEVKCVLRLLPIWLCTIL
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KTEPNKGLTELQRMGIGLVIAIMAMISAGTVEIYRLKNKEPESSTSVSSSSSLSIFWQVPQ
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Arabidopsis lyrata Araly_30 494374

MTVEEVGDDYTKDGTVDLRGNPVRRSIRGRWKACSFVVVYEVFERMAYYGISS
NLVIYMTTKLHQGTVESSNNVTNWVGTSWLTPILGAYVGDALLGRYITFVISCAIYFSG
MMVLTLSVTIPGIKPPECSTTKFEDCKKASVLQLAVFFGALYTLAIGTGGTKPNISTIGAD
QFDVFDPKEKTQKLSFFNWWMFSIFFGTLFANTVLVYVQDNVGWTLGYGLPTLGLAISI
TIFLLGTPFYRHKLPTGSPFTKMARVIVASFRKANAPMAHDNTSFHELPSLEYERKGTFPI
QPTPSLRFLDRASLKTGTTYKWNLCTTTEVEETKQMLRMLPVLFITFVPSMMLAQINTLF
VKQGTTLDRKVTGSFSIPPASLSAFVTLSMLISIVLYDRVFVKITRKFTGNPRGITLLQRM
GIGLIFHILIMIVASVTERYRLKVAADHGLIHQTGVKLPLTIFALLPQFVLMGMADSFLEV
AKLEFFYDQAPESMKSLGTSYSTTSLAIGNFMSSFLLSTVSEITKKRGRGWILNNLNESRL
DYYYLFFAVLNLVNFVLFLVVVKFYVYRADVTDSVVVKEEEMKENE

Arabidopsis lyrata Araly_31 496450

MERKPLEVESTDNHQSPSSAVYGGSVTAVDPVEEDVQNQEKLVYRGWKVMPFII
GNETFEKLGIIGTLSNLLVYLTAVFNLKSITAATIINAFSGTINFGTFIAAFLCDTYFGRYKT
LSVAVIACFLGSFVILLTAAVPQLHPAPCGTAANSICNGPSGGQIAFLLMGLGFLVVGAG
GIRPCNLAFGADQFNPKSESGKRGIDSFFNWYFFTFTFAQILSLTLVVYVQSNVSWTIGLT
IPAVLMFLACLIFFAGDKLYVKIKASGSPLAGIAQVIAVAIKKRGLKPAKQPWLNLYNYY
PPNYANSKLKYTDQFRFLDKAAIMTPEDKLQPDGKPADPWKLCTMQQVEEVKCIVRVL
PIWFASSIYYLTITQQMTYPVFQALQSDRRLGPGGFVIPAATYVVFLMTGMTVFIVVYDR
VLVPTMRRITGLDTGITLLQRIGTGIFFATASLVVAGFVEERRRTFALTKPTLGMAPRKGE
ISSMSAMWLIPQLSLAGVAEAFAAIGQMEFYYKQFPENMRSFAGSIFYVGGGVSSYLGS
FLIATVHRMTQNSSGGNWLAEDLNKGRLDLFYFMIAGILAVNFAYFLVMSRWYRYKGS
DDEVTTYETNEHIIKQQDKNVA

Arabidopsis lyrata Araly_32 497163

MVLEDRKDGSLPRPSGSFSKSSPSELDVVDQYNRKSSPESILGAEKVEKKPGGWR
AVSFILGNETLERLGSIGLLANFMVYLTKVFHLEQVDAANVINIWSGFTNLTPLVGAYIS
DTYVGRFKTIAFASFATLLGLITITLTASLPQLHPASCNSQDPLSCGGPNKLQFGVLLLGL
CFLSVGSGGIRPCSIPFGVDQFDQRTEDGAKGVASFFNWYYLTFTVVLIITQTVIVYIQDQ
VSWIIGFSIPTGLMALAVVMFFAGMKRYVYVKPEGSIFSGIAQVIVAARKKRKLKVPAE
DDGTVNYYDPAIKSSVLSKLHRSNQFRFLDKAAVIIEGDLTPEGAPADKWRLCSVQEVE
EVKCLIRIVPVWSAGIISLAAMTTQGTFTVSQALKMERHLGPHFEIPAGSLSVISLLTIGIFL
PFYDRVFVPFMRRITGHKSGITLLQRIGTGIIFAIFSMIVAGIVERMRRIRSINAGDPTGMTP
MSVFWLSPQLILMGLCEAFNIIGQIEFFNSQFPEHMRSIANSLFSLSFAGSSYLSSLLVTVV
HKFSGGHDRPDWLNKNLNAGKLDYFYYLIAIMGVVNLVYFWYCARGYRYKVGLQIED
FEEDKSSDDVEMTSKKSMK

Arabidopsis lyrata Araly_33 894779

MDVESSSPSSHALIKKEKGGWRAIKYIIANESFEKLASMSLIGNLSVYLTTKYNLG
GVFLVNVINIWFGSCNVLTLAGAFVSDAYLGRFWTLLLGSIASFIGMGIIALTAALPRLRP
EACIDPSNCSNQPAKWQLGVLFSGLGLLAIGAGGIRPCNIAFGADQFDTSTKKGKAQLET
FFNWWYFSFTVALVIALTGVVYIQTNISWVIGFVIPTACLALSITTFLIGQHTYICAKPEGS
VFADIVKVVAAACKKRKLKSGSDIMFYIGPSNDGSPTTLVRDKQRLRFFDKASVVTNPN
ELNEEGNAKYKWRLCSVQQVKNLKCVTAILPVWVTGIACFILTDQQNIYGILQAMQMD
KTFGRHNFQVPAGWMNLVSMITLAIWISLYECVIIPIVKQITGRKKRLTMKQRIEIGIVMG
IACMIVAAFQEKKRRASALKNGSFVSPISIVMLLPQFALAGLTEAFSAVALMEFLTVRMP
EHMRAVAGAIFFLSSSIASYICTLLINVIDAVTRKEGKSWLGDKDLNKNRLENYFFIIAGI
QVANLLYFKFYASRFATDNKKGH

Arabidopsis lyrata Araly_34 897373

MADSNSGDTEARRSTDPSGKRGGWTTLPFMLVTLLGMSITSFGWGMNLIVFLIE
EFNIKNIAAAQISNIVNGVVNMLPVVAAILADSFFGNIPVISASTFISLTGVSLLTLITSLDY
LIPRPCETGSILCQSPSKLQLGILYAALALVIVGSAGTRFTLAAAGANQYKKPKEQGRFFN
WFFLSLYTGAITGTTAIVYTQDNASWKLGFGLCAAANLISFIVFIAGKRFYKHDKPLGSP
YTSLIRVLVSATMKRKAMISSKDEDYHHYGLKKEAKTSTTMPSKSFRFLNRAALKTEED
LNPSGDSINNMWRLCSVQEVEDFKAVLRLVPLWAAVMFLSTPVAVQMSMTVLQALVM
DRELGPHFKVSAGSLQVIVLISGCVFIMLNNWIIYPMYQKLFRKPLTPLQQVGIGHVLTIL
SMAISAIVEARRLKTVENGRPMSVLWLVPALVMVGIGEAFHFPANIAVFYGEFPESLRNT
ATSLTSVVIGISFYLCTAIIDLIQRTTKWTNHTD

Arabidopsis lyrata Araly_35 902003

MEAAKVYTQDGTVDLQGRPVLASKTGRWRACSFLLGYEAFERMAFYGIASNLV
NYLTTRLHEDTISSVRNVNNWSGAVWITPIAGAYIADSYIGRFWTFTASSLIYVLGMILLT
MAVTVKSLRPTCENGVCNKASSLQITFFYVSLYTIAIGAGGTKPNISTFGADQFDNYSIEE
KKQKVSFFNWWMFSSFLGALFATLGLVYIQENLGWGLGYGIPTVGLLVSLIVFYIGTPFY
RHKVIKSDNLAKDLVQVPIEAFKNRKLQCPDDLMELYELDSHYYKSNGKHQVHHTPVF

RFLDKAAIKTSSRILPCTVTKVEVAKRVLGLIFIWLVTLIPSTLWAQVNTLFVKQGTTLDR
KIGSNFQIPAASLGSFVTLSMLLSVPMYDQYFVPFMRKKTGNPRGITLLQRLGIGFAIQIV
AIAVASAVEVKRMHVIREFHITSPKQVVPMSIFWLLPQYSLLGIGDVFNAIGLLEFFYDQS
PEEMQSLGTTFFTSGIGLGNFLNSFLVTMIDKITSRGGGKSWIGDNLNDSRLDYYYGFLM
VISIVNMGFFLWAATKYVYKSDETKELSGGSVQMEAKAFETSPLSI

Arabidopsis lyrata Araly_36 912113

MKIPEEEVTLLEDYVSDSVDHRGLPAGKSSTGGWRSAWFIIGVEVAERFAYFGIA
CNLITYLTGPLGQSTATAAVNVNTWSGTASMLPILGAFVADAYLGRYRTIIVASLIYILGL
GLLTLSASLIIMRLSEQRNNGSAKPSIWVNTLFFCSLYLVAIGQGGHKPCVQVFGADQFD
AYDPKEVIARGSFFNWWFLSLSAGISLSIIVVAYVQENVNWAFGFGIPCLFMVMALAIFL
LGRKIYRYPKGGLEDVNSSNTFTINTFARIGRVFVVAFKNRKLRLEHSGLGLDQVLLEDG
QSEKREGRLNFLAKAMISREEDAEPCSGRDVEDAKALVRLIPIWITSVVSTIPYAQYITFF
TKQGVTVDRRILPGVEIPAASLLSFIGVSILISVPIYERVFLPIARMITKKPFGITMLQRIGA
GMVLSVFNMMLAALVETKRLNIAREHGLVDKPDATVPMSIWWFVPQYLLLGMIDVFSL
VGTQEFFYDQVPTELRSIGLSLSLSAMGLSSFLSGFLITVIDRATGKDGWFNTNLNRAHV
DYFYWLLAAFTAIAFFAFLFISKMYVYRRLD

Arabidopsis lyrata Araly_37 912316

MEVVENRKILPEQKRGGWRAITFILGNETLEKLGSMGVSANFMVYLRNVFHMEP
VEASNVYYLWMGLTNFAPLLGALISDAYIGRFKTIAYASFFSILGLMTVTLTACLPQLHP
PPCNNPRPDECDDPNKLQLGILFLGLGFLSIGSGGIRPCSIPFGVDQFDQRTEQGLKGMAS
FFNWYYLTLTMVLIFSHTVVVYLQTFSWVIGFSIPTGLMACAVVLFFVGMRFYVYVKPE
GSVFSGIARVIVAARKKRNLEIPPVDDGTVEYYEPPVKHGVLSKLPLTDQFKVVPVWSA
GIISIVAMTTQATFMVFQATKMDRHMGPHFEIPAASIAVISYITIGIWVPIYERLLVPFLWR
IRKFRFTLLQRMGIGIVFAILSMFTAGIVEGVRRTRATEMTQMSVFWLALPLILMGLCESF
NFIGQIEFFNSQFPEHMRSIANSLFPLSFAAANYLSSLLVTTVHKVSGTKDQPDWLNKDL
DRGKLDYFYYLIACLGVINLMYFWYCARSYQYKAGSQIEDFKEEKPFLDIEPNKRHDQ

Arabidopsis lyrata Araly_38 912320

MEVEVQGDVSKWEGYADWRNRAAVKGRHGGMLAASFVLAVEILENLAFLANA
SNLVLYLKNFMHMSLARSSSEVTTFMATAFLLALLGGFLADAFFSTFVIFLVSASIEFLGL
ILLTIQARRPSLMPPPCKSSAALPCEVVGGSKAAFLFVGLYLVSLGVGGIKGSLPSHGAE
QFDESTPKGRKQRSTFFNYYVFCLSCGALVAVTFVVWLEDNKGWEWGFGVSTISIFLSII
VFLLGSRFYKNKIPRGSPLTTILKVLLAASIVGCSSKTSSNVVSDFSVSPLNHFASREDQSE
QGKKTPSQSLTNSLRCLNRAIEGKTHYIWLECTVQQVEDVKIVLKMLPIFGCTIMLNCCL
AQLSTYSVHQAATMNRKIINFNIPPASLPVFPVVFMLMLAPAYDHLIIPFARKVTKSEMGI
THLQRIGVGLVLSILAMAVAALVELKRKQVAREAGLLDSKETLPITFLWIAFQYLFLGSA
DLFTLAGLLEFFFTEAPSSMRSLATSLSWASLALGYYLSSVMVPIVNSVTESAGQSPWLG
EKLNRSSLDLFYWLMCVMSVVNFLHYLFWAKRYKYISTGSRN

Arabidopsis lyrata Araly_39 915474

MTVEEVGDDYTKDGTVDLRGNCVRRSQTGRWKACSFVVVYEVFERMAYYGIS
SNLVIYMTTKLHQGTVKSSNNVTNWVGTSWLTPILGAYVADAHLGRYITFVISSAIYLL
GMALLTLSVSLPALKPPKCSTANVENCEKASVLQLAVFFGALYTLAVGTGGTKPNISTIG
ADQFDEFDPKERIHKHSFFNWWMFSIFFGTFFATTVLVYVQDNVGWAIGYGLSTLGLAF
SIFIFLLGTRLYRHKLPTGSPFTKMARVIVASLRKAHEPMPRDSTCFYELSPMEYASKRAF
PIHSTLSLRFLDRASLKTGSTHKWSLCTITEVEETKQMLKMLPVLFVTFVPSMMLAQIMT
LFIKQGTTLDRRLTNNFSIPPASLLGFTTFSMLVSIVIYDRVFVKLMRKLTGNPRGITLLQR
MGIGMILHILIMIIASITERYRLKVAAERGLNHQTAVPIPLTIFTLLPQYVLMGLADAFIEIA
KLEFFYDQAPESMKSLGTSYTSTSMAVGNFLSSFLLSSVSQITKTQGRGWIQNNLNESRL
DKYYMFFAVLNLVNFILFLVVIRFYEYRADVTQSANVEQKEPNQQM

Arabidopsis lyrata Araly_40 920044

MSLPETKSDVLLDAWDFQGRPADRSKTGGWASAAMILCIEAVERLTTLGIGVNL
VTYLTGTMHLGNATAANTVTNFLGTSFMLCLLGGFIADTFLGRYLTIAIFAAIQATGVSI
LTLSTIIPGLRPPRCNPTTSSHCEQASGIQLTVLYLALYLTALGTGGVKASVSGFGSDQFD
ETEPKERSKMTYFFNRFFFCINVGSLLAVTVLVYVQDDVGRKWGYGICAFAIVLALSVF
LAGTNRYRFKKLIGSPMTQVAAVIVAAWRNRKLELPADPSYLYDVDDIIAAEGSMKGK
QKLPHTEQFRSLDKAAIRDQEAGVTSNIFNKWTLSTLTDVEEVKQIVRMLPIWATCILFW
TVHAQLTTLSVAQSETMDRHIGSFEIPPASMAVFYVGGLLLTTALYDRVAIRLCKKLFN
YPHGLRPLQRIGLGLLFGSMAMAVAALVELKRLRTANSHGPTVKTLPLGFYLLIPQYLIV
GIGEALIYTGQLDFFLRECPKGMKGMSTGLLLSTLALGFFFSSVLVTIVEKFTGKAHPWI
ADDLNKGRLYNFYWLVAVLVALNFLIFLVFSKWYVYKEKRLADVGIELDDEPSIPMGH

Arabidopsis lyrata Araly_41 922438

MDVHDLSEEAKRGLHMSEESSDDICVDFRGRPSRPSKHGGTRAALFVLGFQAFE
MMAIAAVGNNLITYVFNEMHFPLSKSANLVTNFIGTVFLLSLLGGFLSDSYLGSFRTMLF
FGVIEISGFILLSVQAHLPELRPPECNMKSTIHCVEANGYKAVTLYAALCLVALGSGCLK
PNIISHGANQFQRKDLRKLSSFFNAAYFAFSMGQLIALTLLVWVQTHSGMDVGFGVSAA
VMAAGMISLVAGTNFYRNKPPRGSIFTPIAQVFVAAITKRKQICPSNPNMLHQPSTDLVR
VKPLLHSNKFKFLDKACIKTQGKAMESPWRLCTIEQVHQVKILLSVIPIFACTIIFNTILAQ
LQTFSVQQGSSMNTHITKTFQIPPASLQAIPYIILIFFVPLYETFFVPLARKFAGNDSGISPL
QRIGTGLFLATFSMVAAALVEKKRRESFLEQNATLSIFWIAPQFLIFGLSEMFTAVGLVEF
FYKQSSQSMQSFLTAMTYCSYSFGFYLSSVLVSTVNRVTSSNGSGTKEGWLGDNDLNK
DRLDHFYWLLASLSFINFFNYLFWSRWYSCDPSATHHSAEVNSLEDLENGENKDSTTEK
PRI

Arabidopsis lyrata Araly_42 925016

MENEILEEKFIDWRGRDTIPGKHGGIRAASIAYVVELLEIMVSIAIGNNMVLYFMK
SMHYSPAKAANMVTNFIGTSYLLTLFGGFVTDSFVTRSTTFIIFCSIEILGLLVLTFQAHYP
NLQPEGNNTPSTLQSTVLFTGLYLFAFGTGGTRPSLLAHGGDQFDSRHQREISKFFNWY
YFFVCFGWLMAITVMAWIKELFNISIVLLAIALCIFALGLPLYRLKRPSGSPLTRIANVFIS

AARYRNGSVLDVEMMQSLTFTDNNIHHHNKLKCLDKALLNKNISATQVEETRTFIGLLP
IFFSTIVMNTCVAQLLTFTVQQGMTMSRKISSSMEIPVPSLNVISIIFILAFISLYELFGKSIN
RTSSFSLKRIGLGLTLSSISMAVAAIVEAKRKHEAVQNDVRISVFWLMFQYLMLSFSDIL
TLGGMQEFFYREAPASMKSMSIALGWCSIAMGFFLSSLLVAITNAVSGWLGHQWLGGE
DLNKSRLDLFYVLVCVLNTLNLLNYIFSAKRY

Arabidopsis lyrata Araly_43 926293

MEVEEEVSRWEGYADWRNRAAVKGRHGGMLAASFVLVVEILENLAYLANASN
LVLYLREYMHMSPSKSANDVTNFMGTAFLLALLGGFLSDAFFSTFHIFLISASIEFLGLIIL
TIQARTPSLMPPSCDSPTCEEVSGSKAAMFFVGLYLVALGVGGIKGSLPSHGAEQFDEST
PKGRKQRSTFFNYFVFCLACGALVAVTFVVWLEDNKGWEWGFGVSTIAIFVSILIFLSGS
RFYRNKIPCGSPLTTILKVLLAASVKCCSSGSSSNAVVSMVVSPSIHCVPKGKKEVVVES
QGELEKPRQEEAVPPRIVRMHSPTSARREVVLKMLPIFACTIMLNCCLAQLSTFSVQQAA
SMNTKIGSLKIPPASLPIFPVVFIMILAPIYDHLIIPFARKATKTETGVTHLQRIGVGLVLSIL
AMAVAALVEIKRKGVAKDSGLLDSKETLPVTFLWIALQYLFLGSADLFTLAGLLEYFFT
EAPASMRSLATSLSWASLAMGYYLSSVIVSIVNSITGSSGNTPWLRGKSINRYKLDYFY
WLMCVLSAANFLHYLFWAMRYKYRSTGSRS

Arabidopsis lyrata Araly_44 926576

MSSSMADNETGTIISNDNVEYSVDFQGKTSIRSSSGAWKSSGFTMCAEVAEKFAY
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MGLGLLTFSASIPSLCKGQEKHESCVPQVKVIVFFCALYLIALGEGGFKVCLRAFGADQF
DEQDPKESKAKSSYFNWLYFAISIGILTTRLITNYVQENLSWTLGYGIPCLSMMLALFLFL
LGIKTYRFSTGGEGRQGRKHDNPFVRIGRVFVAAARNRRQTPDDTCLLLPTKSSKKFRFL
DRAVISCDSSEVEEAKVVLSLVPIWLCSLVFGIVYAQSPTFFTKQGSTMDRSISSTLLVPA
ATLQCFISLAILVFIPIYDRVFVPIARSITRKPAGITTLQRISTGIFLSIISMVIAALVEMKRLK
TARDHGLVDSPKATVPMSVCWLIPQYILFGVSDVFTMVGLQEFFYGQVPPELRSMGLAL
YLSIIGIGNFLSSSMVSVIEEATSQSGQVSWFSNNLNQAHLDYFYWLLACLSSLAFIFIVYF
AKSYVYNSPK

Arabidopsis lyrata Araly_45 929433

MENPPDQTESKEILQQQPIRRRRTKGGLLTMPFIIANEGFEKVASYGLLQNMILYL
MSDYRLGLVKGQTVLFMWVAATNFMPLVGAFLSDSYLGRFLTIAIASLSSLLGMVVLW
LTAMLPQVKPSPCVATAGTSCSSATSSQLALLYSAFALISIGSGGIRPCSLAFGADQLDNK
ENPKNERVLESFFGWYYASSSVAVLIAFTVIVYIQDHLGWKIGFGIPAILMLFAGFLFVFA
SPLYVKRNVSKSLFTGLAQVVAAAYVNRNLTLPDHHDSRDCYYRLKDSELKAPSEKLR
FLNKACAISNREEDLGSDGLALNPWRLCTTDQVEELKALVKVIPVWSTGIMMSINVSQN
SFQLLQAKSMDRRLSSDSTFQIPAGSFGMFTIIALISWVVLYDRAILPLASKIRGRPVRVN
VKIRMGLGLFISFLAMAVSATVEHYRRKTAISQGLANDANTTVNISAMWLVPQYVLHG
LAEALTGIGQTEFFYTEFPKSMSSIAASLFGLGMAVANILASVILNAVKNSSKKGNVSWI
EDNINKGHYDYYYWVLAILSFVNVIYYVLCSWSYGPTVDQVRNDKVNGMKEEEEEVIK
ILN

Arabidopsis lyrata Araly_46 930129

MVHVSSSHGAKDGSEEAFDYRGNPPDKSKTGGWLGAGLILGSELSERICVMGIS
MNLVTYLVGDLHISSAKSATIVTNFMGTLNLLGLLGGFLADAKLGRYKMVAISASVTAL
GVLLLTVATTISSMRPPPCDDFRRLHHECIEANGHQLALLYVALYTIALGGGGIKSNVSG
FGSDQFDTNDPKEEKQMIFFFNRFYFSISVGSLFAVIALVYVQDNVGRGWGYGISAATM
VVAAVVLLCGTKRYRFKKPKGSPFTTIWRVAFLAWKKRKESYPAHPSLLNGYDNTTVP
HTERLKCLDKAAILKNESSPSSKDLEEKDPWIVSTVTQVEEVKLVMKLVPIWATNILFWT
IYSQMTTFTVEQATFMDRKIGSFTVPAGSYSAFLILTILLFTSLNERVFVPITRRLTKKPQG
ITSLQRIGVGLVFSMAAMAVAAVIENARRESAVNNGTKISAFWLVPQYFLVGAGEAFAY
VGQLEFFIREAPERMKSMSTGLFLSTISMGFFVSSLLVSLVDRVTDKSWLRSNLNKARLN
YFYWLLVVLGALNFLIFLVFAMKHQYKADVISVVIDDDDLVEKEVKKKESSEFELKDIP

Arabidopsis lyrata Araly_47 932963

MESKGSWTVADAVDYKGRPADKSKTGGWITAALILGIEVVERLSTMGIAVNLVT
YLMETMHLPSSTSANIVTDFMGTSFLLCLLGGFLADSFLGRFKTIAIFSTIQALGTGALAV
ATKLPELRPPTCHHGEACIPATSFQMTILYISLYLIALGTGGLKSSISGFGSDQFDDKDPKE
KAHMAFFFNRFFFFISMGTLLAVTVLVYMQDEVGRSWAYGICTVSMAIAIVIFLCGTKR
YRYKKSQGSPVVQIFQVIAAAFRKRKMELPQSIVYLYEDNPEAIRIEHTDQFHLLDKAAI
VAEGDFEQTLDGVAIPNPWKLSSVTKVEEVKMMVRLLPIWATTIIFWTTYAQMITFSVE
QASTMRRNIGNFKIPAGSLTVFFVAAILITLAVYDRAIMPFWKKWKGKPGFSSLQRIAIG
LVLSTAGMAAAAIAEQKRLSVAKSSSQKTLPISVFLLVPQFFLVGAGEAFIYTGQLDFFIT
QSPKGMKTMSTGLFLTTLSLGFFVSSFLVSIVKRVTSTSTDGGWLADNINHGRLDYFYW
LLVILSGINFVVYIICALWFKPTKGKDSAEKENGKGFSVEDC

Arabidopsis lyrata Araly_48 935936

MGSIDEERSLLEVEEVKLYAEDGSIDIHGNPPLKQKTGNWKACPFIFANECCERL
AYYGIAKNLITYFTNELHETNVSAARHVMTWQGTCYITPLIGALIADAYWGRYWTIACF
SAIYFTGMVALTLSASVPGLKPAECIGSLCPPATMAQSTVLFSGLYLIALGTGGIKPCVSS
FGADQFDKTDPSERVRKASFFNWFYFTINIGAFVSSTVLVWIQENCGWELGFLIPTVFMG
LATVSFFFGTPLYRFQKPRGSPITRVFQVLVAAYRKSNLKVPEDCKIEHTDGEAESEPFPD
PWKLCTVTQVEEVKILLRLFPIWASGIIFSVLHSQIYTLFVQQGRSMKRTIGSFEIPPATLG
MFDTASVLISVPIYDRIIVPFVRRFTGLAKGLTELQRMGIGLFISVLSLTFAAIVETVRLQL
ARDLDLVESGDTVPLTIFWQIPQYFFMGTAGVFYFVGRIEFFYEQSPDSMRSLCSAWALL
TTTLGNYLSSLIITLVAYLSGKDCWILQTTLTMDILITSSGFWSVLDVLTYPFLSSSLSNTL
TRRLDLFFCSCVYFQNVWTFVLQIESYMALCFGFRI

Arabidopsis lyrata Araly_49 938307

MEHNKVDTELQEAYDDQQKWVLDSSTDSRGEIPLRAKTGAWRAALFIIGIEFSER
LSYFGISTNLVVYLTTILHQDLKMAVKNTNYWSGVTTLMPLLGGFVADAYLGRYGTVL
LATTVYLMGLILLTLSWFIPGLKACHEEMCVEPRKAHEIAFFIAIYLISIGTGGHKPALESF
GADQFEDGHSEERKMKMSYFNWWTAGLCAGILTAVTAMVYIEDRIGWGVAGIILTIVM
ATSFFIFLIGKPFYRYRAPSGSPLTPILQVFVAAIAKRHLPCPSDSSLLHELTNEEYIKGRLL

SSTKNLKFLDKAAVIEDRNENTKAEKQSPWRLATVTKVEEVKLLINMIPIWFFTLAFGVC
ATQSSTLFIKQAIIMDRHITGTSFIVPPASLFSLIALSIIITVTIYEKLLVPLLRPATGNERGISI
LQRIGIGMVFSLFAMIIAALIEKKRLDYAKEHHMSKTMTLSAIWLAPQFLVLGVADAFTL
VGLQEYFYDQVPDSMRSLGIAFYLSVLGAASFVNNLLITVSDHLAEEISGKGWFGKDLN
SSRLDRFYWMLAALTAANIFCFVIVAMRYTYKSVQPSLAVVPDSGDDVETATGTNNTS
KFT

Arabidopsis thaliana Arath_01 / AtNRT1-1 AT1G12110

MSLPETKSDDILLDAWDFQGRPADRSKTGGWASAAMILCIEAVERLTTLGIGVNL
VTYLTGTMHLGNATAANTVTNFLGTSFMLCLLGGFIADTFLGRYLTIAIFAAIQATGVSI
LTLSTIIPGLRPPRCNPTTSSHCEQASGIQLTVLYLALYLTALGTGGVKASVSGFGSDQFD
ETEPKERSKMTYFFNRFFFCINVGSLLAVTVLVYVQDDVGRKWGYGICAFAIVLALSVF
LAGTNRYRFKKLIGSPMTQVAAVIVAAWRNRKLELPADPSYLYDVDDIIAAEGSMKGK
QKLPHTEQFRSLDKAAIRDQEAGVTSNVFNKWTLSTLTDVEEVKQIVRMLPIWATCILF
WTVHAQLTTLSVAQSETLDRSIGSFEIPPASMAVFYVGGLLLTTAVYDRVAIRLCKKLFN
YPHGLRPLQRIGLGLFFGSMAMAVAALVELKRLRTAHAHGPTVKTLPLGFYLLIPQYLI
VGIGEALIYTGQLDFFLRECPKGMKGMSTGLLLSTLALGFFFSSVLVTIVEKFTGKAHPW
IADDLNKGRLYNFYWLVAVLVALNFLIFLVFSKWYVYKEKRLAEVGIELDDEPSIPMGH

Arabidopsis thaliana Arath_02 / AtNRT1-9 AT1G18880

MEVEKTEKNIAEDDESKIIYRGWKVMPFIIGNETFEKLGIVGSSSNLVIYLTTVFN
MKSITAAKVVNIYGGTSNFGTIVAAFLCDSYFGRYKTLSFAMIACFLGSVAMDLTAVIHP
LHPAQCAKEIGSVCNGPSIGQIMFLAGAMVLLVIGAGGIRPCNLPFGADQFDPKTKEGKR
GIESFFNWYFFTFTFAQMVSLTLIVYVQSNVSWSIGLAIPAILMLLGCIIFFAGSKLYVKV
KASGSPIHSITRVIVVAIKKRRLKPVGPNELYNYIASDFKNSKLGHTEQFRFLDKSAIQTQ
DDKLNKDGSPVDAWKLCSMQQVEEVKCVIRVLPVWLSAALFYLAYIQQTTYTIFQSLQ
SDRRLGPGSFQIPAGSYTVFLMLGMTIFIPIYDRVLVPFLRKYTGRDGGITQLQRVGAGLF
LCITSMMVSAIVEQYRRKVALTKPTLGLAPRKGAISSMSGMWLIPQLVLMGIADALAGV
GQMEFYYKQFPENMRSFAGSLYYCGIGLASYLSTFLLSAVHDTTEGFSGGSWLPEDLNK
GRLEYFYFLVAGMMTLNLAYFLLVSHWYRYKDVVAKDKDMDKTSAEFDKVSV

Arabidopsis thaliana Arath_03 AT1G22540

MSISGAVDEAGTPLLAVTVDYRNKPAVKSSSGGWRSAGFIIGVEVAERFAYYGIS
SNLITYLTGPLGQSTAAAAANVNAWSGTASLLPLLGAFVADSFLGRFRTILAASALYIVG
LGVLTLSAMIPSDCKVSNLLSSCSPRFQVITFFSALYLVALAQGGHKPCVQAFGADQFDE
KEPEECKAKSSFFNWWYFGMCFGTLTTLWVLNYIQDNLSWALGFGIPCIAMVVALVVL
LLGTCTYRFSIRREDQSPFVRIGNVYVAAVKNWSVSALDVAAAEERLGLVSCSSSQQFSF
LNKALVAKNGSCSIDELEEAKSVLRLAPIWLTCLVYAVVFAQSPTFFTKQGATMERSITP
GYKISPATLQSFISLSIVIFIPIYDRVLIPIARSFTHKPGGITMLQRIGTGIFLSFLAMVVAAL
VEMKRLKTAADYGLVDSPDATVPMSVWWLVPQYVLFGITDVFAMVGLQEFFYDQVPN
ELRSVGLALYLSIFGIGNFLSSFMISIIEKATSQSGQASWFANNLNQAHLDYFYWLLACLS
FIGLASYLYVAKSYVSKRLDTS

Arabidopsis thaliana Arath_04 AT1G22550

MAIAEEEAALIEDSVSDSVDHRGLPAGKSSTGGWRSAWYIIGVEVGERFAYFGIG
SNLITYLTGPLGQSTATAAVNVNTWSGTASILPVLGAFIADAYLGRYRTIVVASLIYILGL
GLLTLSSILILMGLSEQRQHNRNASAKPFFWVNILFFCSLYLVAIGQGGHKPCVQAFGAD
QFDVGDPKERISRGSFFNWWFLSLSAGITLSIIVVVYVQDNVNWALGFGIPCLFMVMAL
ALFLFGRKTYRYPRGDREGKNNAFARIGRVFLVAFKNRKLKLTHSGQLEVGSYKKCKG
QLEFLAKALLPGEGGVEPCSSRDVEDAMALVRLIPIWITSVVSTIPYAQYATFFTKQGVT
VDRKILPGFEIPPASFQALIGLSIFISVPTYERVFLPLARLITKKPSGITMLQRIGAGMVLSS
LNMVVAALVEMKRLETAKEHGLVDRPDATIPMSIWWFVPQYLLLGMIDVFSLVGTQEF
FYDQVPTELRSIGLALSLSAMGLASFLSGFLITVINWATGKNGGDSWFNTNLNRAHVDY
FYWLLAAFTAIGFLAFLLLSRLYVYRRVDQV

Arabidopsis thaliana Arath_05 AT1G22570

MKIPEEEVALLEDYVSDSVDHRGFPAGKSSTGGWRSAWFIIGVEVAERFAYFGIA
CNLITYLTGPLGQSTAKAAVNVNTWSGTASILPILGAFVADAYLGRYRTIVVASLIYILGL
GLLTLSASLIIMGLSKQRNDASAKPSIWVNTLFFCSLYLVAIGQGGHKPCVQAFGADQFD
AEDPKEVIARGSFFNWWFLSLSAGISISIIVVAYVQENVNWAFGFGIPCLFMVMALAIFLL
GRKIYRYPKGHHEEVNSSNTFARIGRVFVIAFKNRKLRLEHSSLELDQGLLEDGQSEKRK
DRLNFLAKAMISREGVEPCSGRDVDDAKALVRLIPIWITYVVSTIPYAQYITFFTKQGVT
VDRRILPGVEIPAASLLSFVGVSILISVPLYERVFLPIARKITKKPFGITMLQRIGAGMVLSV
FNMMLAALVESKRLKIAREHGLVDKPDVTVPMSIWWFVPQYLLLGMIDLFSMVGTQEF
FYDQVPTELRSIGLSLSLSAMGLSSFLSGFLISLIDWATGKDGWFNSNLNRAHVDYFYWL
LAAFTAIAFFAFLFISKMYVYRRLDQV

Arabidopsis thaliana Arath_06 AT1G27040

MEVEMHGDVSKWEGYADWRNKAALRGRHGGMLAASFVLAVEILENLAFLAN
ASNLVLYLKNFMHMSLARSSSEVTTFMATAFLLALLGGFLADAFFSTFVIFLISASIEFLG
LILLTIQARRPSLMPPPCKSSAALRCEVVGGSKAAFLFVGLYLVSLGIGGIKGSLPSHGAE
QFDEGTPKGRKQRSTFFNYYVFCLSCGALVAVTFVVWIEDNKGWEWGFGVSTISIFLSIL
VFLLGSRFYKNKIPRGSPLTTIFKVLLAASIVSCSSKTSSNHFTSREVQSEHEEKTPSQSLT
NSLTCLNKAIEGKTHHIWLECTVQQVEDVKIVLKMLPIFGCTIMLNCCLAQLSTYSVHQ
AATMNRKIVNFNVPSASLPVFPVVFMLILAPTYDHLIIPFARKVTKSEIGITHLQRIGVGL
VLSIVAMAVAALVELKRKQVAREAGLLDSEETLPITFLWIALQYLFLGSADLFTLAGLLE
FFFTEAPSSMRSLATSLSWASLALGYYLSSVMVPIVNRVTKSAGQSPWLGEKLNRNRLD
LFYWLMCVLSVVNFLHYLFWAKRYKYISTGSIS

Arabidopsis thaliana Arath_07 / AtNRT1-6 AT1G27080

MGVVENRKILPEKKLGGWRAITFILGNETLEKLGSIGVSANFMLYLRNVFHMEPV
EAFNVYYLWMGLTNFAPLLGALISDAYIGRFKTIAYASLFSILGLMTVTLTACLPQLHPP
PCNNPHPDECDDPNKLQLGILFLGLGFLSIGSGGIRPCSIPFGVDQFDQRTEQGLKGVASF
FNWYYLTLTMVLIFSHTVVVYLQTVSWVIGFSIPTSLMACAVVLFFVGMRFYVYVKPEG
SVFSGIARVIVAARKKRDLKISLVDDGTEEYYEPPVKPGVLSKLPLTDQFKFLDKAAVIL

DGDLTSEGVPANKWRLCSIQEVEEVKCLIRVVPVWSAGIISIVAMTTQATFMVFQATKM
DRHMGPHFEIPAASITVISYITIGIWVPIYEHLLVPFLWRMRKFRVTLLQRMGIGIVFAILS
MFTAGFVEGVRRTRATEMTQMSVFWLALPLILMGLCESFNFIGLIEFFNSQFPEHMRSIA
NSLFPLSFAAANYLSSLLVTTVHKVSGTKDHPDWLNKDLDRGKLDYFYYLIAVLGVVN
LVYFWYCAHRYQYKAGSQIEDFNEEKSLLDIEPNQRHDQSPS

Arabidopsis thaliana Arath_08 / AtNRT1-5 AT1G32450

MSCLEIYNKDTMKKKEGEEETRDGTVDYYGRPSIRSNSGQWVAGIVILLNQGLA
TLAFFGVGVNLVLFLTRVLQQNNADAANNVSKWTGTVYIFSLVGAFLSDSYWGRYKTC
AIFQVIFVIGLSSLSLSSYMFLIRPRGCGDEVTPCGSHSMMEITMFYFSIYLIALGYGGYQP
NIATLGADQFDEEHPKEGYSKIAFFSYFYLALNLGSLFSNTILGYFEDEGMWALGFWAST
GSAIIGLILFLVGTPRYRYFKPTGNPLSRFCQVLVAATKKSSVEAPLRGREEMYDGDSEG
KNASVNTGRRIVHTDEFKFLDKAAYITARDLDDKKQDSVNPWRLCPVTQVEEVKCILRL
MPIWLCTIIYSVVFTQMASLFVEQGAAMNTSVSDFKIPPASMSSFDILSVALFIFLYRRVL
EPVANRFKKNGSKGITELHRMGIGLVIAVIAMIAAGIVECYRLKYADKSCTHCDGSSSLS
IFWQAPQYSLIGASEVFMYVGQLEFFNAQTPDGLKSFGSALCMMSMSMGNFVSSLLVT
MVVKISTEDHMPGWIPRNLNKGHLDRFYFLLAALTSIDLVVYIACAKWYKPIQLEGKDE
MQDMSDDDYDTESEEEREKDSKV

Arabidopsis thaliana Arath_09 AT1G33440

MDVHDLSEEAKRGVIHTSEESLDDLCVDFRGRPCRPSKHGGTRAALFVLGFQAF
EMMAIAAVGNNLITYVFNEMHFPLSKSANLVTNFIGTVFLLSLLGGFLSDSYLGSFRTML
VFGVIEISGFILLSVQAHLPELRPPECNMKSTTIHCVEANGYKAATLYTALCLVALGSGCL
KPNIISHGANQFQRKDLRKLSSFFNAAYFAFSMGQLIALTLLVWVQTHSGMDVGFGVSA
AVMAAGMISLVAGTSFYRNKPPSGSIFTPIAQVFVAAITKRKQICPSNPNMVHQPSTDLV
RVKPLLHSNKFRFLDKACIKTQGKAMESPWRLCTIEQVHQVKILLSVIPIFACTIIFNTILA
QLQTFSVQQGSSMNTHITKTFQIPPASLQAIPYIILIFFVPLYETFFVPLARKLTGNDSGISP
LQRIGTGLFLATFSMVAAALVEKKRRESFLEQNVMLSIFWIAPQFLIFGLSEMFTAVGLV
EFFYKQSSQSMQSFLTAMTYCSYSFGFYLSSVLVSTVNRVTSSNGSGTKEGWLGDNDLN
KDRLDHFYWLLASLSFINFFNYLFWSRWYSCDPSATHHSAEVNSLEALENGEIKDSTTE
KPRI

Arabidopsis thaliana Arath_10 AT1G52190

MENPPNETEAKQIQTNEGKKTKGGIITMPFIIANEAFEKVASYGLLPNMIMYLIRD
YRFGVAKGTNVLFMWSAASNFTPLLGAFLSDSYLGRFLTISIASLSSFLGMVLLWLTAM
LPQVKPSPCDPTAAGSHCGSSTASQLALLYSAFALISIGSGGIRPCSLAFGADQLDNKENP
KNERVLESFFGWYYASSAVAVLIAFTGIVYIQEHLGWKIGFGVPAVLMLIAALLFILASPL
YVTRGVTKSLFTGLAQAIVAAYKKRKLSLPDHHDSFDCYYHMKDSEIKAPSQKLRFLN
KACLISNREEEIGSDGFALNPWRLCTTDKVEELKALIKVIPIWSTGIMMSINTSQSSFQLLQ
ATSMDRRLSRHGSSFQVPAGSFGMFTIIALALWVILYDRAVIPLASKIRGRPFRLSVKLR
MGLGLFMSFLAMAISAMVESFRRKKAISQGYANNSNAVVDISAMWLVPQYVLHGLAE
ALTAIGQTEFFYTEFPKSMSSIAASLFGLGMAVASLLASVVLNAVNELTSRNGKESWVS

DNINKGHYNYYYWVLAIMSFINVIYYVICSWSYGPLVDQVRNGRVNGVREEEELIDIVG
KGFEKEDLSPVVKTN

Arabidopsis thaliana Arath_11 AT1G59740

MAEINKQSNKWEQEEVSNENNWELAEEESVDWRGRPSNPNKHGGMRAALFVL
GLQAFEIMGIAAVGNNLITYVINEMHFPLSKAANIVTNFVGTIFIFALLGGYLSDAFLGSF
WTIIIFGFVELSGFILLSVQAHLPQLKPPKCNPLIDQTCEEAKGFKAMIFFMALYLVALGS
GCVKPNMIAHGADQFSQSHPKQSKRLSSYFNAAYFAFSMGELIALTLLVWVQTHSGMD
IGFGVSAAAMTMGIISLVSGTMYFRNKRPRRSIFTPIAHVIVAAILKRKLASPSDPRMLHG
DHHVANDVVPSSTLPHTPRFRFLDKACIKIQDTNTKESPWRLCTVTQVEQVKTLISLVPIF
ASTIVFNTILAQLQTFSVQQGSSMNTRLSNSFHIPPASLQAIPYIMLIFLVPLYDSFLVPFAR
KLTGHNSGIPPLTRIGIGLFLSTFSMVSAAMLEKKRRDSSVLDGRILSIFWITPQFLIFGISE
MFTAVGLIEFFYKQSAKGMESFLMALTYCSYSFGFYFSSVLVSVVNKITSTSVDSKGWL
GENDLNKDRLDLFYWLLAVLSLLNFLSYLFWSRWNIKSSRRNNTNVVGDENI

Arabidopsis thaliana Arath_12 AT1G62200

MVNSNEEDERRILDVEESLLTQEEVNNHLTGLSSTAEDGSIDIYGNPPSKKKTGN
WKACPFILGNECCERLAYYGIAKNLITYYTSELHESNVSAASDVMIWQGTCYITPLIGAV
IADSYWGRYWTIASFSAIYFIGMALLTLSASLPVLKPAACAGVAAALCSPATTVQYAVFF
TGLYLIALGTGGIKPCVSSFGADQFDDTDPRERVRKASFFNWFYFSINIGSFISSTLLVWV
QENVGWGLGFLIPTVFMGVSIASFFIGTPLYRFQKPGGSPITRVCQVLVAAYRKLKLNLP
EDISFLYETREKNSMIAGSRKIQHTDGYKFLDKAAVISEYESKSGAFSNPWKLCTVTQVE
EVKTLIRMFPIWASGIVYSVLYSQISTLFVQQGRSMNRIIRSFEIPPASFGVFDTLIVLISIPI
YDRFLVPFVRRFTGIPKGLTDLQRMGIGLFLSVLSIAAAAIVETVRLQLAQDFVAMSIFW
QIPQYILMGIAEVFFFIGRVEFFYDESPDAMRSVCSALALLNTAVGSYLSSLILTLVAYFT
ALGGKDGWVPDDLNKGHLDYFFWLLVSLGLVNIPVYALICVKHTKKKAL

Arabidopsis thaliana Arath_13 / AtNitr1 AT1G68570

MEEQSKNKISEEEKQLHGRPNRPKGGLITMPFIFANEICEKLAVVGFHANMISYLT
TQLHLPLTKAANTLTNFAGTSSLTPLLGAFIADSFAGRFWTITFASIIYQIGMTLLTISAIIP
TLRPPPCKGEEVCVVADTAQLSILYVALLLGALGSGGIRPCVVAFGADQFDESDPNQTT
KTWNYFNWYYFCMGAAVLLAVTVLVWIQDNVGWGLGLGIPTVAMFLSVIAFVGGFQL
YRHLVPAGSPFTRLIQVGVAAFRKRKLRMVSDPSLLYFNDEIDAPISLGGKLTHTKHMSF
LDKAAIVTEEDNLKPGQIPNHWRLSTVHRVEELKSVIRMGPIGASGILLITAYAQQGTFSL
QQAKTMNRHLTNSFQIPAGSMSVFTTVAMLTTIIFYDRVFVKVARKFTGLERGITFLHR
MGIGFVISIIATLVAGFVEVKRKSVAIEHGLLDKPHTIVPISFLWLIPQYGLHGVAEAFMSI
GHLEFFYDQAPESMRSTATALFWMAISIGNYVSTLLVTLVHKFSAKPDGSNWLPDNNLN
RGRLEYFYWLITVLQAVNLVYYLWCAKIYTYKPVQVHHSKEDSSPVKEELQLSNRSLV
DE

Arabidopsis thaliana Arath_14 / AtNRT1-2 AT1G69850

MEVEEEVSRWEGYADWRNRAAVKGRHGGMLAASFVLVVEILENLAYLANASN

LVLYLREYMHMSPSKSANDVTNFMGTAFLLALLGGFLSDAFFSTFQIFLISASIEFLGLIIL
TIQARTPSLMPPSCDSPTCEEVSGSKAAMLFVGLYLVALGVGGIKGSLASHGAEQFDEST
PKGRKQRSTFFNYFVFCLACGALVAVTFVVWLEDNKGWEWGFGVSTIAIFVSILIFLSGS
RFYRNKIPCGSPLTTILKVLLAASVKCCSSGSSSNAVASMSVSPSNHCVSKGKKEVESQG
ELEKPRQEEALPPRAQLTNSLKVLNGAADEKPVHRLLECTVQQVEDVKIVLKMLPIFAC
TIMLNCCLAQLSTFSVQQAASMNTKIGSLKIPPASLPIFPVVFIMILAPIYDHLIIPFARKAT
KTETGVTHLQRIGVGLVLSILAMAVAALVEIKRKGVAKDSGLLDSKETLPVTFLWIALQ
YLFLGSADLFTLAGLLEYFFTEAPSSMRSLATSLSWASLAMGYYLSSVIVSIVNSITGSSG
NTPWLRGKSINRYKLDYFYWLMCVLSAANFLHYLFWAMRYKYRSTGSRS

Arabidopsis thaliana Arath_15 AT1G69860

MDNEKGTSSSDLTTRQRKPLGWKAMPYIIGNETLERLATFGLMANFMVYMVRE
YHMDQVQAVTLINTWSALTNFAPIIGAFISDSYTGKFNTIVFGSIAELLGMLVLTFTSLVP
NLRPPPCTADQITGQCIPYSYSQLYVLLSGLFLLSVGTGGIRSCSVPFSLDQFDDSTEEGRE
GSRSFFSWYYTTHTIVQLVSMTLVLYVQNNISWGIGFAIPTVLNFFALLLLFVGTRYYVF
VKPEGSVFSGVFKVLVAAYKKRKARFTSGIDYHQPLLETDLQSNKLVLTDQFRFLNKAV
IVMNNDEAGNEEWRTCTVRQIEDIKSIISIIPIFASSIIGFLAMNQQQTFTVSQALKMDLQF
PGTSYLIPPASITVISLLNIGIWLPFYETVLVRHIENITKQNGGISLLQKVGIGNIFSISTMLIS
GIVERKRRDLSLNGVKMSVFWLTPQQVLMGFYQVFTIVGLTEFFNKQVPINMRSIGNSL
LYLGLSLASYLSSAMVSIVHSVTARGGQSWLTDDIDKSKLDCFYYFIAALSTLNFIFFFW
CARRYRYRNYSNEQ

Arabidopsis thaliana Arath_16 / AtNRT1-7 AT1G69870

MVLEDRKDGSSLPGRSGSFSKSSPSELDVVDPYKRISSPGSILDAEKVEKKPGGW
RAVSFILGNETLERLGSIGLLANFMVYLTKVFHLEQVDAANVINIWSGFTNLTPLVGAYI
SDTYVGRFKTIAFASFATLLGLITITLTASFPQLHPASCNSQDPLSCGGPNKLQIGVLLLGL
CFLSVGSGGIRPCSIPFGVDQFDQRTEEGVKGVASFFNWYYMTFTVVLIITQTVVVYIQD
QVSWIIGFSIPTGLMALAVVMFFAGMKRYVYVKPEGSIFSGIAQVIVAARKKRKLKLPAE
DDGTVTYYDPAIKSSVLSKLHRSNQFRCLDKAAVVIEGDLTPEGPPADKWRLCSVQEVE
EVKCLIRIVPIWSAGIISLAAMTTQGTFTVSQALKMDRNLGPKFEIPAGSLSVISLLTIGIFL
PFYDRVFVPFMRRITGHKSGITLLQRIGTGIVFAIFSMIVAGIVERMRRIRSINAGDPTGMT
PMSVFWLSPQLILMGLCEAFNIIGQIEFFNSQFPEHMRSIANSLFSLSFAGSSYLSSFLVTV
VHKFSGGHDRPDWLNKNLNAGKLDYFYYLIAVLGVVNLVYFWYCARGYRYKVGLPIE
DFEEDKSSDDVEMTSKKSMK

Arabidopsis thaliana Arath_17 AT1G72120

MTTTSEISLQEEYVTDAVDHRGLAARRSNTGRWRAALFIIGVEVAERFAYYGIGS
NLISYLTGPLGESTAVAAANVNAWSGIATLLPVLGAFVADAFLGRYRTIIISSLIYVLGLA
FLTLSAFLIPNTTEVTSSTSSFLNVLFFFSLYLVAIGQSGHKPCVQAFGADQFDEKDSQEK
SDRSSFFNWWYLSLSAGICFAILVVVYIQEEFSWAFGFGIPCVFMVISLVLFVSGRRIYRY
SKRRHEEEINPFTRIGRVFFVALKNQRLSSSDLCKVELEANTSPEKQSFFNKALLVPNDSS
QGENASKSSDVEDATALIRLIPVWFTTLAYAIPYAQYMTFFTKQGVTMDRTILPGVKIPP

ASLQVFIGISIVLFVPIYDRVFVPIARLITKEPCGITTLKRIGTGIVLSTITMVIAALVEFKRL
ETAKEHGLIDQPEATLPMSIWWLIPQYLLLGLADVYTLVGMQEFFYSQVPTELRSIGLAL
YLSALGVGSLLSSLLISLIDLATGGDAGNSWFNSNLNRAHLDYFYWLLAIVSAVGFFTFL
FISKSYIYRRVDRV

Arabidopsis thaliana Arath_18 AT1G72125

MTTTSKTSLQEEYVIDAVDHRGFSARRSITGRWRAAWFIIGVEVAERFANYGIGS
NLISYLTGPLGQSTAVAAANVNAWSGISTILPLLGAFVADAFLGRYITIIIASFIYVLGLAF
LTLSAFLIPNNTEVTSSPSSFLNALFFFSLYLVAIGQSGHKPCVQAFGADQFDEKNPQENS
DRSSFFNWWYLSMCAGIGLAILVVVYIQENVSWALGFGIPCVFMVISLVLFVLGRKSYR
FSKTRQEEETNPFTRIGRVFFVAFKNQRLNSSDLCKVELIEANRSQESPEELSFLNKALLV
PNDSDEGEVACKSRDVEDATALVRLIPVWLTTLAYAIPFAQYMTFFTKQGVTMERTIFP
GVEIPPASLQVLISISIVLFVPIYDRVLVPIGRSITKDPCGITTLKRIGTGMVLATLTMVVAA
LVESKRLETAKEYGLIDQPKTTLPMSIWWLFPQYMLLGLADVHTLVGMQEFFYSQVPTE
LRSLGLAIYLSAMGVGSLLSSLLIYLIDLATGGDAGNSWFNSNLNRAHLDYFYWLLAVV
SAVGFFTFLFISKSYIYRRVDVV

Arabidopsis thaliana Arath_19 AT1G72130

MAITYSSADELGNTTEGFLEIRENTSGGWKSARLIIVVQMAERFAYFGIASNLIMY
LTGPLGESTAAAAANVNAWTGTVAFLPLLGGFLADSYLGRFRTIIISSSLYILGLGLLSFS
TMIPSHQSKDSNQLQETIFFFSLYLVAIGQGGYNPCIKVFGADQFDGNDHKEARDKSSFF
NWLMFGNCISILTTRLVSTYIQENLSWSLGFGIPSVSMLLSLFLFLLGTTSYRFSTERVGK
KNPFARISRVFMEALKNRRQPDLDIANANANETLLLLAHQSSKQFRFLDRAAISCELAEI
EEAKAVLRLIPIWITSVVYTIVHAQSPTFFTKQGATMDRSISPGLLVPAATLQSFINLSVV
VFIPIYDRLLVPFARSFTQNSSGITTLQRIGTGIFLSILAMVLAALVETKRLQAARDELSIP
MSVWWLIPQYVIFGVSDMFTMVGLQEFFYGQVPSELRSVGMALNLSIYGAGNYLSSFMI
SVIDKITNQYGQRSWFDNDLDQAHLDYFYWLLACLGFIGFAFYLWFAKSYVYSRSNTF

Arabidopsis thaliana Arath_20 AT1G72140

MSTSIGDNETGAIVSNENVEFSVDFRGNPSIRSSSGAWKSSGFTMCAEVAEKFAY
FGIASNLITYFTEALGESTAVAASNVNLWLGTAAFLPLIWGSIADSFLGRFRTILLTSSFYI
MGLGLLTFSATIPSLCNDQETRESCVSQVKVIIFFCALYLIALGEGGFKVCLRAFGADQFD
EQDPNESKAKSSYFNWLYFAISIGILTTRLVTNYVQENLSWALGYAIPCLSMMLALFLFL
LGIKTYRFSTGGEGRQGKKHDNPFVRIGRVFVAAARNRRQTPSDTCLLLPNESTKKFRFL
DRAVISCDSYEVEEAKAVLSLIPIWLCSLVFGIVFAQSPTFFTKQGSTMDRSISSTLQVPA
ATLQCFISLAILVFIPIYDRLFVPIARSITRKPAGITTLQRISTGIFLSIISMVIAALVEMKRLK
TARDHGLVDSPKATVPMSVCWLIPQYILFGVSDVFTMVGLQEFFYGEVPPQLRSMGLAL
YLSIIGIGNFLSSFMVSVIEEATSQSGQVSWFSNNLNQAHLDYFYWLLACLSSLAFIFTVY
FAKSYLYNSPK

Arabidopsis thaliana Arath_21 AT2G02020

MASIDEERSLLEVEESLIQEEVKLYAEDGSIDIHGNPPLKQTTGNWKACPFIFANE

CCERLAYYGIAKNLITYFTNELHETNVSAARHVMTWQGTCYITPLIGALIADAYWGRY
WTIACFSAIYFTGMVALTLSASVPGLKPAECIGSLCPPATMVQSTVLFSGLYLIALGTGGI
KPCVSSFGADQFDKTDPSERVRKASFFNWFYFTINIGAFVSSTVLVWIQENYGWELGFLI
PTVFMGLATMSFFFGTPLYRFQKPRGSPITSVCQVLVAAYRKSNLKVPEDSTDEGDANT
NPWKLCTVTQVEEVKILLRLVPIWASGIIFSVLHSQIYTLFVQQGRCMKRTIGLFEIPPATL
GMFDTASVLISVPIYDRVIVPLVRRFTGLAKGFTELQRMGIGLFVSVLSLTFAAIVETVRL
QLARDLDLVESGDIVPLNIFWQIPQYFLMGTAGVFFFVGRIEFFYEQSPDSMRSLCSAWA
LLTTTLGNYLSSLIITLVAYLSGKDCWIPSDNINNGHLDYFFWLLVSLGSVNIPVFVFFSV
KYTHMKV

Arabidopsis thaliana Arath_22 / AtPTR2 AT2G02040

MGSIEEEARPLIEEGLILQEVKLYAEDGSVDFNGNPPLKEKTGNWKACPFILGNEC
CERLAYYGIAGNLITYLTTKLHQGNVSAATNVTTWQGTCYLTPLIGAVLADAYWGRY
WTIACFSGIYFIGMSALTLSASVPALKPAECIGDFCPSATPAQYAMFFGGLYLIALGTGGI
KPCVSSFGADQFDDTDSRERVRKASFFNWFYFSINIGALVSSSLLVWIQENRGWGLGFGI
PTVFMGLAIASFFFGTPLYRFQKPGGSPITRISQVVVASFRKSSVKVPEDATLLYETQDKN
SAIAGSRKIEHTDDCQYLDKAAVISEEESKSGDYSNSWRLCTVTQVEELKILIRMFPIWAS
GIIFSAVYAQMSTMFVQQGRAMNCKIGSFQLPPAALGTFDTASVIIWVPLYDRFIVPLAR
KFTGVDKGFTEIQRMGIGLFVSVLCMAAAAIVEIIRLHMANDLGLVESGAPVPISVLWQI
PQYFILGAAEVFYFIGQLEFFYDQSPDAMRSLCSALALLTNALGNYLSSLILTLVTYFTTR
NGQEGWISDNLNSGHLDYFFWLLAGLSLVNMAVYFFSAARYKQKKASS

Arabidopsis thaliana Arath_23 / AtNRT1-4 AT2G26690

MESKGSWTVADAVDYKGRPADKSKTGGWITAALILGIEVVERLSTMGIAVNLVT
YLMETMHLPSSTSANIVTDFMGTSFLLCLLGGFLADSFLGRFKTIGIFSTIQALGTGALAV
ATKLPELRPPTCHHGEACIPATAFQMTILYVSLYLIALGTGGLKSSISGFGSDQFDDKDPK
EKAHMAFFFNRFFFFISMGTLLAVTVLVYMQDEVGRSWAYGICTVSMAIAIVIFLCGTK
RYRYKKSQGSPVVQIFQVIAAAFRKRKMELPQSIVYLYEDNPEGIRIEHTDQFHLLDKAA
IVAEGDFEQTLDGVAIPNPWKLSSVTKVEEVKMMVRLLPIWATTIIFWTTYAQMITFSVE
QASTMRRNIGSFKIPAGSLTVFFVAAILITLAVYDRAIMPFWKKWKGKPGFSSLQRIAIGL
VLSTAGMAAAALVEQKRLSVAKSSSQKTLPISVFLLVPQFFLVGAGEAFIYTGQLDFFIT
QSPKGMKTMSTGLFLTTLSLGFFVSSFLVSIVKRVTSTSTDVGWLADNINHGRLDYFYW
LLVILSGINFVVYIICALWFKPTKGKDSVEKENGKGFSVEDC

Arabidopsis thaliana Arath_24 AT2G37900

MEHKNIGAEVLQDTYDDQQKWVLDSSLDSRGRVPLRARTGAWRAALFIIAIEFS
ERLSYFGLATNLVVYLTTILNQDLKMAIRNVNYWSGVTTLMPLLGGFIADAYLGRYAT
VLVATTIYLMGLVLLTMSWFIPGLKPCHQEVCVEPRKAHEVAFFIAIYLISIGTGGHKPSL
ESFGADQFDDDHVEERKMKMSFFNWWNVSLCAGILTAVTAVAYIEDRVGWGVAGIILT
VVMAISLIIFFIGKPFYRYRTPSGSPLTPILQVFVAAIAKRNLPYPSDPSLLHEVSKTEFTSG
RLLCHTEHLKFLDKAAIIEDKNPLALEKQSPWRLLTLTKVEETKLIINVIPIWFSTLAFGIC
ATQASTFFIKQAITMDRHIGGFTVPPASMFTLTALTLIISLTVYEKLLVPLLRSITRNQRGI

NILQRIGTGMIFSLITMIIAALVEKQRLDRTNNNKPMSVIWLAPQFMVIGFADAFTLVGLQ
EYFYHQVPDSMRSLGIAFYLSVIGAASFLNNLLITAVDTLAENFSGKSWFGKDLNSSRLD
RFYWFLAGVIAANICVFVIVAKRCPYKSVQPSQGLS

Arabidopsis thaliana Arath_25 AT2G40460

MEAAKVYTQDGTVDLQGRPVLASKTGRWRACSFLLGYEAFERMAFYGIASNLV
NYLTKRLHEDTISSVRNVNNWSGAVWITPIAGAYIADSYIGRFWTFTASSLIYVLGMILL
TMAVTVKSLRPTCENGVCNKASSLQVTFFYISLYTIAIGAGGTKPNISTFGADQFDSYSIE
EKKQKVSFFNWWMFSSFLGALFATLGLVYIQENLGWGLGYGIPTVGLLVSLVVFYIGTP
FYRHKVIKTDNLAKDLVQVPIAAFKNRKLQCPDDHLELYELDSHYYKSNGKHQVHHTP
VFRFLDKAAIKTSSRVPCTVTKVEVAKRVLGLIFIWLVTLIPSTLWAQVNTLFVKQGTTL
DRKIGSNFQIPAASLGSFVTLSMLLSVPMYDQSFVPFMRKKTGNPRGITLLQRLGVGFAI
QIVAIAIASAVEVKRMRVIKEFHITSPTQVVPMSIFWLLPQYSLLGIGDVFNAIGLLEFFYD
QSPEEMQSLGTTFFTSGIGLGNFLNSFLVTMIDKITSKGGGKSWIGNNLNDSRLDYYYGF
LVVISIVNMGLFVWAASKYVYKSDDDTKEFSGGGCVQMEAKALDTSPLSI

Arabidopsis thaliana Arath_26 AT3G01350

MDLEQKTRGLSKSCALLIVIAGMERYAFKGVASNLVTYLTDVVKMSNSRAAKT
VNTWAGFTSMLPLFSAPLADTYWDRFFTILASSSVYFVGLVGLTWTAFAGSRSATKTISS
YFLYSSLCLVSIGLGVLNPSLQAFGADQLDHDLDKNFDLSSGDQKDAKATRKTQFFQL
WYFGVCTGSLMGVTVMAYIQDTFGWVLGFAIPGIVIFLSILVFMSGCGIYVYAPGARLK
KKTTTTPFEKILKFIKGRVVKQRSIYTLADEKDLDAMELELEERPLCKCETEDIETPSTTS
KGLEDDESSKTVFSGIDNVKLVIRLFPIWMMLLMFAVIFQLPATFFTKQGVTMKRNIGSN
FKIPPATLQSTITLSIILLMPLYDKILIPITKRIKKNGTGISVMERMGVGMFLSIIAIVIAAIVE
RKRLAISQKMKTLPDYDPETVPLSIFWLLPQYILLGISDIFTVVGMQEFFYSEVPVRMRT
MGFALYTSVFGVGSFVSAALISIVEAYSSSTGDRQNWFADDMSEARLDKYYWLLALTS
TISFVVYIFLCKFFKSSSDQGDEKEEAPK

Arabidopsis thaliana Arath_27 AT3G16180

MENPPDQTESKETLQQPITRRRTKGGLLTMPFIIANEGFEKVASYGLLQNMILYL
MSDYRLGLVKGQTVLFMWVAATNFMPLVGAFLSDSYLGRFLTIVIASLSSLLGMVVLW
LTAMLPQVKPSPCVATAGTNCSSATSSQLALLYTAFALISIGSGGIRPCSLAFGADQLDN
KENPKNERVLESFFGWYYASSSVAVLIAFTVIVYIQDHLGWKIGFGIPAILMLLAGFLFVF
ASPLYVKRDVSKSLFTGLAQVVAAAYVKRNLTLPDHHDSRDCYYRLKDSELKAPSDKL
RFLNKACAISNRDEDLGSDGLALNQWRLCTTDQVEKLKALVKVIPVWSTGIMMSINVS
QNSFQLLQAKSMDRRLSSNSTFQIPAGSFGMFTIIALISWVVLYDRAILPLASKIRGRPVR
VNVKIRMGLGLFISFLAMAVSATVEHYRRKTAISQGLANDANSTVSISAMWLVPQYVL
HGLAEALTGIGQTEFFYTEFPKSMSSIAASLFGLGMAVANILASVILNAVKNSSKQGNVS
WIEDNINKGHYDYYYWVLAILSFVNVIYYVVCSWSYGPTVDQVRNDKVNGMRKEEEE
VIKLN

Arabidopsis thaliana Arath_28 / AtNRT1-3 AT3G21670

MVHVSSSHGAKDGSEEAYDYRGNPPDKSKTGGWLGAGLILGSELSERICVMGIS
MNLVTYLVGDLHISSAKSATIVTNFMGTLNLLGLLGGFLADAKLGRYKMVAISASVTAL
GVLLLTVATTISSMRPPICDDFRRLHHQCIEANGHQLALLYVALYTIALGGGGIKSNVSG
FGSDQFDTSDPKEEKQMIFFFNRFYFSISVGSLFAVIALVYVQDNVGRGWGYGISAATM
VVAAIVLLCGTKRYRFKKPKGSPFTTIWRVGFLAWKKRKESYPAHPSLLNGYDNTTVPH
TEMLKCLDKAAISKNESSPSSKDFEEKDPWIVSTVTQVEEVKLVMKLVPIWATNILFWTI
YSQMTTFTVEQATFMDRKLGSFTVPAGSYSAFLILTILLFTSLNERVFVPLTRRLTKKPQG
ITSLQRIGVGLVFSMAAMAVAAVIENARREAAVNNDKKISAFWLVPQYFLVGAGEAFA
YVGQLEFFIREAPERMKSMSTGLFLSTISMGFFVSSLLVSLVDRVTDKSWLRSNLNKARL
NYFYWLLVVLGALNFLIFIVFAMKHQYKADVITVVVTDDDSVEKEVTKKESSEFELKDI
P

Arabidopsis thaliana Arath_29 AT3G25260

MQIEMEEKFEDWRGKEAISGKHGGIKAAFIACVVETMENMVFLACSTNFMMYF
TKSMNYSTPKAATMVTNFVGTSFLLTIFGGFVADSFLTRFAAFVLFGSIELLGLIMLTLQ
AHITKLQPQGGKKPSTPQSTVLFTGLYAIAIGVGGVKGSLPAHGGDQIGTRNQRLISGFF
NWYFFSVCLGGFLAVTLMVWIEENIGWSSSFTISTAVLASAIFVFVAGCPMYRFKRPAGS
PLTRIVNVFVSAARNRNRFVTDAEVVTQNHNSTDKSIHHNKFKFLNKAKLNNKISATQV
EETRTFLALLPIFGSTIIMNCCVAQMGTFSVQQGMVTNRKLSRSFEIPVASLNAIPLLCML
SSLALYELFGKRILSNSERSSSFNLKRIGYGLALTSISMAVAAIVEVKRKHEAVHNNIKIS
VFWLELQFVMLSLSDMLTVGGMLEFFFRESPASMRSMSTALGWCSTAMGFFLSSVLVE
VVNGITGWLRDDLNESRLELFYLVLCVLNTLNLFNYIFWAKRY

Arabidopsis thaliana Arath_30 AT3G25280

MENDMEEKFEDWKGKEAIPGKHGGIRAASIVCVVVMMENIVFIANGFNFVKYF
MGSMHYTPATAANMVTNFMGTSFLLTLFGGFIADSFVTHFTTFIVFCCIELMGLILLTFQ
AHNPKLLPEKDKTPSTLQSAILFTGLYAMAIGTGGLKASLPSHGGDQIDRRNPRLISRFFD
WLYFSICSGCLLAVTVVLWIEEKKGWIWSFNISVGILATALCIFTVGLPFYRFKRPNGSPL
KKIAIVIISAARNRNKSDLDEEMMRGLISIYKNNSHNKLKWIDKATLNKNISETEVEETRT
FLGLLPIFGSTIVMSCCVAQLSTFSAQQGMLMNKKLFHSFEIPVPSLTAIPLIFMLLSIPLYE
FFGKKISSGNNNRSSSFNLKRIGLGLALSSVSMAVSAIVEAKRKHEVVHNNFRISVLWLV
FQYLMLSVSDMLTLGGMLEFFYREAPSNMKSISTALGWCSTALGFFLSTTLVEVTNAVT
GRLGHQWLGGEDLNKTRLELFYVLLCVLNTLNLLNYIFWAKRY

Arabidopsis thaliana Arath_31 / NAXT1 AT3G45650

MASSVTGDAETAISADSSTKRRGGGWITFPFMIATLLGLTIAAWGWLLNLIVYLIE
EFNVKSIAAAQIANIVSGCICMVPAVAAIASDSFFGTIPVISVSAFISLMGVALLTLTASLD
TLRPRPCETASILCQSPSKTQLGVLYTAITLASIGTGGTRFTLATAGANQYEKTKDQGSFF
NWFFFTTYLAGAISATAIVYTEDNISWTLGFGLSVAANFFSFLVFVSGKRFYKHDKPLGS
PFTSLLCVIFAALRKRKAVVSTNEKDYHNESITMPTKSFRFFNRAALKQEDEVKPDGTIR
NPWRLCSVQQVEDFKAVIRIIPLALATIFLSTPIAMQLSLTVLQGLVMDRRLGPSFKIPAG

SLQVITLLSTCLFIIVNDRVLYPFYQKLTGKHLTPLQRVGIGHAFNILSMAVTAIVEAKRL
KIVQKGHFLGSSSVADMSVLWLFPPLVIVGIGEAFHFPGNVALCYQEFPESMRSTATSITS
VVIGICFYTSTALIDLIQRTTAWLPDDINHGRVDNVYWILVIGGVLNLGYFLVCSWLYRY
RNLKDDDHKQAANVSH

Arabidopsis thaliana Arath_32 / NAXT AT3G45660

MSGSVSRDAEALKSADSSTRRSGGRITFPFMIVTLFGLTLATLGWLQNLIVYLIEE
YNMKSIAAAKILNIFSGFTFMFPAIGAIAADSFFGTIPVILVSSFISLVGVVLLALTTLFDSL
RPQACETASKLCQAPTNIQLGVLYTAITLGCVGAGGLRFTLATAGANQYEKTKDQGSFF
NWFFFTWYLAASISATAIVYAEENISWSFGFGLCVAANLLGLIVFISGKKFYKHDKPLGS
PFTSLLRVIFAAIRKRKAVVSTNEKDYHSESKKTPTKSFRFFNRAALKQDDEVNSDGTIH
NQWRLCSVQQVEDFKAVIRIIPLVLAILFLSTPIAMQLGLTVLQGLVMDRRLGPHFKIPA
GSLQVITLLSTCLFIIVNDRFLYPFYQKLTGKFPTPIQRVGIGHVFNILSMAVTAIVEAKRL
KIVQKGHFLGSSSVADMSVLWLFPPLVIVGIGEAFHFPGNVALCYQEFPESMRSTATSITS
VLIGICFYTSTALIDLIQKTTAWLPDDINHGRVDNVYWILVIGGVLNLGYFLVCSWFYKY
RNLENADHEQDANVSH

Arabidopsis thaliana Arath_33 AT3G45680

MASLVSGDKEAQISGDPGSKRGGWITFPFMLATLLGLSVTSFGWVMNLIVFLIEE
FNIKSIAAAQISNVANGCLSMLPVVAAILADSFFGNIPVIAASSFISLLGIVLLTLIASLDYL
RPRPCEAGSVLCTPPSKLHLGILYTALALVTTGAGGTRFTMASAGANQYEKPKEQGSFF
NWYFLTLYAGAITGATAIVYIQDNASWKLGFGLCAAANLISFIVFVSGKRYYKHDKPMG
SPFTSLIRVVVSATVKRKAVISCNEEDYHHYGLEKEVKTSAAMPSKSFRFLNRAALMTK
DDLNQKEGSVNNIWRLCSVQEVEDFKAILRVFPLWLSIIFVSTPMVMQTSLIVLQALVTD
RGLGPNFKVPAGSLQVIIIITACIVIIMNNWLVFPMYKKLTHKLLTPLQKVGIGQVLTILS
MALSAVVEAKRLKTVENGHPMSVLWLFPPLVIVGIGEAFQFPANIELFYGEFPESLRNTA
TSLTSVVIGISFYLSTALIDLIQRTTAWLPNDINHGRVDNVYWLLVIGGILNFGYFLVCSW
VYKYRNLKDNDQEQDPKDGTM

Arabidopsis thaliana Arath_34 AT3G45690

MARSVDTEAMTTRDPSSKRGGWKTFPFMIATLLGLSIASFGWVMNLVVFLIKEF
NIKSIAATQNSNIVNGCVSMLPVVAAILADSFFGNIPVISVSAFISLLGIILLTMITSLDHLR
PPPCETGSILCESPSKLQLGILYIALALVIIGSAGTRFTLASAGANQYEKPKEQGSFFNWYF
LTLYTGAITGATAIVYTQENASWKLGFGLCAVANLISFIVFVSGKRYYKHDKPMGSPFT
NLIRVVVAATRKRKAVISSREEDYHHGLGREGKTSSAMPSKSFRFFNRAALKTEDDSVN
NNWRLCSVQEVEDFKAVFRVLPLLLAIIFVSTPMVTQTSLIILQALVTDRGLGPHFKIPAG
SLQVIVIITACIVILMNNCLVYPMYQKLAHKPLTPLQKVGIGHVFIILSMAISAIVEAKRLK
TVTNGHSMSVLWLHRDFIASVVIGISFYLSTALITLIQKTTKWLPNDINHGRVDNVYWLL
VIVGVLNYFLVCAWFYRYRNLNDDDDQEQDPKDDTT

Arabidopsis thaliana Arath_35 AT3G45700

MANSDSGDKEAHRSSKHGGWITLPFMLVTLLGMSITYFGWVMNLIVFLIEEFNIK

SIAAVQISNIVNGVVNMLPVVAAILADSFFGNIPVISASAFISLTGISLLTLIASLDYLRPRP
CETGSILCQSPSKLQLGILYAALALVITGTAGTRFILASAGANQYKKPKEQGRFFNWYFF
TLYGGAITGTTAIVYAQDNASWKLGFGLCVAANLISFIIFVAGKRLYEHDQPLGSPYTSL
VRVLVAATMKRKAVISYKDEDYHHRELEKETKTYVAMPSKSFRFLNRAALKTEGDSNN
NMWRLCSVQEVEDFKAVLRLVPLWTSVMFLSAPLAVQMSMTVLQAMVMDRKLGPHF
KVSAGSMQVIALVSGCVFIILNNWTTYPMYQKLIRKPLTPLQKVGIGHVLTILSMAISAV
VEAKRLKTVENSHLMSVLWLVPALVINGIGEAFHFPANIAIFYGEFPESLRNTATSLTSV
VMGISFYLSTALIDVIQRTTKWLPNDINHGRVDNVYLVLVIIGVSNFGYFLVCSWFYKYR
NLKNDDHEQDLKDVTN

Arabidopsis thaliana Arath_36 AT3G45710

MADSKSGDTEVAHRSSDPSEKRGGWITLPFMLVTLLGMSITSFGWGMNLIVFLIE
EFHIKNIAAAQISNVVNGVVNMLPVVAAILADSFFGNIPVISTSTFISLAGTSLLTLITSLNY
LMPRPCETGSILCQSPSKLQLGILYVALALVIIGSAGTRFTLAAAGANQYKKPKEQGRFF
NWFFLALYIGAITGTTAIVYTQDNASWKLGFGLCAVANLISFIVFIAGVRFYKHDKPLGS
PYTSLIRVLVAATMKRKAVISSKDEDYHQYGLGKEAKTYTTMPSKSFRFLNRAALKNK
EDLNTSGDSSNNMWRLCSVQEVEDFKAILRLVPLWAAVMFLSTPVAVQMSMTVLQAL
VMDRKLSPHFEVSAGSLQVIVLVFGCVFIMLNNWIIYPMYQKLIGKPLTPLQQVGIGHVF
TILSMAISAVVEAKRLKTVENGGHPMSVLWLVPALVMVGIGEAFHFPANVAVFYGEFPE
SLKNTATSLTSVVIGISFYLSTAVIDVIQRTTSWLPNDINHGRVDNVYWVVVIGGVLNLG
YFLVCSWFYKYRNLKDDDHEQDPKDVKT

Arabidopsis thaliana Arath_37 AT3G45720

MAGLVLSNDTEAKISGDCKRGGCITFPFMIATLLGISVTSYGWVLNLIVFLIEEYNI
KSIAAAQISNIVNGCLSMLPVVTAILADSFFGNIPVISASAFISLLGIFLLTLISSFENLRPRP
CETGSILCQSPSKLHLGVLYAALALVTAGTSGTRVALASAGANQYDKPRDKGSFFNWY
FLTVNTGAIISATAIVYTQENASWRLGFGLCAAANLISFIVFISGKRFYKHDKPMGSPFTS
LIRVLVAAILKIKVVTSSKEEDYHREVEKESKTCIGMPSKSFRFLNRAALKSEKDLNQED
GLCHNPWRLCSVEEVEDFKSVLRVLPLWLAILFVGTSIGVQASMTVLQALVTDRGLDSK
FKVPAGSLQVIVLISSCVFLVLNNWTIYPIYQKITHKQLTPLQQVGIGQVFNILSMAISAIV
EAKRLKTVENEHPMSVLWLLPPLVIVGIGDAFHYMANVAVFYGEFPESMRNTATSVTS
VAFGISFYLSTALINLIQRTTAWLPDDINHGRVDNVYWVLVIGGVLNLGYFFVCSWYFT
YRKIQDDNRQDPKDVTN

Arabidopsis thaliana Arath_38 / AtGTR1 AT3G47960

MKSRVILNHRDRRDKNHNNNNTNHYTQVDTMERKPLEVEPSTTTTNTDVVDSF
EEEQRKIVYRGWKVMPFIIGNETFEKLGIIGTLSNLLVYLTSVFNLKSYTAATIINAFSGTI
NFGTFIAAFLCDTYFGRYKTLSVAVIACFLGSFVILLTAAIPSLHPVACGNKISCEGPSVG
QILFLLMGLGFLVVGAGGIRPCNLAFGADQFNPKSESGKKGINSFFNWYFFTFTFAQIISL
TAVVYIQSNVSWTIGLIIPVALMFLACVIFFAGDRLYVKVKASGSPLAGIARVIAAAIKKR
GLKPVKQPWVNLYNHIPSNYANTTLKYTDQFRFLDKAAIMTPEEKLNSDGTASDPWKL
CTLQQVEEVKCIVRVIPIWFASTIYYLAITIQMTYPVFQALQSDRRLGSGGFRIPAATYVV

FLMTGMTVFIIFYDRVLVPSLRRVTGLETGISLLQRIGAGFTFAIMSLLVSGFIEERRRNFA
LTKPTLGMAPRTGEISSMSALWLIPQLTLAGIAEAFAAIGQMEFYYKQFPENMKSFAGSI
FYVGAGVSSYLASFLISTVHRTTAHSPSGNWLAEDLNKAKLDYFYFMLTGLMVVNMA
YFLLMARWYRYKGGNDEDITEIETNEEETKQQQLQDKNSV

Arabidopsis thaliana Arath_39 AT3G53960

MEHNKVDTEPQDSYDDQQKWVLDSSTDSRGEIPLRAQTGAWRAALFIIGIEFSER
LSYFGISTNLVVYLTTILHQDLKMAVKNTNYWSGVTTLMPLLGGFVADAYLGRYGTVL
LATTIYLMGLILLTLSWFIPGLKACHEDMCVEPRKAHEIAFFIAIYLISIGTGGHKPSLESF
GADQFEDGHPEERKMKMSYFNWWNAGLCAGILTAVTVIVYIEDRIGWGVASIILTIVMA
TSFFIFRIGKPFYRYRAPSGSPLTPMLQVFVAAIAKRNLPCPSDSSLLHELTNEEYTKGRLL
SSSKNLKFLDKAAVIEDRNENTKAEKQSPWRLATVTKVEEVKLLINMIPIWFFTLAFGVC
ATQSSTLFIKQAIIMDRHITGTSFIVPPASLFSLIALSIIITVTIYEKLLVPLLRRATGNERGISI
LQRIGVGMVFSLFAMIIAALIEKKRLDYAKEHHMNKTMTLSAIWLAPQFLVLGVADAFT
LVGLQEYFYDQVPDSMRSLGIAFYLSVLGAASFVNNLLITVSDHLAEEISGKGWFGKDL
NSSRLDRFYWMLAALTAANICCFVIVAMRYTYKTVQPSLAVVADGGDDVETATGTNN
TSKFT

Arabidopsis thaliana Arath_40 / AtPTR1 AT3G54140

MEEKDVYTQDGTVDIHKNPANKEKTGNWKACRFILGNECCERLAYYGMGTNL
VNYLESRLNQGNATAANNVTNWSGTCYITPLIGAFIADAYLGRYWTIATFVFIYVSGMT
LLTLSASVPGLKPGNCNADTCHPNSSQTAVFFVALYMIALGTGGIKPCVSSFGADQFDE
NDENEKIKKSSFFNWFYFSINVGALIAATVLVWIQMNVGWGWGFGVPTVAMVIAVCFF
FFGSRFYRLQRPGGSPLTRIFQVIVAAFRKISVKVPEDKSLLFETADDESNIKGSRKLVHT
DNLKFFDKAAVESQSDSIKDGEVNPWRLCSVTQVEELKSIITLLPVWATGIVFATVYSQM
STMFVLQGNTMDQHMGKNFEIPSASLSLFDTVSVLFWTPVYDQFIIPLARKFTRNERGFT
QLQRMGIGLVVSIFAMITAGVLEVVRLDYVKTHNAYDQKQIHMSIFWQIPQYLLIGCAE
VFTFIGQLEFFYDQAPDAMRSLCSALSLTTVALGNYLSTVLVTVVMKITKKNGKPGWIP
DNLNRGHLDYFFYLLATLSFLNFLVYLWISKRYKYKKAVGRAH

Arabidopsis thaliana Arath_41 AT3G54450

MADSTSLINKRTKGGWNAALFIIVVEIAERFAFYGLASNLITFLTNELGQSTATAA
KNINTWIGVSCMFPILGAFLADSILGRFKTVLLTSFIYLLGIVMLPLSVTVVARRMREKVF
FMALYVMAVGEGGHKPCVMTFAADQFGEANAEEKAAKTSFFNYWYMAIVLASSIAVL
ALIFIQERVSWSLGFSIIAGSVVIAIVIFLIGIPKYRKQVPVGSPFTRVAQVMVAALKKWRL
SSTRHHYGLCYEEEDEHKLESTNSNQVYLLARTNQFRFLDKATIIDEIDHNKNRNPWRL
CTVNQVEEVKLILRLIPIWISLIMFCATLTQLNTFFLKQGSMMDRTIGNHFTIPPAAFQSIV
GVTILILIPLYDRVFVPMVRKITNHHSGITSLQRIGVGLFVATFNMVICGLVEAKRLKVAR
DHGLIDSPKEVVPMSSLWLLPQYILVGIGDVFTIVGMQELFYDQMPETMRSIGAAIFISVV
GVGSFVSTGIISTVQTISKSHGEEWLVNNLNRAHLDYYYWIIASLNAVSLCFYLFIANHFL
YKKLQDKDDDVESER

Arabidopsis thaliana Arath_42 / AtNRT1-8 AT4G21680

MDQKVRQFEVCTQDGSVDRHGNPAIRANTGKWLTAILILVNQGLATLAFFGVG
VNLVLFLTRVMGQDNAEAANNVSKWTGTVYIFSLLGAFLSDSYWGRYKTCAIFQASFV
AGLMMLSLSTGALLLEPSGCGVEDSPCKPHSTFKTVLFYLSVYLIALGYGGYQPNIATFG
ADQFDAEDSVEGHSKIAFFSYFYLALNLGSLFSNTVLGYFEDQGEWPLGFWASAGSAFA
GLVLFLIGTPKYRHFTPRESPWSRFCQVLVAATRKAKIDVHHEELNLYDSETQYTGDKKI
LHTKGFRFLDRAAIVTPDDEAEKVESGSKYDPWRLCSVTQVEEVKCVLRLLPIWLCTILY
SVVFTQMASLFVVQGAAMKTNIKNFRIPASSMSSFDILSVAFFIFAYRRFLDPLFARLNKT
ERNKGLTELQRMGIGLVIAIMAMISAGIVEIHRLKNKEPESATSISSSSTLSIFWQVPQYM
LIGASEVFMYVGQLEFFNSQAPTGLKSFASALCMASISLGNYVSSLLVSIVMKISTTDDV
HGWIPENLNKGHLERFYFLLAGLTAADFVVYLICAKWYKYIKSEASFSESVTEEEEV

Arabidopsis thaliana Arath_43 / AtPTR5 AT5G01180

MEDDKDIYTKDGTLDIHKKPANKNKTGTWKACRFILGTECCERLAYYGMSTNLI
NYLEKQMNMENVSASKSVSNWSGTCYATPLIGAFIADAYLGRYWTIASFVVIYIAGMTL
LTISASVPGLTPTCSGETCHATAGQTAITFIALYLIALGTGGIKPCVSSFGADQFDDTDEKE
KESKSSFFNWFYFVINVGAMIASSVLVWIQMNVGWGWGLGVPTVAMAIAVVFFFAGSN
FYRLQKPGGSPLTRMLQVIVASCRKSKVKIPEDESLLYENQDAESSIIGSRKLEHTKILTFF
DKAAVETESDNKGAAKSSSWKLCTVTQVEELKALIRLLPIWATGIVFASVYSQMGTVFV
LQGNTLDQHMGPNFKIPSASLSLFDTLSVLFWAPVYDKLIVPFARKYTGHERGFTQLQRI
GIGLVISIFSMVSAGILEVARLNYVQTHNLYNEETIPMTIFWQVPQYFLVGCAEVFTFIGQ
LEFFYDQAPDAMRSLCSALSLTAIAFGNYLSTFLVTLVTKVTRSGGRPGWIAKNLNNGH
LDYFFWLLAGLSFLNFLVYLWIAKWYTYKKTTGHAL

Arabidopsis thaliana Arath_44 AT5G13400

MVASEIKSPVSVPETPGSSSVHHRKQLSVFFIESDNRRLALGRGYTGGTTPVNIHG
KPIANLSKTGGWIAAFFIFGNEMAERMAYFGLSVNMVAFMFYVMHRPFESSSNAVNNF
LGISQASSVLGGFLADAYLGRYWTIAIFTTMYLVGLIGITLGASLKMFVPDQSNCGQLSL
LLGNCEEAKSWQMLYLYTVLYITGFGAAGIRPCVSSFGADQFDEKSKDYKTHLDRFFNF
FYLSVTLGAIIAFTLVVYVQMELGWGMAFGTLAVAMGISNALFFAGTPLYRHRLPGGSP
LTRVAQVLVAAFRKRNAAFTSSEFIGLYEVPGLKSAINGSRKIPHSNDFIWLDKAALELK
EDGLEPSPWKLCTVTQVEEVKILIRLIPIPTCTIMLSLVLTEYLTLSVQQAYTLNTHIQHLK
LPVTCMPVFPGLSIFLILSLYYSVFVPITRRITGNPHGASQLQRVGIGLAVSIISVAWAGLF
ENYRRHYAIQNGFEFNFLTQMPDLTAYWLLIQYCLIGIAEVFCIVGLLEFLYEEAPDAMK
SIGSAYAALAGGLGCFAATILNNIVKAATRDSDGKSWLSQNINTGRFDCLYWLLTLLSFL
NFCVFLWSAHRYKYRAIESEEDKSSAVL

Arabidopsis thaliana Arath_45 AT5G14940

MAGGEKRRGLSKSCALLIVIAGIERYAFKGVASNLVTYLTDVVKMSNSRAATTV
NTWSGFTFMLPLFSAPFADSYWDRFFTILASSSLYFVGLVGLTFTAFAGSRSTTKTISLYF
LYTSLSLVALGLGVLNPSLQAFGADQLDYDLDHDNDHEPSSENKEVKSNRKTQFFQWW
YFGVCAGSLLGVTVMAYIQDTFGWVIGFAIPTASMLLLIFLFLCGCGVYVYADPDLKAK

PFQRILEIIKERVCGRNKITLVNDHDLNAMELELQDQKPLCNCSNTEANTTTKSLPDDHK
SCKTGFSGLETVKLLLRLLPIWTMLLMFAVIFQQPATFFTKQGMTMKRNIGPNFKIPPAT
LQSTITLSIILLMPFYDKILIPIAKKLTKNEKGISVKERMGIGMFLSIIAIVIAALVERKRLKI
SKMMKTTPNLDPVSILWLLPQYILLGISDIFTVVGMQEFFYSEVPVSMRTMGFALYTSVF
GVGSFVSAALISIIETYTSSRGGKHNWFADDMSEARLDNYYWLLAFTSAISFLMYIVICK
HFKSRSDDDDQCDTNC

Arabidopsis thaliana Arath_46 AT5G19640

MAAMDPRNNGNVAPLNERERAENLEVREVVEVQDDQSVVSLMSNDSDLQKKM
MKKEEKKNGGWTNAIILLVNQGLATLAFFGVGVNLVLFLTRVMGQGNAEAANNVSKW
TGTVYMFSLVGAFLSDSYWGRYLTCTIFQVIFVIGVGLLSFVSWFFLIKPRGCGDGDLEC
NPPSSLGVAIFYLSVYLVAFGYGGHQPTLATFGADQLDDDKNSKAAFFSYFYFALNVGA
LFSNTILVYFEDKGLWTEGFLVSLGSAIVALVAFLAPTRQYRYVKPCGNPLPRVAQVFV
ATARKWSVVRPGDPHELYELEGPESAIKGSRKIFHSTKFLFLDRAAVITENDRNGTRSNA
WRLCSVTQVEEAKCVMKLLPIWLCTIIYSVIFTQMASLFVEQGDVMNAYVGKFHIPAAS
MSVFDIFSVFVSTGIYRHIIFPYVRPTELMRMGIGLIIGIMAMVAAGLTEIQRLKRVVPGQ
KESELTILWQIPQYVLVGASEVFMYVGQLEFFNGQAPDGLKNLGSSLCMASMALGNYV
SSLMVNIVMAITKRGENSPGWIPENLNEGHMDRFYFLIAALAAIDFVVYLIFAKWYQPIS
HDEDSIKGGSGGSLKKTVSELEQV

Arabidopsis thaliana Arath_47 AT5G28470

MDVESSSPSSHALIKKEKGGWRAIKYIIANESFEKLASMSLIGNLSVYLMTKYNL
GGVFLVNVINIWFGSCNILTLAGAFVSDAYLGRFWTLLLGSIASFIGMGIFALTAALPSLR
PDACIDPSNCSNQPAKWQLGVLFSGLGLLAIGAGGVRPCNIAFGADQFDTSTKKGKAHL
ETFFNWWYFSFTVALVIALTGVVYIQTNISWVIGFVIPTACLALSITTFVIGQHTYICAKAE
GSVFADIVKVVTAACKKRKVKPGSDITFYIGPSNDGSPTTLVRDKHRLRFFDKASIVTNP
NELNEDGNAKYKWRLCSVQQVKNLKCVTAILPVWVTGIACFILTDQQNIYGILQAMQM
DKTFGPHNFQVPAGWMNLVSMITLAIWISLYECVIIPIVKQITGRKKRLTLKHRIEIVMGII
CMIVAGFQEKKRRASALKNGSFVSPVSIVMLLPQFALAGLTEAFSAVALMEFLTVRMPE
HMRAVAGAIFFLSSSIASYICTLLINVIDAVTRKEGKSWLGDKDLNKNRLENYFFIIAGIQ
VANLLYFRLFASRYATENKKGH

Arabidopsis thaliana Arath_48 AT5G46040

MTVEEVGDDYTKDGTVDLRGNRVRRSQTGRWKACSFVVVYEVFERMAYYGIS
SNLVIYMTTKLHQGTVKSSNNVTNWVGTSWLTPILGAYVADAHFGRYITFVISSAIYLLG
MALLTLSVSLPGLKPPKCSTANVENCEKASVIQLAVFFGALYTLAIGTGGTKPNISTIGAD
QFDEFDPKDKIHKHSFFNWWMFSIFFGTFFATTVLVYVQDNVGWAIGYGLSTLGLAFSIF
IFLLGTRLYRHKLPMGSPFTKMARVIVASLRKAREPMSSDSTRFYELPPMEYASKRAFPI
HSTSSLRFLNRASLKTGSTHKWRLCTITEVEETKQMLKMLPVLFVTFVPSMMLAQIMTL
FIKQGTTLDRRLTNNFSIPPASLLGFTTFSMLVSIVIYDRVFVKFMRKLTGNPRGITLLQR
MGIGMILHILIMIIASITERYRLKVAAEHGLTHQTAVPIPLSIFTLLPQYVLMGLADAFIEIA

KLEFFYDQAPESMKSLGTSYTSTSMAVGYFMSSILLSSVSQITKKQGRGWIQNNLNESRL
DNYYMFFAVLNLLNFILFLVVIRFYEYRADVTQSANVEQKEPNMVDNYNE

Arabidopsis thaliana Arath_49 / AtPTR3 AT5G46050

MTVEEVGDDYTKDGTVDLQGNPVRRSIRGRWKACSFVVVYEVFERMAYYGISS
NLFIYMTTKLHQGTVKSSNNVTNWVGTSWLTPILGAYVGDALLGRYITFVISCAIYFSG
MMVLTLSVTIPGIKPPECSTTNVENCEKASVLQLAVFFGALYTLAIGTGGTKPNISTIGAD
QFDVFDPKEKTQKLSFFNWWMFSIFFGTLFANTVLVYVQDNVGWTLGYGLPTLGLAISI
TIFLLGTPFYRHKLPTGSPFTKMARVIVASFRKANAPMTHDITSFHELPSLEYERKGAFPI
HPTPSLRFLDRASLKTGTNHKWNLCTTTEVEETKQMLRMLPVLFITFVPSMMLAQINTL
FVKQGTTLDRKVTGSFSIPPASLSGFVTLSMLISIVLYDRVFVKITRKFTGNPRGITLLQR
MGIGLIFHILIMIVASVTERYRLKVAADHGLIHQTGVKLPLTIFALLPQFVLMGMADSFLE
VAKLEFFYDQAPESMKSLGTSYSTTSLAIGNFMSSFLLSTVSEITKKRGRGWILNNLNES
RLDYYYLFFAVLNLVNFVLFLVVVKFYVYRAEVTDSVDVKEVEMKETE

Arabidopsis thaliana Arath_50 / AtGTR2 AT5G62680

MERKPLELESTDNHQNPSSAVYGGSVTAVDSVEEDVQNQKKVVYRGWKVMPFI
IGNETFEKLGIIGTLSNLLVYLTAVFNLKSITAATIINAFSGTINFGTFVAAFLCDTYFGRY
KTLSVAVIACFLGSFVILLTAAVPQLHPAACGTAADSICNGPSGGQIAFLLMGLGFLVVG
AGGIRPCNLAFGADQFNPKSESGKRGIDSFFNWYFFTFTFAQILSLTLVVYVQSNVSWTI
GLTIPAVLMFLACLIFFAGDKLYVKIKASGSPLAGIAQVIAVAIKKRGLKPAKQPWLNLY
NYYPPKYANSKLKYTDQFRFLDKAAILTPEDKLQPDGKPADPWKLCTMQQVEEVKCIV
RVLPIWFASSIYYLTITQQMTYPVFQALQSDRRLGSGGFVIPAATYVVFLMTGMTVFIVV
YDRVLVPTMRRITGLDTGITLLQRIGTGIFFATASLVVAGFVEERRRTFALTKPTLGMAP
RKGEISSMSAMWLIPQLSLAGVAEAFAAIGQMEFYYKQFPENMRSFAGSIFYVGGGVSS
YLGSFLIATVHRTTQNSSGGNWLAEDLNKGRLDLFYFMIAGILAVNFAYFLVMSRWYR
YKGSDDEVTTYETNENIIKQQDKNVA

Arabidopsis thaliana Arath_51 AT5G62730

MSTNYTAINHILHFHSPNSCFLMIMSLEFEQMDEANRLSAWNGYVDWRSRPALR
GRHGGMLAASFVLVVEVLENLAFLANASNLVLYLSTKMGFSPSGAANAVTAFMGTAFF
LALLGGFLADAFFTTFHIYLVSAAIEFLGLMVLTVQAHEHSTEPWSRVFLFVGLYLVALG
VGGIKGSLPPHGAEQFDEETSSGRRQRSFFFNYFIFSLSCGALIAVTVVVWLEDNKGWSY
GFGVSTAAILISVPVFLAGSRVYRLKVPSGSPITTLFKVLTAALYAKYKKRRTSRIVVTCH
TRNDCDDSVTKQNCDGDDGFLGSFLGEVVRERESLPRPLRCTEEQVKDVKIVIKILPIFM
STIMLNCCLAQLSTFSVQQASTMNTKLGSFTVPPAALPVFPVVFMMILAPTYNHLLLPLA
RKSTKTETGITHLQRIGTGLVLSIVAMAVAALVETKRKHVVVSCCSNNNSSSYSSSPLPIT
FLWVAIQYVFLGSADLFTLAGMMEFFFTEAPSTMRSLATSLSWASLAMGYYFSSVLVSA
VNFVTGLNHHNPWLLGENLNQYHLERFYWLMCVLSGINFLHYLFWASRYVYRSNQG

Brachipodium distachyon Bradi_01 Bradi1g03500

MSFKQGLSGVQAAAEEQEKWVDDSSVDHRGRPPLRSATGSWKAAFFIILIEFSER

LSYFGIATSLMLYLTKVLQQDMKTAAENANYWMSVTTLMPLLGGFLADAYLGRFSTVL
FSTLIYLMGLAILAVSQLAPALKPTVSLRRHETLFFVGIYLVSVGTGGHKPALESFGADQ
FDGGHPGERRQKMSYFNWWNCALCSGVLLGVTAVVYVQERLGWGAADLLLAAVMA
GSLVVYLAGYRTYRFRVPDGSPLSPLLRVAVAAFLKRRLRLPNDAAELHHEDLGALPPQ
EGGSKKKKKRMLCHTEQFRFLDKAAVVDGGKWLATVTEVEETKLVLAMVPIWLTTLA
FGVTAAQVSTFFIKQGSVMDRRLGPSFEIPPASVFALAAVGMILAVAAYDKLLEPYVRR
AKGAAAERGISILQRIGVGMGFGILAMAVAAAVERRRLRSPSPASMSVFWLVPQFVLM
GVGDGFALVGLQEYFYEQVPDNMRSLGIGLYLSVIGAGSFLSGVIIAAADRATSGGGSE
GWFGKDLAHSRLDLFYWLLAVIGAINLGFYVLVATRYSYKQTVAKAATASSARVGHDI
ECANVAGDTA

Brachipodium distachyon Bradi_02 Bradi1g10490

MAEVVRAEGEHTLEQGLLAIPEESNQLTYTGDGSVDFSGNPVVKERTGRWRACP
FILGTECCERLAYYGISTNLVTYLTKKLHDGNASAARNVTTWQGTCYLTPLIGAILADA
YWGRYWTISTFSAIYFIGMSVLTLSASVPALMPPSCEGSICPPANPLQYTAFFLGLYLIAL
GTGGIKPCVSSFGADQFDDTDPAERIQKGSFFNWFYFSINIGALISSSFLVWVQDNLGWG
LGFGIPTVFMGLAIISFFSGTSIYRFQKPGGSPITRVCQVVTATVRKWNVQVPEDSSLLYE
LSDGVSAIEGSRQLEHTDEFRCLDKAATISDFDVKTDSFTNPWRVCTVTQVEELKILVRM
FPVWATTIVFSAVYAQISTMFVEQGMVLDTSLGSFKIPPASLSTFDVVSVIIWVPIYDSILV
PIARRFTGNARGFTELQRMGIGLVISILAMSAAAVLEIKRLAIARDEHLVDQNVPVPLSIF
WQIPQYFLVGAAEVFTFVGALEFFYDQSPDAMRSLCSALQLLTTALGNYLSAFILTMVA
YFTTRGGNPGWIPDNLNEGHLDYFFWLLAGLSFLNFLVYVLCANKFRSKKAA

Brachipodium distachyon Bradi_03 Bradi1g12190

MRSGGGGGREDDEAGQKLKSMDVDKMENGADDSPRPLVKYHGWKAMPFIIGN
ETFEKLGTLGTSANLLVYLTQVFHMQSVDAATLLNGLNGTTSLAPIVGAFLSDAYLGRY
LALAIASVASLIGMFFLTLTAGADSLHPPECGAGEVCQKATSYQFAVLFISFAFLVIGSAG
IRPCSMPFGADQFDPHTESGKRGINSFFNWYYFTFTSAMLVSATVIIYVQSNVSWPIGLGI
PTALMFLACVLFFMGTKLYVRVIPEGSPFTTIVQVFAAAVSKRSLKQAKDPKQDLFDPP
HTSNVVSKLAHTDQFRCLDKAAMVASPEEVRPGGAAPVNPWRLCTVQQVEEVKCLIRI
VPVWSTGIIYYVAVVQQSTYVVFSALQSDRRLGSSFHVPAASFTVFAMLAQTLWIPIYD
RILLPRLRKVTGKDEGFTLLQRQGIGIALSTVAMVISAIVEDRRRDIALNQPVIGTTQTGG
GISAMSSFWMVPQLMILGLSEAFNLISQIEFYYKEIPEHMRSVAGALAFCNLALGNYLSG
FLTTIVHQTTGAGQNWLAQDLNKGRLDLFYWMIAGIGVFNFVYFMICARWYRFKGASN

Brachipodium distachyon Bradi_04 Bradi1g21010

MEGAADVERPLIHDHDHDHPQDECSKYTSDGTLDINNQPALKQSTGNWRACFFI
LGTEFSECLCFFAVARNLVTYLTTTLHESNVGAARNVSTWIGTCFLTPLVGAFLADAHW
GRYSTIVVFLSVYLLGMLIMTLSASLPLFQPSSSPNASGIHGFAVYMGLYLVALGTGGIK
PCSSALGADQFDGADPAELVTKGSFFNWYYFAINIGSLLSATAIVWIQDNVGWSVGFGIP
MLVMALGLAVFVAGRNFYRYKRRPPGHCSSPLTRVAQVVVAAVRNCRLELPDDPSAL
HELLLPSSSSLGSTTKEEEEGDYCRIAHTSQFRFLDKAAIVEENKKGKKKAGPWKQCR

VSQVEELKMLLRMSPVWASLLLFFAATAQMSSTLIEQGMAMDTRVFGFTVPPASLSTFD
IASVLLWVPLYDALLVPLARRLTGESRGFTQRQRIGAGLALSALAMAYAAHVEAWRLS
MAAAAARETEGKKRVGIMWQAPCYFVMGAAEVFASIGMLEYFYDQSPEGMKSLGTAL
AQLAIAGGNYLNSGLLGAVASATGWITDDLDEGHLDYFFWFMAALGVANLLQFVYCS
TRHKG

Brachipodium distachyon Bradi_05 Bradi1g22087

MDESGLRASLLVEDDATCHGGESHSLLEVYQQPRLMGRQDDWRSPAIILGFECL
ESMAFNGVATNLVVYIRSVLHGGIASSASTVSLWYGTTFFVPVIGAVIADAYWGNFKTV
LISLVLYLLGMVLVTVGAFIPSAPVLCNLSSCPSSKGAQNLIFFSGLYLAAFGCGGVRSAL
LPLGADQFNNENSLDRQKRRNFFSLFYICVIFGVITSGTIVVWVQENVSWALGYGIATTCI
ALALACFMIGTPIFRQREPSGSPVKSIFQVIVTASKNMRLEIPADSSLLYETRSKNTHKVE
LKLAHTDDFRFLDKAAIISDLSIDNGNCGSSWRICTITQVEELKILIRLLPIWATGVFFGAA
ISQMHTTFIQQGTVMNTKIGSLSVPPASLYSFEVICVTLWVLLINKVIVPAGRTCFTSGAE
LTQLQRIGIGRFLMIFAMAMAAILETKRLENVQYGKPLSIVWQLPQYIVIAGAECFAIITQ
LEFFHGEAPDSMKSMLTAFALLTTALGNYLSSAIITLVAGVTRAWRSPGWIPDDLNEGH
LDYFYWCLAAISVANFVVYIYFASKYKLKKVVLEG

Brachipodium distachyon Bradi_06 Bradi1g25460

MASSGEQREHTVALLDSPAAEVEGEYTIDQSLDFDGNPALKHHTGGWRACRSV
LATEFCYCLAYSGVSQNLVTYLTTVLRESNVAAAKNVSTWQATCFLTPIAGAVVADSY
WGRYRTMVVSCSMGVAGLVVIALSANLPLLTKNAELFTGFPTLVSNLASAQESVLFLGL
YMTAFGLGGLRPCLMSFGADQFDHNDPPERASKGSFFNWYVFTMSCASVVSSTCVVW
AQDHFGWPLGLAIPAAVLAVGLACLVSASRRYRFQRTQGSPLTRVCQVLVAAVCKFNA
QQPADRSLLYELPEDGSMKGIQRIEHTNDLQFFDKAAIVLASEAAEEEATLPPARNPWRL
CIVTQVEELKILVRMVPVWASIVFYYAVSAQVSSTFVEQGMAMDTNVGPVRVPPASMS
AFDLLTVVVLVPLYDRLLVPAARRLTGRAKGISDLQRIGAGLAMPALAMAAAALVETE
RLRRAPSGPAMSVLWQAPQYVLMGVGDVLATVGQLDFFYSQAPASMKTVCTALGFLV
MAAGSYLSSFLLAAVEWATAAGGRPGWIPDDLDQGHLDRFFWMMSGLACLNLVAFGS
CAVRYNSRKAS

Brachipodium distachyon Bradi_07 Bradi1g34610

MASGRDHREHAVPLLAHPPAETTEAYTTDGSLDFDGNRALKHRTGGWRACRSV
LGTEFCYCLAFYAISYNLVTYLTGVLGQSNVDAARSVSTWQATCFLTPLAGAVVADSY
WGRYRTMVVSCSVGVAGMLMTALSAYLPLLAQMNGGAWFRGLIATSNMASAQGLVL
FLGLYMIAFGLGGLRPCLMSFGADQFDDGDPAERATKGSYFNGYVFTMHCASALSSTA
LVWVEDHYGWALGLTIPAAVLAVGLSCLVAASRNYRFQRTRGSPLTSVCQVVVAAVR
KFDIEPPADCSLLHELPEDDSGMKGVQTQRIEHTSDLRFFDKAAIVAASDKEAGLAPAPR
SPWRLCAVTQVEELKILVRMLPLWATVVFFYAVSTHVTSTFVEQGMAMDAAVGSLRV
PPASLSFFDILTVIVLVPLYDRAFVPAARRLTGKDKGVTELQRVGAGLAMPVLAMAAAA
LVETQRLRAAKAEGAKTKISVLWQAPQYALVGVGEVLTTIGQLDFFYGQAPPAMKTLC

TALGFLAVAAGGYLSSLLLTVVQWATATGGRAGWIPDDLNEGHLDRFFWMMAGLGCL
NLTAFVSCATRYKYRKA

Brachipodium distachyon Bradi_08 Bradi1g37330

MEDGVAQWEGYVDWRNRPATKARHGGMVAASFVLVVEVLENLAFLANASNL
VTYLMKTMHYSPAQSATTVTNFMGTAFLLALLGGFLSDAVCTTYVAYLISAFVEFMGL
VILTIQARSSSLMPAQCDKGAPGCLPVGGSKKAMLFVGLYLTALGVGGIKGSLPPHGAE
QFDEDTPRGRKGRSTFFNYYVFCLSCGALVAVTFGVWVEDNMGWQWGFGISTVAILLS
IPVFLAGSGRYRSKVPTGSPLTTIAKVLLAAASARSRGSGTQNGASNGAVIDRAPSPTGS
TDMKEYYGNKESCEAVEPSQELKALNRAVQCQPRHRALACSVQEVEDVKIVLMVLPIF
LATIMLNCCLAQLSTFSVEQAATMDTRVGGLKVPPASLPVFPVTFIILLAPIYDHVIVPLA
RRVTGTEMGITHLQRIGTGLVLSIVAMAVAAVVEVKRKKVATDAGMVDSTAGTPPLPIT
FFWIAFQYLFLGSADLFTLAGLLEFFFSEAPPRMRSLATSLSWASLALGYYMSSVLVAVV
NSATGRGGHQPWLEGAKDNLNRYHLERFYWLMCVLSALNYVFFLVLAIRYKYRNAGV
IKG

Brachipodium distachyon Bradi_09 Bradi1g43970

MGIEEKKKSRKKGGLRTMPFIFANEVAEKQAVVGFSTNMLTYLTQQMHMPLAK
AATTLTNFGGTSAMTPLIGAYLADACIGRFWTIAGASLVYQLGMVLLTVSAALPQFRPG
PNQEAAPWQLAVLYVSLLLNAVGAGGYRPCIVAFGADQFDESEAAERARSWGFFNWY
YFCNGASMLVAVTAVVYVQDNVGWGWGLGVPAFCMALSVVAFVSGYPLYRRLDPAG
SPFTRLAQVVVAAVRKRRLLRKVDEPGRLYENDALDKPISMYGKLVHTDQLSFFDRAAI
VTDGDMVTTDAAATSDKLPPAPIPNLWRLSTVHRVEELKSVVRMGPIWAAGILVITASS
QQHTFSLQQASTMDRRLAPHLSSFQIPAGSMTVFTMLAMLVTLFAYDRVLVPVARRST
GLDRGISVLHRMGVGFAISVAASLVAGFVERHRREAAAAGGTTDAGTAPLSAYWLVPQ
YALHGVAEAFTSVGHLEFMYDQAPESMRSTATALFWLSISLGSYVSTLLVAVVHRWSA
GPGGSNWLPDNINRGKLDYFYWIVTLLQVLNLVYYVICARRYTFKPLQLLHETDQEGK
DESVVELQEKV

Brachipodium distachyon Bradi_10 Bradi1g59840

MAAAARDDQEEKPAETTMDGTVDFSGKPAVRRKTGGWRACPFILGNECCERLA
YYGMSSNLVNYMVSELHQGNAAAAANVNNWSGTCYVMPLVGAFLADAYLGRFRTIA
AFMALYIAGLALLTASAAVPGLKPPGSCAGCEPSRGQNAAFFSALYLIAVGTGGIKPCVS
SFGADQFDDADPGELRSKGSFFNWFYMSINVGALVASSVLVWVQTNVGWGWGFGIPA
AAMAVAVLSFLLGSRLYRYQKPGGSPLRRMGEVVVLALQKSHLPLPADYLHETPPGAD
GIRKLAHTEQLRWLDRAAVVTLENPRRLCTVTQVEETKAMIRLLPVWASGIVMAAVYS
QMSTMFVLQGNTLDPRMGSRFSIPAASLSIFDTISVIFWAILYDRLIVPVARRFTGHPRGF
TQLQRMGIGLVISVFSMIAAGVLEVARLRAAASHGMLDSKDFLPVSIFWQVPQYFIVGA
AEVFVFVGQIDFFYDQAPDAMRSLGAALSLTSAALGNYLSTLLVVIVTAVSTRNGGIGW
IPDNLNKGHLDYFFWLLAALSVLNFVVYLWIAKWYKYKVYKTAEPSSQIDTASTG

Brachipodium distachyon Bradi_11 Bradi1g68820

MNSMDHFDKSPLLEGNNSSQENTAEYTGDGSVCVSGHPASRKHTGSWKASSLTI
VCSFCCYLAYSSIGKNLVSYLTKILQETNLAAARDVATWQGTSYLAPLIGAFIADSYLGK
YRTALISCTILIIGMMILLLSAALPLISIGPQAWSVWADPISSQYIIFFVGLYMVGLGYGAQ
SPCVTSFGADQFDDTDEVEKIKKSSFFNWHYFAINTGSLIAGTVIVWVQEHEGWLWGFTI
STLFVTIGIGIFFLGSIVYRFQKPGGSPLARICQVVVAATRNFDKVLPCDSSALYEFLGQGS
AIEGSRKLEHTTGLEFFDKAAIVTLSDCESPGPSNTWKICTVTQVEELKILIRMFPIWSAM
VLFAAVQEHMFSTFVEQGMVMDKHIGSFEIPAASFQSIDTITVIMLVPVYERVLVPVLRK
FTGRPNGITSLQRIGIGLFFSMSSMVSAALVENNRLQIAQAEGLVHLKEAVPMSIMWQGP
QYFLLGVAEVFSNIGLTEFFYDESPDAMRSLCMAFSLANISAGNYLSSFILSLVPVFTAKG
GSPGWIPDNLNEGHLDRFYLMLAGLSLLNLFIFVFNAMRYKCKKAS

Brachipodium distachyon Bradi_12 Bradi1g68830

MGSSLEEQQILLVRATQPENFDEYTGDGSVDFRGHPILKHNTGNWRACSLILGTE
VCERLAYYGISKSLVTYLSTRLHQGNVSAARNFTTWQGTCYLTPLIGATLADSYWGKY
QTIAVFSTIYFLGMAALTLSASVPSLQPPQCIGSFCPQPALPQYLIYFIGLYMIALGAGGIK
PCVSSFGADQFDDTDPVERTRKGAFFNWFYFSINIGSLISGTVLIWVQENCGYSIGFGIPTF
FIALAIGSFFLGSEIYRFQIPGGSPFTRACQVVVAAIRKRNVDLPVDSSLLYECHGKTSAIE
GSRKLEHSREFSFLDKSAVILLSEHDGCHNPWRLCTVTQIEELKILIRMFPIWATGIVFFTV
CAQNSSMFIEQGMVLNNKVGSFKIPPATLSSLDVISIVVWVPIYERFIVPLARKLTGKERG
LSELQRMGIGLFVSTIAVAVAALVEIKRLENARSEDLIHEKVPVPMSILWQAPQYLLIGV
GEVFTSIGQAEFFYNQSPDSMRSMCSAFALVTVSLGSYLSSFILTLVSYFTTRGEQMGWI
PDNLNEGHLDRFFWLVAGLSSLNFLAFIYFAQRYKCKKASVL

Brachipodium distachyon Bradi_13 Bradi1g68837

MGSSSLEELEDGQQILLVRAAQPDPENLDEYTGDGSVHFRGHPILKHNTGNWRA
CSLILGTEVCERLAYYGISKSLVTYLSTRLHQGNVSAARNFTTWQGTCYLTPLIGATLAD
SYWGKYRTIAVFSTIYFLGMAALTLSASVPSLQPPQCIGSFCPQANLQQYLIYFIGLYMIA
LGAGGIKPCVSSFGADQFDDTDPVERTKKGAFFNWFYFCISIGSLISGTVLIWVQENCGY
SIGFGIPTFFIALAIGSFVLGSEIYRFQVPGGSPLTRACQVVVAAIRKQNVDLPVDSSLLYE
CHGKMSAIEGSGKLEHSSEFSFLDKSAVILLSEHGGCHNPWRLCTVTQIEELKILIRMFPI
WATGIMFFTVYAQNSSMFIEQGMVLNNQVGSFKIPPATLSSLDTISVVVGIPIYERLIVPV
ARRLTGKERGFSELQRIGIGLFVSTIAVIVAALVEVKRLENARTEGLIHQNVPIPMSILWQ
APQYLLVGIGEVFTSIGQAEFFYNQSPDSMRSLCSAFALLTVSLGSYLSSFILTLVSYFTTR
GEQMGWIPDNLNEGHLDRFFWLVAGLSSLNCLAFIYFAQRYKCKKASVL

Brachipodium distachyon Bradi_14 Bradi1g68850

MASLKEKLNLEEPLLEDLAVHRGDRIVDIEGTPTPGTKHRTGSWKACTFILVTEC
FEELAYYGIQFNLVTFLKTVLQESNVSAARNYTNWQGTCYIAPLVGAVVADSYLGRYL
TTLAFFAVYLAGMAAMSISASFPACTGLDCRQEGSSSSQSAVFFLGLYMMAIGAGGIKP
CVSSFGADQFDDSVPSERLKKSSFFNWFFFSIYIGSFASGTVVVWMQDNLGWVVGLWIP
TLFIALAMASFLLGSGSYRVQKPLGSPLVRVSQVLVAAVRKRNASLPKDASLLYELPEG

ASMADGTKKLQHTPVLSALDKAAVIASTEELCSSDPWRLCTVTQVEELKAVIGMLPIWA
TGIVYFAVLAQFSSTFLEQGRMMNTTVTIPGRSFSIPPASLASFDAVSVILFVPVYDRVLV
PAARRLTGNDRGLSELQRFGAGLFLSVLVMAAAALVETFRLQTMAAAAAGDEGEKKM
CILWQVPQYLLVGASVVFACVGQSEFFYNEAPESMRSLCAALGLLTVSLGSYLSSLLVT
VVSAVTTKGGREPGWIPDDLDEGHLDRFFWLVAALSGLNFAVFVCCAVRYKCK

Brachipodium distachyon Bradi_15 Bradi1g68860

MDAAEERRLLVQDDGDREPLLPSLDASHHTGDGSIDIKGHPASKLTTGSWRACF
FILGNECCERLAYYGIAKNLVTYLKVKLHQGNFEAARNVTTWQGTCYLTPLIGALLADS
YWGKYWTIAVFSSIYFIGLAVLTLSASLPALQPPACLGSVCPEASLLQNGTFFLGLYMIA
LGTGGIKPCVSSFGADQFDDSDPTERAKQGSFFNWFYFCINIGAFISGTVIVWIQDNSGW
GIGFAIPTVFMALAIASFFAASNMYRFQKPGGSPLTRVCQVIVAAFRKWHVEVPHDNCL
LYEVDGQNSAIEGSRKLEHTCELEFLDKAAIISSADAKIDFFTNPWRVCTVTQVEELKILV
RMFPVWATTIIFNAVYAQNSSLFIEQGMVLDKRVGSFNVPPASLSTFDVISVLIWIPIYDR
VLIPIARKFTGREKGFSELQRIGIGLVLSIVAMASAALVELKRLEIARSEGLIHENVAVPMS
ILWQIPQYFFVGAAEVFTAIGQVEFFYDQAPDAMRSLCAAFALVTVSLGSYLSSMILTLV
SYLTTQGGDPGWIPDNLNEGHLDRFFWLIAGISFVNLLVYIGCAMRYRYKNV

Brachipodium distachyon Bradi_16 Bradi1g72910

MTLEHASGAEVSEGICFFGVQKNLVTFLTSVLHESNVDAARSVSTWTGTCFFTPL
IGAFLADTYLGRYLTVVTFLSVYVVGLLVMTFSASLPLLMPSSYSIDIQHVVVYLGLYLV
ALGTGGIKPCASSFGADQFDSADPVEQVAKGSFFNWYYFLINIGSVLSATLLVWVQDNI
GWGVGFGILMVLMVFGLTVFVTGKKIYRYKKLGASPLKRVSQVVVAALRNYRLKLPD
DISALHGVPSLAGANCKTEHTNQFRFFDKAAIVLPPLDGKGSSVMSPWRLCTVSQVEEL
KTLLRLCPVWASLLFFFAVTGQMTSTLIEQGMAMDNRVGGFTVPPASLSTFDIITVVALI
PLYDVFLVPLARRATGKNRGISQLQRIGTGLALSAAAMAYSALVETRRLAAAAGADQS
AAAVAAPLSIMWQAPSYIVLGAAEVFASIGALEFFYDESPESMKSLGAALAQLAIAGGS
YLNSALLGVVASATARGGAPGWIPDDLNQGHLDYFFWMMAGLSVLNLLHFMYCSMR
YKG

Brachipodium distachyon Bradi_17 Bradi1g75820

MAVAESLAMESGAGAAEYAQDGSVDLRGNPVLRSKRGGWTACSFIVVYELFER
MAYYGIAANLVIYLTEKLHQGTVEASNNVTNWSGTVFLTPLLGAYVADAYLGRYWTF
VVGSVIYFIGMVLLTLSVTVHKLQPAECAGKVCPRATTLQLGIYFGGLYIIALGNGGTKP
NISTIGADQFDEFDPREKSHKLSFFNWWMFTIFLGILFSTTVLVYLQDNVSWAVGYGIPT
LGLVLSICIFLAGTPVYRHRVPQGSAFSRMGKVIAAALSKWRAQVPADAKELHELDLDA
HYTKKRKYRMDSTSSMKFLNKAAVKDAVDWRLCTVTEVEETKQMVKLLPLLAAMFV
PCTLIAQTNTLFVKQGTTLDRHMAPGSSFQIPPASLGAFVTLTMLIAVVVYDRCFVSFAR
RYTGNPRGITMLKRMGTGLLIQVVTMATASVIENRRLAYARGHGLDETADPLPLTIFML
LPQFVLMGLADAFLVVGKIEFFYDQAPESMKSLGTALSLTAYGVGNILSSFVLSAVTHV
TKERGSPWVTNNLNASHLDYYYAFLTLLAVANYGVFAVLAVRYKYRAESTETIDVVA
MDHAQVQLEAAKIHSEPMA

Brachipodium distachyon Bradi_18 Bradi1g78330

MVPLPETTTEAAAEEGSSSSSSKKYKEEDGSSSTLSDAWDYRGRPAVRENSGGW
SSAAMILGVELNERLTTLGIAVNLVTYLTGTMHLGNAASANAVTNFLGTSFLLCLLGGF
LADTFLGRYLTIAIFTAVQASGMAILTVSTAAPGLRPVACADPTGASRTCAAPSGAQLGV
LYLGLYLTALGTGGLKSSVSGFGSDQFDEADPVERRVMARFFGWFFFISLGSLLAVTV
LVYVQDNVGRRWGYGICVVAVLAGLAVFLAGTRRYRFKKLAGSPLTQIAVVTAAAWT
KRRLPMPSDPALLYDVDDAAGEDVVKGKGIKRRLLPHSNQYRFLDQAAIVEPSPASGK
NKWACCTVTEVEEVKQVVRMLPTWATTILFWTVYAQMTTFSVSQAQSMGRRLGPFTIP
SGSMTVFFVASILLTVPLYDRLVAPLARRLTGHPHGLTPLQRIAAGLALSALAMAAAAL
TERHRLLSSSKKPPSVFLLVPQFLLVGAGEAFAYVGQLDFFLRECPADMKTMSTGLFLTT
LSLGFFLSTALVTAVHAATGSGGRPWLADDIDQGRLDYFYWLLAVLSVLNLAVFVAAA
RGYVYKDKRLADAGVKVNDDEGLVLHA

Brachipodium distachyon Bradi_19 Bradi2g02822

MGEVAAAEMYTQDGTVDLKGNPALKENTGNWRACPYILANECCERLAYYGMS
TNLVNFMKDRLGMENALAANSVTNWSGTCYITPLIGAFLADAYLGRFWTIASFMIIYILG
LGLLTMATSVHGLVPTCTGGTCSPTSGQTAAVFVALYLIALGTGGIKPCVSSFGADQFDE
HDALERRSKSSFFNWFYFSINIGALVASSVLVYVQTHVGWSWGFGIPAVVMAIAVGSFF
VGTPLYRHQRPGGSPLTRVAQVLVAAARKWSLPLPEDPSALHETADKESGIEGSRKLEH
TPQFAFLDRAAIETDSDKKSASSSPAPASSSWRLCTVTQVEELKSVVRLLPIWASGIVFAT
VYGQMGTLFVLQGNTLDASMGPHFKIPSASLSIFDTLSVIAWVPVYDKLLVPLARSVTG
KPRGFTQLQRMGIGLVISIFAMLAAGILELVRLRSIAAHGLYGKKDIIPISIFWQVPQYFVI
GAAEVFTFVGQLEFFYDQAPDAMRSMCSALALTTVALGSYLSTLLVTVVSKVTTKGGN
VGWIPDNLNVGHLDYFFWLLAALSVANFAVYLVIASWYTYKKTAEDGPAPAEDKLKG
EDGRQHEQ

Brachipodium distachyon Bradi_20 Bradi2g03560

MEPPSSPNNPNHKEIKSPPPVPSPAPPPPPNPSLHRKKLSFHFMDSDDRRYPPPGPG
STTPLNIRGSPIPAADLPKTGGWTAAFFIFGNEAAERMAYYGLSVNMVVFLFKVMHLPF
AASANAVNAFLGISQASSVLGGFLADAYLGRYWAIALFATLYLLGLAALTLCATLPALV
PAQDGCDKLLLLLGGCAKASPWQTGCLYAALYVTAFGAAGIRPCVSSFGADQFDDRDG
NYKRRLDRFFNVFYLAVTVGAIAAFTVVVYIQMNHGWAAAFGTLALAMGASNALFFA
GTPLYRHKAPGGSPLTRVAQVLVAAFRNRNADVTETGFVGLYEVAGPKSAIRGSGKLE
HTDRMAWLDKAALMTPEAAGGDAPDPWRVCTVTQVEEVKILLRLVPVPACTVMLSVV
LTEFLTLSVQQAYTLNTDLAALHLPVTCMPVFPCIAIFLVLALYYNTFAPIARRLTGHPH
GASQLQRVGLGLFFSIVSVAWAGVFERYRRRYAVEHGYLGLFLTPMPGLSAYWLLIQY
CLIGIAEVFCLVGLIEFLYQEAPDAMRSVGSAYAAVAGGLGCFFATALNNAVDAATGDV
ANGRPSWLAQNINVARFDYLYWLLAVLSTVNLAVFIYFAKIYKYRSSSSRPDNSNSSNK
LEISISDHK

Brachipodium distachyon Bradi_21 Bradi2g24327

MAEDSAVAAVDHRGRPASRASTGRWRSALFIIAVEIAERFAFYGVSANLISYLTG

PLGEGNAKAASAINAWNGVAQLLPLLGAALADSWLGRYRTIVIASLLYVLALGVLALST
LLSSGGHKCSNATAGAGTACPPSGLQMVFFYISLYMVAVAQGGHKPCVQAFGADQFD
ASDPRESVSRSSFFNWWYFGMCAGTAVTLVVLSYIQDNIGWGLGFGIPCVVMAAALAV
FLLGTRTYRYYYVSGTKQQSLFARAGEAFAEWRRSRQKSTAPLAISDPHQRHQAPEFSG
QVDVEEQDQVVGKADLVEETKRVLRLFPIWATCLIYAVAFAQSSTFFTKQAATLDRRV
GHRGLQVPPAALQSFISVTIVVFMPIYDRAIVPLARRYTGVSSGITMLQRIGAGMLLSLVS
MVVAALVETHRLRVAMDAGLADKPKVPVPMSLWWMVPQYVLFGAADVFTMVGLQE
FFYDQVPDKLRSVGLALYLSIFGVGSFISSGLVSGIDRVTAAKGHSWFSNNLNRGHLDYF
YWLVAALSALELLAYVFIAATFKYKKNKAAAIETTAG

Brachipodium distachyon Bradi_22 Bradi2g25417

MAEDGKEGTKDAAAEKSKTKEGGFRTMPFILANDFCDRLATVGFGSNLISYLTL
QLHLPLVEASNMLTNYHGTTNLTPLVGGLIADSFAGRFWTITVGSIIYQLGMVCLTLSAA
IPSLRPPPCAKHGAECQRASAYQIAILYLSLLCTSIGSGGTRPCNMAFGADQLELDARRR
RGGKAPMWSFFNLYFFGIELAKLTAVTAVVYVQENVGWGWGLGVPTIAMFVAVIGFVS
GYSLYVKMPPGGSPLVRLAQVAAAAFKKRKAVVTDPGLLYEDKALDAGISTTGRLLHT
NQLKFFDKAAIVMDGDVLPSGQPKLWRLSTVHRVEEIKSIVRMLPIWAAGILMVTASSH
NSSFAIQQARTMDRGITNNFKIPPASMLIFSNLAMLLTLAFYDRVLVRVLRRFTGRPNGIT
HLQRAGVGMTIAMLANVAAAAVERRRRSVAAASGMLDAPKGAVLPISVFWLVPQYAI
HGIANAFMDVGRMEFLYDQAPESMRSTAAALYWLTISAGSYLGTLLVTIVHERTQRSG
QWLQDNLNRGRLDNYYWLVVGLQGLNLVYYFVCVKYYTFKPLEMVDESDKETELYG
GNGNGTKNAKKSASFR

Brachipodium distachyon Bradi_23 Bradi2g25430

MAGAAPADEDGSPKKTKQGGFKTMPFILANEICDRFATAGFNANLITYLTQQLH
LPLVEASNLLTNFMGTAAFTPVFGAIIADSFTGRFWAIAGGGLLYQLGMLGLVVSALTPS
LRPGPCTAPPGTSCQRANGGQLAMLYLSLLFTALGSGGIRPCVVAFGADQFGVGGRRPG
GGQKWSFFNFYFFTMGLAVLLALTVVVYIQENVGWGWGFGIPAMAMFVSVLSFVAGY
PLYVRVKPGGSPFVRLVQVVVAAVRKRNEAVPEDAALLYQNKELDAPIAVDGRLLHTN
QLRFLDRAAIVTTTDAVVVDSSTGAEPEPDPWRLSTVHRVEELKSIVRMLPLWAASITLI
AAASHNFTFAIQQSRTMDRRLSSHFEIPPASMIIFTTLTMLLSLSLYDRAFVPLARRYTGL
PSGITYFQRMGAGLAVSVLGVLAGALVERKRRAVAAEHGLLDGGAAAAVPMSVFWLV
PQYALHGVSDTLSTVAHMEFLYDQSPESMRSSAAALFWVAGSLGNYLGTALVTVVQSA
SGGEWLQDNINRGRLDYYYWLVTFLMALNLVYYIVCFHFYTLKSFEVDAGDKARRPED
GADQGPSIEPVTALSAGQIGGSRHCEGPI

Brachipodium distachyon Bradi_24 Bradi2g25460

MAAAAVDSGDRDGDRKKTKQGGFRAMPFILVNEVCDRFATAGFSANLITYLTQ
QLHLPLVEASNTLTNFNGTASLMPVLGALAADSFAGRFWTIIAGSVFYQLGMLGLVLSA
LLPSLRPAGLQRANGLQIAVLYMSLFCTSLGSGGIRPCVVAFGADQFDNNQQQIRDNKE
TVAGKKRRYFNLYFFTMGFAVLLALTVVVYIQENVGWGWGFGIPAIAMFASIVVFLAG
YPLYVRLKPGGSPFTRLAQVAAAAFRKRNAPLPEDPRMLYQDHELDALISTNGRLLHTN

QLTFFDRAAIVTPGDTAGDKLQNPWRLSTVHRVEELKSIVRMLPIWSAGILLATAASHN
NSFAIQQARTMDRHVTPGGGFQIPPATMSIFMTTAMLVTLGLYDRALVPLARRFTGLPS
GINYFQRMGAGLAISILGVAAAALVEAKRRAFAAHHGGLLFDGPQPPDAVVPMSVFWL
VPQYAIHGVAEGFSSVGHMEFLYDQAPESMRSTAAALFWLATSLGSYMGTVLVTAVQS
ATRGSGEWLQDNINRGRLDAYYWLVTCLMVLNLGYYLICFHFYTMKPLELVEEADRD
KEFELSSAHKNGGAAAGAGGLV

Brachipodium distachyon Bradi_25 Bradi2g27987

MEADGSLESRQESHLGFDHESLKEPRDPEKRKGGWITFPFLAVAILGLGLATGGA
LSNMVVYLIKEYNVPSVDAAQISTIISGSISVAPVAGAIVADALFGCYPIVAVAMALSVLS
LIMFTLTASIPTLRPAVCQFGAGQPCDQASTGQMAALYGAVCLLCLSAAGARFNQATM
GANQFDASADRDVFFNWYFIMLYASSVLGATVIVYIQDTVSWSLGFGVSCAASVVGLG
ALLLGARYYRQPAAQGSPFTGLARVVVAATRKRKVNLVASEELKFYYGIRSTSSSEGDG
EVISDGNLAPTDSFSFLNRAAAITDGDVDGADGRAVRPWRICTVQQVEDFKTVLRILPL
WSSAVVLSISIGVQINFTVLQALVMDRAVGRFTVPAGSMFVGSLISVVIFLGLLDRILLPL
WKRLTRGHTPTPLQCVGVGHALTVASMAASAVIERSRTATVRAHGEEGNPAWVSPLSA
MWLLLPFAVAGAGEALHFPAQVTLYYQEFPPSLKNTATGMMAMIVALGFYLSTAVINI
VQRATTWLPDNMNASKLENLYWLLTALVAVNFGYYLVCAKLYRYQNIGK

Brachipodium distachyon Bradi_26 Bradi2g30380

MEEPKQQEFTKDGSVDLRGRPALASRTGRWKAFPARCEHAGYEAFERMAFYGV
ASNLVVYLTTQLREETVSSVRSVNNWTGSVWMTPIVGAYIADTFLGRFWTFTISSFIYLS
GMVLITLAVSVKTLHPHCTPDGGCARATRQQVTFFYAALYTMAIGAGGTKPNVSTFGA
DQFDDLDARERKIKASFFNWWTFSSFTGGLVAMLVLVYVQEEVGWGVGYTIPTVGLAL
SLLLFYVGTPFYRHKPLRRSTAAGPAKLIGKVLRAAYEKRGCQLPSDPKELHERDTAWY
AAAGNKRRLLHTPAYRFLDKAACTLSERESETSLAMVSCCTVTEVEEVKLIAGMIVVWL
VTLVPCTIWVQVNTLFVKQGTTLDRSVGGLRIPAASLGSFITISMLLSIPIYDRVFVPLVRR
RTGNPRGITLLQRLGIGCALQVLVVACAYLVEIRRMRVIRERSIHGAHDTVPMNIFWMLP
QYVLLGVGDVFNSIGILEFFYDQSPEGMQSLGTTFFTRGLGVGNFLNSLLVTIVDQATRG
SSGKSKSWIGDNLNDSHLDYYYVFLVFLSVVNMALFVWVAMRYKYKREFMEDGAIGIS
ETDIVAGGKVTDTLLMLEHGKAEGCGKVADTPLVVEHGKVDSP

Brachipodium distachyon Bradi_27 Bradi2g30437

MGRGERAPLLRQISYRSFKRKPSRGPRVLDETPEVELLEDKKKMGSKAPAVVLG
FECLESTAFNGISTNLVVYLETVLHGSNLASASNVTTWFGTSYLTPIFGAIIADTFWGNYN
TILVSLAVYILGMIVVTLTAFMPAPAEVCTPGSSCVTGNATLPFIGLYLVAIGSGGVRSSL
LPFGAEQFDDVSGVEDQEGKRSFFSLFYLCVDFGPIVSGVFIVWIQQNVSWGLGFGISTL
CIALAYGGFVYATPMYKRSMPTGTPLKSLCQVVVAAFRKVSLTLPFDADHLYDVSGDS
MDPHARIAHTTEFSFLDRAAIISDSELEDRLLDAHSSSWTLCTVTQVEELKILLRLLPIWA
TSIVISAAYSQMNSTFILQGSAMDINILSVPIPAASLSSFEVLCVLAWVLLYSNFIVPALNN
FSSDGHWEPSQLQRMGAGRVLMALAMAVAALVEMKRLDSVATGEVIGIAWQLPQYFL

LAGAEVFCYIAQLEFFYGEAPDSMKSMCTSLALLTIALGSYMSSLIYAVLAAITVKPGSP
GWISDDLNQGHLDYFFWSMAVMCILNFAVYSAFARNYKLKTILP

Brachipodium distachyon Bradi_28 Bradi2g41060

METGARPSWIGAGNGNLVHDAVDYHGCPADRSRTGSWVAAALVLGIELCERLA
TMGIAVNLVTYLTDTMHLPSAESANVVTDFMGTSFLLCLLGGFLADSFLGRFLTIAIFAL
LQALGTGLLAVSTTVRQLRPGPGEAATGLQMGVLYACLYLIALGTGGLKSSVSGFGTD
QFDERDDQERAAMGHFFNRFFFFISLGTLMAVTVLVYVQDHVGRSWAYGICSACMLLA
VAVFLSGTRRYRYKRSAGSPIVHILQVLVAAARKRGPIKRGPLAAAALYEDRQEDERIPH
TAQFLCLDAAAVMAGEEDNEIGTVGRQAPNPWKLCSVSRVEEVKMVARLMPVWATTI
LFWTIYAQMITFSVEQATTMDRRMVGSFEIPAASLTVFFVGAIMLTLALYDRIFIPLCRIL
TGRQGFTSLEKIGIGLALSIAGMAAAAVCEKKRLAVAAAASTDTAVLPISVFMLIPQFLL
VGAGEAFIYTGQLDFFITRSPKGMKTMSTGLFLATLSLGFFLSSALVSLVKGATTWLGDT
INHSRLDYFYWLLAVLGAVNLAAYLLCAMWATPAAGSSKADPAATAADEKC

Brachipodium distachyon Bradi_29 Bradi2g43917

MRASSPRPDIVMDAAADMEIGVRAPLLRQLTFRRSFKRSKSLVPRIDEENQIEAPP
PVDDEKEKPSSKAPFVVLGFECLESTAFNGISTNLVVYLETVLRGSNVSSASNVTTWFGT
SYLTPIIGAVVADSFWGNYNTIVVSLVVYLLGMLLVTFSAFLPVVASPLFISTKTLAFVGL
YLVALGSGGIRSSLLPFGAEQFDDTSAADRENKAAFFSWFYLCVDFGPIVSGLFIVWIQE
NISWGLGFGISTACIALALGAFLLATPMYKRSTPTGTPLKSLCQVVVAACRKVNLRMPS
DAGLLYEVSDKADLQPRIAHTSEFRFLDRAAIFSELDDPEQKLVDATGASASWKLCTVT
QVEELKILLRLLPVWATSIIVSAAYSQMNTTFIQQGSVMDMNILSFSVPAAALLSFEVLFV
IAWVILYGSVIVPVLSAFSVEEPSQLRRMGAGRVLMAISMSLAALVEMSRLSSAARGEEI
TIAWQLPQYFFLAGGEVFCYIAQLEFFYNEAPDAMKSTCTSLALLTIALGSYMSSLIYGII
EVFTATADSPGWISDDLNKGHLDYFFWIMAAISMINFFVYTAFAKNYKLKTVLS

Brachipodium distachyon Bradi_30 Bradi2g49817

MYFMLIMHVGLADASNLLTNYMGTSYMIAVLITVFADTVIGRYQTVIISSLIELV
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DQFDDKHPKEKRQMSSFFNWLLLSMCIGGAFSVTIFVWIQNKKGWDKGFGAATGVMG
LAVIAFVIGLPRYRIFTVQGSSALLEIFRAIFVWTSVLVKRVLNVRVVFQVYVAAIRNRNL
QLPENPDELYEISRSKASPETEFVAHRDKPFRFLDRAAIVQAPTGETPNPWRQCRVTQVE
NAKTMLAMVPIFCSAIIMGTVLAQFQTFSIQQGATMDTRIAKHVQMPPATLPIIPLGMLIF
AVPIYERLFVPFARRITGHPNGIPYLQRVGVGLVLSILSMCIAAIVEMRRKRVAVRHNML
DAIPQLQMLPMSCFWLAPQYGVFGIADMFTLIGLLEFFYSQAPPALKSMSSAFLWCSMS
LGYFLCTILVKAVNAATKNYTASGGWLGGNNINRNHLDLFFWLLAVLSFLNFLNYLYW
SSWYKYVKPQEQPDHVVVPVEQQQV

Brachipodium distachyon Bradi_31 Bradi2g50570

METQEGDAHSSESDAPKVKEKGGFVALPFIIANEMLEKVAGFGLNTNMIMYLTK
QYHLSNVTAGAMLFVWAAAANFAPIPGALIADMYIGRFMAISLGSVACLTGIVFLWLSA

MIHGARPAPCGAGIVPEQCMPPGPRHLAWLIAGFTFLSIGAGGIRPCSMAFGADQFSRHP
KEKRARILQAYFNAYYASIGVAFTVAVTVIVYVQDNVGWKAGFAVPMGLMMLSAVSF
LLGSRLYIKEKGSRQMFSGIGAAFTAAIKNRRVRLPVKTEDGVYYHLKDCKLTVPTDKL
RFLNKACMISNSEEALPAHSDVAASECRGLCTVDQVEQLKSAIRILPIWSSTVFLAQAMS
QNYAVLQANEMDRRVGVGRFHVPGCSLTMFNMVTMSLWSGSYDRWIAPVLQRITGNP
RGLTMKQRIGAGLVLATAGMVVSAAVEGARRRLALSGGGGTMSAFWLVPQFALMGL
AEAFGVIGELEFFYTELPKSMASFSMALLYMAMGVGNLVNSLIVKVVHEASRHGGRTS
WLSSDLNLGHYDYYYWLLACLGALNFVYFLCCGWAYGEEGKNVEWEEEAETERPMA

Brachipodium distachyon Bradi_32 Bradi2g50580

MEVSGMEKALPVPEGRKKGGLRTIPFIISNEIFEKVATFGLQANMILYLTKRYHLT
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TSPECSAHPRECTRLPCQLPLLFTSFLLMSLGSGGIRPCTLAFGADQLDTRDNSAKNVRT
LQTFFNWYYTVLGLSIVFASLVIVYIQETKGWVIGFAVPVVLMLVALSLFLLGSSFYLRA
DADRSVILGIVQVLVVSYKNRHDPLPAEAADASCFHNKPGVRPRAPTNRLRYLNRACVL
RNPSKLTNGVDDGAACGDDPWTVCTVQQVEDAKAVIRVLPIWSTAIVPGVLVGQQMFP
VLQASNMERRMGGLEIPAASFGVFSIVTLTVWVAVYDRVLVGPLSRLTGRARGLSLRQ
RMGLGLIIFAVAMGVAARTETLRRAAAIAEGLRDVDPQTTGRTVRMSAMRLVPQHCLM
GLAEALNLIGQIEFYYSEFPKTMSSIGVSLLALGMGCGALLGSAIVGIISRATGADGRDSW
VSSNLNRGHYDYYYMVLAGLSVANFVYFVWCGWTYGEEGQNRVMATEDEEEDVQK
W

Brachipodium distachyon Bradi_33 Bradi2g56347

MDTNTQGLLLPRSDGAVPGVVDFRGGPAPRASTGRWSAAMFVLGVEIAERFAY
HGVSANLISYLTGPLGESTAGAAAAINAWSGVATMLPLLVACVADAWLGRYRTIVLAS
LLFVVSMGMLTLSSALPAFHSDGCSSFTSKSLACSPSPVQVTIFYISLYLVALAEAGHKPC
AQAFGADQFDQHHPKESVSRSSFFNWWYFGMCSGTAATTMVSSYIQDNIGWGLGFGIP
CLVMVFALAMFLLGTRRYRYYTSTRSSPFARLARALIALIRGSKSSQSDNALASEDDEFN
TEHREEVRGLLRLFPIWATCIIYAVIFSQSSTFFTKQAATLDRRIGQSFKVPPAALQTFISV
TIITFIPVYDRLFVPVARRFTRLSSGITMLQRIGTGLVLAMVAMAVAALVEMKRLGVAR
DAGLVDEPKAALPMSLWWMVPQYVLFGLSDVFAMIGLQEFFYDQVPDALRSLGLAFFL
SIFGVGHFLSSFLISAIDGATKKSGASWFSNNLNRAHLDYFYWLLAGLCAVELLAFLIVS
RVYVYKKRVAHHDDGAAAVM

Brachipodium distachyon Bradi_34 Bradi2g56360

MGDTVSGAADYRGQPASRAATGGWKSSIFVMAMEIAERFAYKGVASNLIQYLT
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AVRIFGAGGHVAVFYVALYLVALGEGAHKPCAQAFAADQFDDKDPKESVARSSFFNW
WYLGMCSGTAVTIMVSSYVQDNVGWGLGFGIPCIVIAVSLAVFLLGTRSYRYYTTKEPS
PVARVGKAFFTLIKSWRSKHRTNPASSAKVEGGDSAEDLVEEVKSVFRLLPIWASCIIYA
IIFSQTSTFFTKQAATLDRRIGPSFKVPPAALQTFISISIVVFIPVYDRLFVPLARRYTGRPSG
ITMLQRVGVGLALSLAAVVLSALVEMKRLRVASAAGLVNTPKTQLPMTLWWMVPQYI

LIGVSDVFAMIGLQEFFYDQVPDAVRSLGLALFLSIFGVGHLLSSFLISVIDGATKKNGAS
WFSNNLNKAHLDYFYWLLAGLCAVELVAFLFFSRLYVYKKKAGDGDYRGDDPDAIVV

Brachipodium distachyon Bradi_35 Bradi2g56450

MALAGGEALTAVDHRGHPVSRRSSGRWPAALFVVGVEVAERFAFSGISGNLITY
LTGPLGQSTAAAAAAVNAWSGTALLLPLLGAAVADSWLGRYRTIVHASLLYILGLAML
TVSSAQPAAAACEGSTVDSAGCSGNLQSALQVAFFYISLYLVAFAYGGQKPCVLAFAAE
QFDGSDPEELAARGSFFNWWCFASYGGNAVTVSALNYVQESVGWQFGFGIPCVAMAL
ALAVFWMGAKTYRFYPPARNGSLLVQLGEPLVARIQSWRLSWRSKLPDDSLPLLANAS
SSSSSKGDDGNTDFTDHEAASLLKLFPIWSASLIYAVVLSQWSTLFTKQASTLDRRVGSL
VVPAAALQNLSPAAVMIFLPIYDRVFVPLARKHTKKPHGITMLQRIGVGLAISIVATIVA
ALVEMKRLRVAEDHGLLDEPGAVVPMSFLWVVPELILSGLSNVFAAVGLQEFFYDQVP
DSLRSLGAALALSIGGVGNFISSFLVYAIDKVTSSRGESWFSNNLNRGHLDYFFWLLAAL
SALGFSAYLHFARLYVHKKRDAAVLVQ

Brachipodium distachyon Bradi_36 Bradi2g57927

MDGIEESKGRQGDAEHGRTTSKINDRRTSWGCVFLLVNNLFQYTAYFGVSTDLV
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VTASAWASSSNSSSTAPFYAGLYLIALGGALQPVMSSFGADQFDASASPSERARQSSFFN
WFYLSVNAGSLVGGTLLVWVQASHGWRLGYGIPALLSALAVALFLAGAPAYRRHQPP
GGSPLTRVAQVVVAAVRNWDAEVPQDDAAGKLYECGGEDGMSVIQGSRRLAHTDQFR
NLDPSSSSSSSDNKAAAAPSPWRQCTVTQVEELKCVLRLLPVWACGIIFAAAYTQMTTT
FILQGDTLDPYLFGRRRGFRVPAAMLSVFDTLSVMLWVPLYDRALVPLARRLTRRSNTT
AGFSPLVRMGVGYVILTLAMLCAGALEVARRRVISRHGAPGAGEGNYLPLSIFWQVPQ
YAVVGAAEVFTFIGQMEFFYDQAPDAMRSLCSGLSNAAFAMGNYASSALVAVVVRAT
ARGGDPGWIPDDINVGGHLDYFFWLMAMLCAGNFGAYLLVTRSYTYKKTVDCKFSDE
SGRD

Brachipodium distachyon Bradi_37 Bradi2g58470

MADAGAGTDADAGAAVPEVLESGGRRRRRPRGWKCMPFIIGTETCEKVGSIGV
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MLGLTLSASLPALKVSSCNQTTQLGEHCNSPSTLQLSVLYLSLGFLIIGGGAIRPCSLPFG
VDQFDMTDEKSRKGLNSYYNWYYGTTSAALVFSMTIIIYIQTKISWPIGFGIPTFFMLMAI
IILFMGTRLYVHVPPEGSIFTGIAHVLVASFKKRRLKIPCPGDTNQQELLLYNPPTRGNRIF
RLPLTSQFRFLNKGTIVREGDINSDGSARNPWELCSIQQIEEVKCLIRIVPICISGIMCFVAL
AQQYTYIILQILTMDCHLGPHFEIPAASVITISFIALTVFMPIYDRILVPMARRFTGVESGIT
LLQRQGIGLVISPISMVVAGLVECKRRNSALSNGGKSPLSVFWLAPQLVLMGIAEAFNA
VGQIEFYNKQFPEHMLTLAGSLFFVTLAGANYLSTALASITGKVTSRDGHTSWLTDNINL
GKLDYYFYFIALMGVLNLFYFLICSHYYQYKSMSLYAEESIEEADKEIEINTDVRNK

Brachipodium distachyon Bradi_38 Bradi3g16670

MVGLIPQTNAAAEVLGDAWDYRGRPAARVSTGRWGAAAMILVAELNERLTTL

GIAVNLVTYLTATMHVGNAEAANVVTNFMGTSFMLCLLGGFVADSFLGRFLTIAIFTAI
QASGVTILTISTAAPGLRPASCTPSSSSPVCARASGAQLGILYAALYLTALGTGGLKSSVS
GFGSDQFDESNDTEKSQMMRFFNWFFFFISLGSLLAVTVLVYVQDNLGRPWGYGACAA
AIAVGLVVFLAGTRRYRFKKLAGSPLTQIAAVVVAAWRKRKLPLPAEPDMLYDIDVGK
AAAADEAGNGKKSKLKERIPHTKQFRFLDHAAINNDPAGEQSKWELATLTDVEEVKTV
ARMLPIWATTIMFWTVYAQMTTFSVSQATTMDRHIGSSFQIPAGSLTVFFVGSILLTVPIY
DRIVVPISRRLSGNPHGLTPLQRIGVGLVLSILAMAAAALTEVRRLRIARENPTSDGVVP
MTVFWLIPQFLLVGSGEAFTYIGQLDFFLRECPKGMKTMSTGLFLSTLSLGFFVSSALVS
AVHKLTAHRRPWIADDLNQGELHKFYWLLAGLCLANLVVYLFAARWYKYKAGRPGA
DGSVNDAEPCLH

Brachipodium distachyon Bradi_39 Bradi3g28400

MENGYGEYAKDGSVDLRGNPVLRSKRGGWKACTFIVVYELFERMAYYGISSNL
VMYLTNRLHEGTVQASNNVTNWSGTVFLTPLVGAVVADAYLGRYWTFVAGSVIYLMG
MILLTLSVTVPALKPPSCSGGSTASSSCPRASALQLGVYFGGLYTIALGHGGTKPNISTIG
ADQFDEFHPSEKLQKLSFFNWWMFTIFTGILVSSTVLVYLQDNISWGVGYGVPTLGLLV
SVAIFLAGTPLYRHKVPQGSPLTTIARVLAAAVWKRRVSLPNDVKDQELHELEPEHYAS
KRTFRIEATDTMKFLNKAAVPTGTPAPRWTLCTVTQVEETKQIIKLLPLLVAMVLPCTLI
AQTNTLFVKQGATLDRRVGKFSVPPASLGVFVTLTLLVCLALYDRVFVPVARRRTGNPR
GITLLQRIGTGMLLQVATMAVTAAVESGRLSFARTHPAVHGVLPLTIFILLPQFVLMGAS
DAFLAVGQMEIFYDQAPESMKSLGTALSLTAYGAGNALSSVILSLVQRVTAARGTPWV
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RSDSAPTA

Brachipodium distachyon Bradi_40 Bradi3g28410

MAGTTQLEAGSRDDYTEDGTTDLHGNPILRSKRGGWRACSFIVVYEVFERLAYY
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NISTIGADQFDEHEPRERRHKLSFFNWWMFSIFFGTLFANTVLVYIQDKIGWTVGYALPT
AGLAVSIAIFTAGTPFYRHKPTSESSFAKMAGVIVAAVRKCTIAAPVDPRDLHELDPEHY
AKKKTTQLPYTPNFSMLSKAAVRTGGSTSRWSLSTVTQVEETKQMLKMLPVLAITFVPS
AMLAQINTLFVKQGTTLERHVGSQDGFEIPPASLQGFVTISMLVSVVLYDRLFVPFMRRL
TKNPRGISLLQRMGVGLVFHIVIMAIASVTEHHRLDVARANGIFESKGTTIPLSIFVLLPQF
VLMGVADAFLEVAKIEFFYDQAPEGMKSLGTSYSMTSLGIGNFLSSALLSTVSHLTRRH
GSGGWIQNNLNASRLDLYYAFFTMLNCANLVLFFAVCRMYVYNVEVTHGVDGDGEKK
GELVVIQPSAVVGALDM

Brachipodium distachyon Bradi_41 Bradi3g28417

MAGRTSSLLEAASGDAYTQDGTTDLCGGPILRSKRGGWRACSFVLVYEVFERM
AHYGISSNLVLYLTKELHQGTVQSANNVTNWAGTAMLTPIVGAYIADAHLGRYRTFMV
FSVIYLIGMSLLTMVVSLPSLKPPKCGLGTPDLSCEHKASSLQLGVFFLALYILAMGTGG
TKPNISTIGADQFDKNEPRERRHRLSFFNWWMFSIFVGALFGNTVLVYIQDKIGWTVGY

ALPTVGLAVSIAIFTAGTPFYRHKPTSESSFAKMAGVIVSTVRKCTLAAPVDPSDLHELDP
EHYAKKKTTPLPYTPNLSILSKAAVRTGGRASRWSLSTVTQVEETKQMLKMLPVLAITF
VPSAMLAQINTLFVKQGTTLERHVGSQDGFEIPPASLQGFVTISMLVSVVLYDRLFVPFM
RRLTKNPRGISLLQRMGVGLVSHIVIMAIASVTERRRLDVARANGIFESKGTTIPLSIFVLL
PQFVLMGVADAFLEVAKIEFFYDQAPEGMKSLGTSYSMTSLGIGNFLSSALLSTVSHLTR
RHGSGGWIQNNLNASRLDLYYAFFVVLNCANLVLFFVVCRMYVYNIEIAHDDDGGGEK
QQRELVVIRPFAVVGASDM

Brachipodium distachyon Bradi_42 Bradi3g33030

MASVLPEIAADAGKGTGILTDAWDSKGRPAARASTGGWGCAAMICGAELFERM
TTLGIAVNLVPYMTSTMHLGSAAAANTVTNFIGTSFMLCLLGGFVADTYLGRYLTIAVF
SAVQATGVMVLTISTVAPGLRPAACGDATGQSSECVPANGTQLGVLYLGLYMTALGTG
GLKSSVSGFGSDQFDESDDVERKKMMRFFNWFYFFVSIGALLAVTVLVYVQDNVGRR
WGYGICAVGILAGLGVFLSGTRRYRFKKLVGSPLTQVAAVTAAAWWKRTLPLPSDPGM
LYDVDDAAAAGEDLKGKQKLPHSKECRFLDHAAIVDRAAGESPATASKWTLCTRTDVE
EVKQVVRMLPIWATTIMFWTIHAQMTTFAVEQASVMDRGIGGSGFLIPAGSLTVFLIGSI
LLTVPLYDRLVAPVARRITGNPHGLSPLQRVFLGLFLSIAGMAVAALVERHRLTSSSHGA
TLTVFLLMPQFLLVGAGEAFTYMGQLDFFLRECPKGMKTMSTGLFLSTCALGFFLSTLT
VTIVHKITGHGPQGSAGWLANNLDQGRLDYFYWLLAVMSAVNLVFFVVAARGYVYKE
KRLADAGIELADEEAIMVGH

Brachipodium distachyon Bradi_43 Bradi3g33040

MGTVLPETTADAGKLQAGADTALTDAWDYKGRPASRAATGGWGCAAMICGAE
LFERMTTLGIAVNLVPYMTATMHLGSAAAANTVTNFIGTSFMLCLLGGFVADTYLGRY
LTIAVFSAVQATGVMVLTISTVAPGLRPAACGDATGQSSECVPANGTQLGVLYLGLYMT
ALGTGGLKSSVSGFGSDQFDESDDGERKKMMRFFNWFYFFVSIGALLAVTVLVYVQDN
VGRRWGYGICAVGILSGLGVFLSGTRRYRFKKLVGSPLTQVAAVTAAAWCKRGLPLPS
DPGMLYDVDDAAAAGEDLKGKQKLPHSKECRFLDHAAVVDRESSPATASKWTLCTRT
DVEEVKQVVRMLPIWATTIMFWTIHAQMTTFAVEQASVMDRGIGGSGFLIPAGSLTVFL
IGSILLTVPLYDRLVAPVARRITGNPHGLSPLQRVFLGLFLSIAGMAVAALVERHRLTSSS
HGATLTVFLLMPQFLLVGAGEAFTYMGQLAFFLRECPKGMKTMSTGLFLSTCALGFFFS
TLIVTIVHKVTGHGTRGSGGWLANNIDQGRLDYFYWLLAVMSAINLVFFTVAARGYVY
KDKRLADAGIELADEEAMVVGH

Brachipodium distachyon Bradi_44 Bradi3g34590

MDTESGEAPLLQVSSSNSQYKPFNWKAPAIILAFEFLESIAYSGIALNLVVYLGKV
LHGTTASSAANVDTWNGTTFLTPVLGAFLADTYWGKYKTVAISIIFYLTGLLIITASALIP
SLRPASCEGTSCPPATGFQYFVFFASLYLVSVGTGGVKSALLPFGADQYDDSNIEQSKKK
QAFFSLFFIAINLGVFISGTVVVWIQQNVAWSLGFGISSICLIVATIAFLVGTPIYRVQLPTG
SPLKSLIAVFVASFKKRKVEVPGDTTILFEGDDADLSNPGPNKLAHTDGFRCLDKAAVV
LGDQEIKDSNSGRPWLLCTVTQVEEVKILLRMLPIWVTSVFYAASMCQTATTFVQQGNA
LNTKIGSFSVPAASLNSAAVVFMMIWVVFQDSIVIPIARRYTGNAAGLTQLQRMGVGRF

LAIPALAVAALLEMSRLRSVRAGHNLSIVWQLPQFVILSCSDVFCGIAQLEFFYSEAPVS
MRSLCSAFSFLAMSLGYYLNSMIISAIAVLSKSKGGQGWLPADLNDGHLDYYFWLWTG
ISAVNFVVYTGFAKNYTVKKVAPR

Brachipodium distachyon Bradi_45 Bradi3g34600

MAMLESGDRSSSPSSTPATTRKRPRRFTWTGPAIVLGFELLESIAFSGVALNLVVY
LGTVLHGTTAFNAAHVDTWNGTTFIVPVIGAFLADSWWGKYNTILASIVFYLAGLVLLT
LSAGIAPFKPASCTAALQAGVSSTCPPATKTQFTAFFVALYLTSIGTGGVKSALLPFGAEQ
YDGCEGSSLERKQSFFTWFFGAINLGIFVAGTLVSWVQQNVSWALGFGVSALCLLLAA
AGFLAGTPWYSRAPLPAGSSPLRDILRVLVASFRKRNHRVSGELHEGVLRLEDEDQKLE
HTKGLRWLDKAAVKKNNGGEGGEEEGAWDLCTVSEVEGVKILARMAPIWVTCVLYA
AALGQMTTTFIQQGMAMDNRLRLSSSGEGKSIKVPVASMVSVEVAFMLLWVLLHDFA
VMPLARRFRRRRGSGTGNTVGLTQLQRMGVGRFLVVFAMAAAALVERRRLRQFSGSG
EKMGIAWQVPQFVLIAGSDVFCGIAQLEFFYGEAPASMRSICSALSFLALSLGFYVNSAV
VMAVARIAPGWLAPDLDRGHLDYYFWLWTVIAAANLMLYMLLAARYKPKQVSPTAT
HN

Brachipodium distachyon Bradi_46 Bradi3g39040

MEAADEERPLLHVQPYPQDVGSEYTSDGSVDINKQPALKRNTGNWRACSMILG
VEFCECMAFFAIARNLVSYLTTVLHESKVTAARNVSAWAGTCFLTPLIGAFLADTYLGR
YLTMVVSLPVYFVGMLVLTVSASVPTSYYTGDVHRTVIYLGIYIAALGSGGIKPCASAFG
ADQFDSADPMELAKKASFFNWYYFLITFSSLLSSTVLVWLQDNVGWGISFAIPAVLMAL
GLTVLVSGSRVYRFRKLRVSPFTSICQVVVAAVRKWHVQLPDDISLLYELASSSLTPEAS
HKIQHTNQFRFLDKAAIVLPPSAKTLMVPPMCPWRLCTVTQVEELKILLRMFPVWASFV
IFYAVAGQTTSTFIEQGMVMDNRVGPFAIPPASLSIISVFSVLIWVPVYETVLVPLARRYT
GKEKGFSQAQRLGIGFALSTLTMVYSAVLEMKRLAMAQASGLANENVPTRMSILWQGP
SYVMLGAAEVFASIGMTEFFYDQAPYSMKSLCAALAQLAIASGAYFNTIMFAAVAVAT
TQGGAPGWIPDNLNEGHLDYFFWMMATLSLLNLAQFVHNSLRFRVKTAS

Brachipodium distachyon Bradi_47 Bradi3g39990

MAPSSPVSGAGGQRAGVVVIGGGDPEARNAGEEAIHKSVAVPADDDALSASEEV
RYRGWKTMPFVIGNETFEKLGSIGTAANLMMYLTSVFHMANADAAMALNAFSGTTNL
ATVLGAFASDLCLGRFATVGIGCVSTFIGMIILTLTAALPTLHPSPCSAEDGGRHHYCAG
ATRLQMAVLVLSFAFIVAGAGGIRPCNLAFGADQFDPRSEAGRRGINSFFNWYYFTFTIA
VCVSSTAIIYVQTNLSWWVGFAVPAALMLVSCALFFAGTTLYVRVKPEESPLAGIARVA
VAAFRKRRVPDGSKSLFRTTRHGSQLVSRLPYTDQFMFLDKAAVVVHKSEIDEISGLPK
DPWRLCSVQQVEETKCVLRVLPVWATCIVYYVAFAQTNTYLVLQAAQSDCRLGSFKA
AHGPRGRHHAAQRMGIGMALSAVAMLVSGLVERRRRDHDASGKVSPQSAFWLVPQLA
ALGLSEAFNQVSQMEFYYKQFPENMRSVAGSLLFSGLALSSYLSGLLVSVVRRVSAGVD
GDEGWLAEDLNVGRLDCFYFLIGAIGIADFLVFLACANWYRYKVSDDDMHEHDADEN

Brachipodium distachyon Bradi_48 Bradi3g47010

MVSAGGHIDNGDDAVDFRGNPVDKSKTGGWLGAGLILGTELAERVCVMGISMN
LVTYLVGELHLSNAKSANIVTNFMGTLNLLAIVGGFLADAKLGRYLTIAISATIAALGVS
LLTVDTTVPGMRPPPCGDPRQSTQQECVPASSGQLALLYAALYTTAAGAGGLKANVSG
FGSDQFDGRDPREERAMVFFFNRFYFCISLGSLFAVTVLVYVQDNVGRGVGYGVSAAA
MALGVAVLLAGTAKYRYRRPQGSPLTVIGWVLWAAWKKRKLPLPADAGDLNGFHTA
KVAYTDRLRCLDKAAVVDEADQLGAPPPSKQQPEQTTTSTATVTQVEEVKMVVKLLPV
WSTCILFWTVYSQMTTFSVEQATRMDRRLGSFVVPAGSLSVFLFLSILLFTSLNERLLVP
LARRLTRRPQGLTSLQRVGTGLALSTAAMAVAALVEKMRRHAAVKDHASPPVSAFWL
VPQFFLVGAGEAFAYVGQLEFFIREAPERMKSMSTGLFLVTLSMGFFLSSFLVFVVDAVT
RGAWLPNDLDAGRLDLFYWMLALLGVVNFVVFLVIARGHEYKPSTSAVVAPAGEDSG
SSGKEMDDMIVVKENVEGMDV

Brachipodium distachyon Bradi_49 Bradi3g52096

MSANDGDMKMRVIVMDSEAERSAAKEKLCEYTLDGSVDIKGRPAVKGKSGGW
LAGGLILVNQGLATMAFFGVNVNLVLFLTRVVQQSNGDAANNVSKWTGTVYMFSLIG
AFLSDSYWGRYKTCAIFQAIFVLGLALLSLSSRLYLIRPFGCGTQGTPCAPHSGAEMGIFY
IALYMIAFGNGGYQPNIATFGADQFDEEDPAEAHSKVSFFSYFYLALNLGSLFSNTFLSYI
QDKGNWVLGFWASTAAAATALLLFLSGTPQYRHAQPCGNPIGSICQVASAACRNWKSG
VSPDHEVLYEGDDGSKADSGGRKLLHTEGFRFLDRAALTKASDSNTKLGGACPGPRDQ
WKLCTVTQVEQVKSILRLLPIWLCTILYSVVFTQMASLFVVQGAAMRRTTMFPGFYVPA
SSMSAFDILTVATTIFLYRRAICPFLARLTGRPTGPTELQRMGLGLVLGAMAMATAGTV
EHFRKAGATGTAANSSDLHIIWQVPQYALIGVSEVMMYVGQLEFFNGEMPDGFKSFGS
ALCMMSMSLGNYFSDVILTAVTRATAVDGRPGWVPDDLNEGHLNKFYFLLAILAVADF
AVYLVFASRYRRSGNKVDGRSDDDEEEGSVHGQVAYAA

Brachipodium distachyon Bradi_50 Bradi3g52427

MDAMERGERAPLLPESYGPKTQEDSLQVPLLKHKKRSGSKAPAVILGFECLESTA
FNGISTNLVVYLETVLHGSNLASASNVTTWFGTSYLTPMFGAVMADTFWGNYNTILISL
AVYLLGMMLITFSAFLPAAAAATTALCAAGASCAGASSGISSVVSSQTVAFVGLYLVAI
GSGGIRSSLLPFGAEQFDDEDNAERKASFFSWFYLCVDFGPIICGVFLVWIQQNVSWGLG
FGIATACIALAFAAFVLATPLYKRRMPTGTPLKSLCQVLAAACRKASLKVPTDARLLHE
ASEKLDSSRPKIAHTSEFTFLDKAAIVVSEEGASSSWKLCTVTQVEELKILLRLLPVWVTS
VVVSSAYSQMNTTFVQQGSAMDTTVLSVPVQAASLGSFEVLCVLTWVLLYDKAIVPAL
RGFSGEPSQLQRMGAGRLLMALTMAVAALVEMKRLDGASRGEQIGIAWQLPQYFFLA
GGEVFCYIAQLEFFFGEAPDTMKSMCTSLALLTIALGSYMSSFIYAVVEAFTATGGRPG
WISDDLNEGHLDYFFWTMAALCTLNFVVYSAVVKNYKLKTVLS

Brachipodium distachyon Bradi_51 Bradi3g53380

MAPSIVDSKGISPITEDGSMDRRGNPAVKANTGKWKSSILLLVNYGLVTCAFFGV
GVNLVVFLRRVLHQDNAEAANSISKWTGTVYIFSLIGAFMSDSYWGRYITCAIFQMIYV
TGLVILSLTSWFLLVKPSGCGDGETHCDKPSTAGVALFYLSTYMIAFGNGGYQPSIATLG

SDQFDETDPDEARSKVAFFSYFYLALNVGSLFSNTVLVYYEDSGQWVMGFWVSAAAA
ALALVLFLLGTPNYRYFKPSGNPLTRIAQVLVAASRKWRTHAPRGELLHEVDGDESKVS
GIRKILHSDQLRYLDKAATVTEEEYFDPERMKDPWRLCTVTQVEEVKCILKMLPIWMCT
IVYSVVFTQMASLFVEQGTTMDTNIVGSFHVPAASMSVFDILSVLAFIAIYRRVLVPVMA
RLSGNPQGLTELQRMGVGLVIGMGAMVVAGVVEVERLKRVAAPDQPSSLSVLWQVPQ
YALIGASEVFMYVGQLEFFNGQAPDGVKSFGSSLCMASISLGNYVSIMLVSVVTSLTAG
ERRPGWIPGNLNSGHLDRFYFLLAALSLVDLAVYVACAMWYKGIKLDNSNEEKGKVPA
HV

Brachipodium distachyon Bradi_52 Bradi4g00530

MDQGNKLRAQQEEGQELADQHNKAMGSMDMETTTKAAVFSDAVVHNYRGW
KAMPYVIGNETFEKLGTIGTLSNMLVYLTTVYHMPSVTAATLLNVFSGTSNLATVVGAF
VSDTYLGRYTTIAAATISSFLGMLILTLTAALHSLHPPSCPPNSTSCHGPSSSQLAALMAS
FFFLVIGAGGIRPCNLAFGADQFDPRTADGRRGIASFFNWYYFTFTIAMMLSATVIIYLQS
SVNWALGLAVPALLMGLSCAVFFMGSRLYVRVRPEGSPFTSFAQVLVAAVRNRKLHLP
AGAGGTRELLFDPPHQSKLVSKLAYTDQFPCLDKAAAMVAIASPEGEKKERNPWRLCT
LQQVEEVKCLARIIPVWSSGIVYFIVLSQLGNYVVLQAAQTDRRITASSGFEIPQGSFVVF
QMLALTFWIPVYDRLLVPAIRRLTGRSGGITLLQRIGVGLALCIATMLVSAAVEHHRRNL
ARTKTLMPWFWLVPQQLLAGLSEAFSAIGQIEFYYSQFPENMRSVAGALYFLGFAIASY
TSGFMIMVVHRATRGRDGGPDWLAQDLDQGRVDLFYLLTAAMAAVNLVYFIACARW
YRFSKPQDAPSGAGDDDDSPKKLGDAEPV

Brachipodium distachyon Bradi_53 Bradi4g17950

MAGFITEAEQEKLPLLPLLHGTPSQSQDHHGPYTGDGSVDFKGAPAPRERSGKW
RACCSILGGEFCGALAYYAVGTNLVSYLTKVQHRSNVSAASSIASWQGTCYLASPLGAF
LADSYWGRHRTIVVSLTIFTFGMVLLTLSAVAPEIADSVVIISPRDTLSSLGLYMTALGLG
GIWPCVPTFGADQFDDTDAAEKTHKERYYNWYYFAVNGGFFFASTVMVWIQDNLGW
GLGFGIPTLFSAAGIAGFLASTKIYRYQRPGGSALTRACQVAVAAIRKIHVHVPVESSLLY
EIPGKESAIAGSRKLMHTDGLMFFDRAATITYSDKTSADNLLNPWKLCTVTQVEELKILA
RMLPVVVTAIIFNTAEASFPLFVEQGSVMDNRINGFDVPPASLMTFNCICILLLAPTYNRV
LMPMVSRITGIKRGISELHRIGIGMFFAMLSMVMAALVENARLRIAENRGLVHQNVVVP
MNILWQAPQYILVGVAKVFSVVGFIEFAYEQSPDAMRSMCQACALIMVTLGSYLVSMIL
KIVGSVTVKGGSHYWIPENLNEGHLDRFFWLMAGLQFLNLLAFVYSATRFKRKVAT

Brachipodium distachyon Bradi_54 Bradi4g21150

MGSSSGLVDWRGRPINSKKHGGVRASIFIHALVLLSNAANIANIMNLVTYLRGT
MHMGVAEASTTASNFFAALQMFSIPAAFLADSYIKRVYAVLIFGPIEILGYILLAVQAHIP
MLHPPPCSQTGATATCEPVHGSNLSLLLLGLYLIPIGDGAARACLPALGGDQFDTADPAE
QRQETSFFNWYTFAVSSGGFLGLVLIVWVQNRQGWDIGFALCALCVLLGMLIWIAGFPF
YRNQLPGGSAITRMLQVLVVAFKKRNVELPKDTSELKQMNQDDSNNGLEKLERTVGFQ
CLEKSAIDTGETGPWSLCTVTQVEETKIVLRMVPIFLSAILGYIPVPLILNFTVQQGNTMD
TKLGAIHISPATLFLIPTVFQMVILVLYDRFIVPFLRRITGYVGGVTHLQRIGIGFLSATLAT

GVAALVETKRKRVAEENGLMDAATGIPISVFWLTVQFFLLGVVDVTSFVGLLEFFYSEA
STGMKSVGSSIFYCILGVSAWLGSLLIQVTNQVTRRGGSGAAAAATGWLDGTNLNMGK
LDRFYWLLAVLELVAFFIYMFFAWRYEYRNNQRVVDNTGDTKAPLAPEGAAGDLII

Brachipodium distachyon Bradi_55 Bradi4g21790

MDVESSRHQGPKGDSNCMAAVASQEVFVDWRGRPCEPHKHGGMKAAVFVLGI
QALEIMAIAAVGNNLITYVFNEMHFPLPKAANIVTNFIGTIFLLSLLGGFLSDSYLGSFWT
MLIFGFVELSGFILLAVQAHLPQLRPPPCAMTATAGAGEQCEEVGGAKAGIFFAALYLV
ALGSGCLKPNIIAHGADQFRGHGGGGNGGDGDDKRLSRYFNAAYFSFCVGEMVALTLL
VWVQTRVGMDVGFGVSAAAMALGLVFLVSGASFYRNKPPQGSICTPIAKVFVAAVTKR
KQVCPSAGVGAHEIARSSTNIRRINKFRFLDKASAKAQDGVATTKEETSLAAGWGQQQ
YMECTAAEVEQVKVLLCVVPIFACTIVFNTVLAQLQTFSVQQGSAMDTRLFSSSFRIPPA
SLQAIPYLTLVGLVPAYEAFFVPAARKLTGLSTGISPLQRIGVGLFAASFSMVAAALVEA
RRRHCQDRISILWIAPQFLIFGVSEMFTAVGLIEFFYKQSMAGKGMQAFLTSMTYCSYSF
GFYLSSVLVSLVNRVTSSGINGNGGWLGNNDLDKDRLDLFYWLLAGLSLLNFFNFLFW
SRWYSRSVETVQVAGVGSSGDDVAGQGQVENEKSSAAC

Brachipodium distachyon Bradi_56 Bradi4g39780

MAVQGIVDWRGRPVHPKRHGGVKAAMFIYFLIVMTNMGNIPTMLNMVSYLHG
TMHMGIADASTTATNFFGALCVFSFLGAFLSDSYLTRFYTILIFAPVEILGYMLLACQAH
FPSLHPPPCAMANEKYDCAPVSGKNLSLLTLGLYVIPVGEGALRVCAAALGGDQFDGD
DDPRGKTSFFNWYAFCISLGGLVGLVFLVWVQNNVGWDLGFALPALMALVGMLVLLA
GLPLYRHQVPTGSPLTRILQVFVAAFRKRKLSLPEDWMEMHEISDGTSRSIEVLDRTPSF
KFLEKAAVNDGDGRRWSLCTVTQVEEAKMILRMLPIFLSSVLGYLPIPLLLTFTVQQGG
AMDTRIGFGKNAKINIPPASLFVVPIVFQLLILVAYDRAFVPWLRQATGHTGGVTHLQRV
GTGFASSVVALAVAAVVEARRKRISLSEPETTLSVLWLTPQFFLLGVMDVTSFVGLLEFF
YSEASAGMKSIGGAIFFCILGVASWLGGFLVKAVNRTTASSSHGSGHGWLAGDSLDDSH
LDWFYWLLASFGLVSFLLYLCCASRYTCRHEHSSRMLETVQDDGKALTVLAKKAAV

Brachipodium distachyon Bradi_57 Bradi5g01737

MEAADEERPLLLHRLPPDLNLDWDSRYTCDGTLDVKGQPAVKTSTGNWRACFF
LLGIEFSECLAFFAISKNLVTYLTSVLHESNIDAARNVSTWIGTTFFTPLVGAFLADTYWG
RYKTIVIFLSVYAVGMLVLTVSAAVPFMLQSSTHSEIHRVAVYLGLYLTALGNGGIKPCT
SAFGADQFDIADPVELVKKSSFFNWYFFSINVGSLLSTTIIVWVQDNVGWGIGFAVPMIL
MSLGFTVFVAGRRMYRYKKLGESPMKRVSQVVVAAARNCRLELPDDCSALHQLPSPSE
AIFKVDHTNQFRFLDKAAIVPALTSEKKGPWRLCTVSQVEDVKMLLRLCPVWASMVVF
FMATSQMSSTLIEQGMAMDNLVGPFAVPPASIAGFDVISMLVLIPIYDIVLVPLARRATG
EPRGFSQPQRIGVGLALSTLAMAYSALLEMKRLTMARAQQKASIMWQAPAYTVLGAG
EVFATIGILELFYDRAPKSMKSLCTALAQLAVAAGNYLNSAVLGAVASAGWIPEDLDDG
HLDYFFWVMAALGTLNLLQFWLCSIPALGYSSKPASRQRRPY

Brachipodium distachyon Bradi_58 Bradi5g10920

MDVESSAAHEVSVDWRGRPCEPRRHGGMRAAVFVLGIQAFEIMAIAAVGNNLIT
YVFGEMHFPLSEAANVVTNFVGTIFLLSLVGGFLSDSYLGCFWTILTFGFVELSGFILLSV
QAHLPQLKPAPCNMASMDGSCEQARGFKSSIFFVALYLVALGSGCLKPNMIAHGADQF
AAGAGVDNAKRLSTYFNSAYFSFCLGELFALTALVWVQTHSGMDVGFGISAAAMAAG
LACLVSGAAFYRNKPPQGSIFTPIARVFVAAFNKRKQICPASPANVGVCEPARLDGNFRH
GNKFRFLDKACIRENAGQQQGQDGNTKPESPWRLCTVAEVQQAKTLLAVTPIFACTIVF
NTVLAQLQTFSVQQGSAMDTALGGHGSFRVPPASLQAIPYAMLLFLVPCYELLLVPLMK
RLTGTRSGITPLTRIGVGLCTVAFSMVAAATVERRRRDLALSPGGAQQKMSVLWIVPQF
LVFGVSEMFTAVGLIEFFYKQAAASGAGIGMQSFLTALTYCSYAFGFYLSSVLVKLVNM
VTAGHGGAGGWLGDNDLNKDRLDLFYWMLAVLSVLNFFCYLVCARWYNSGADGLD
AASAQIAAEGDGKEIS

Brachipodium distachyon Bradi_59 Bradi5g14380

MEASRQHSFSMVVYSPEWISQVRTVLAVLRSCPSSANFSIVAYFHGILHLDIVTSS
AVIAYLVGAVSFFAALTNFISDAYIQRTTAIFVFGPFVVLAYILLALQAHLPSLHPLDCEIN
KELNNCEPPQGWNLTLLYLSLLMFAIGEGCMRACIPFLGGDQFSNDGPKETQLKGIFLR
WLKFANSLGALIGLVFLVWIQNNLGWAVGFMIPALIVLVGLLVAASGLPFYRTHTPNGS
PLPRILQVVASSKKRQAAVVDAIELQEIGASNCVNGEDKSNNKIICTTQAEEEGEVIIRML
PIFLSCLLIYLPFTLLMTLTIQVGSTMHRGIGAIQISSASLIAIPTAFHMFMQPCYKRILTPLL
RRFTGHTNRITPLQRIGAGSACGIAAACLATLVETRRMTVAEQHGLTSTKAGVPMSVFW
LVMQFFLLSIMDAASLTGLTEFIKSESSPEMKLVAPAVQSILAAIAAWLACAFIQLANRA
TRNGDNGRGWLDGANFNRTRLDRFFLLLAAFELVALINYAFWARRYTKKEQSRAVGLS
STDQETK

Brachipodium distachyon Bradi_60 Bradi5g14390

MRQQLGKYGPCASVYDNAPMYMILSINCLQINCDFEGYMLLALQAHLPSLHPPD
CEIIKEPNNCETTEGWNLTLLLLSLLMFAVGEGCMNACIPFLGGDQFNNDDPNETQLKG
MFLSWLKFANSLGALIGLIFLVWIENNVGWTIGFAISAVLVLVGLFVAASGLPFYRTKKP
NGSPRKRILQVLVSSSKKRQAATVDVIELQEIGAADCIDGEDKPNSEITGTTEVDELTKAII
RMLPIFISCLLIYLPFTLLRTLTIQVGSTMDKGIGTIQISSASLIAIPTAFHMFMQPCYKWIL
TPLLKRFTGHTHAITPLQSIGAASACGIAAACLATLVETRRLTVAEQHGLSSTGAAVPMS
VLWLVMQFFLLSIMDAASFTGLIEFIKNESSPEMKLIAPAVQSILAGIAAWLACAFIHLVN
RATKYGNNGRGWLDGANFNRARLDRFFLLLAAFELVALINYAFWARRYANKQRSSAV
GLVETDQETR

Brachipodium distachyon Bradi_61 Bradi5g14400

MALGGFVDWRGNTINREVHGGVRAAWFLYVLTVVTNVVIVPNLLNMVTYLQG
TMHMGVSGSATTATNFFGATSGFALIGAFLSDSYITRSRTVLIFGPFMFLGYGLLALQAY
LPSLHPPPCNIEAELNNCKKVHGWNAALLYTGLYMSAFGDGSIRVCLPSLGADQFDHED
PTESHQQSSFFNWYTFGISFGGFVGLILIAWLENFKGWDIGLGVCCILILLGLVIVASGLPF
YRNQVPEGSPLTRILQVLVVAFRNRKHELPQKLEETQESNSRTGSVGAFSQTNSLKFLDK

ACISRGKSGAWSVCTATKVEETKIVLLMLPVFITSMIGYISNIILLTFTVQQGGMTNTRLG
MIHVAPATLFIIPITFQMAMLAVYDQFLVPFLRRRTGYVRGITHLQRIGIGFGSMSLASAI
AAIVERKRKQAVVQMSLFWLAPQFFLLGVSDVTSFTGLLEFFNSEAPRGMKSIATALFW
CELGLASLMATFLVEIVNKATRHGNQGGWLEGSSLNSSHLDLFYWVVAVVGLLSFFNY
LYWAKKYVYQHNPRITEPMVDHQDSP

Brachipodium distachyon Bradi_62 Bradi5g14410

MALGGFVDWRGNAINREVHGGVRAAWFLYVLTVVTNVVIVPNLLNLVTYLHG
TMHMGVSGSATTSTNFFGATSGFALIGAFLSDSYITRSRTMLLFGPFMFLGYGLLALQAY
LPSLHPPPCNIEAELNNCKEVHGWNAALLYTGLYMTAFGDGFVRVCLPSLGADQFDHK
YPSESRQQSSFFNWYTFGISFGGFVGLIFIVWLENYKGWAIGLGVCCILILLGLLIVAAGF
PFYRNQVPEGSPLTRILQVLVVAFKNRKLELPQKPEEAQENNTGSGTGSIDALSQTNSLK
FLDKACINPGRNGAWSVCTVTKVEETKIVLRVLPLFISSMVGYISNIILFTFTVQQGGMTN
TSLGKIHVSPATLFIIPITFQMVMLAVYDQFIVPFLRKRTGYVGGITHLQRIGIGFVAMLL
ASVIAAIVEKKRKEAVVQMSLFWLAPQFFLLGVADVTSFTGLLEFFNSEAPRGMKSIAT
ALFWCDLGLASLMATFLVEVVNKATRHGQQGGWLEGSSLNNSHLDLFYWVVAVVGL
LGFLNYLYWAKKYVYQHNPRIAELPADQDSP

Brachipodium distachyon Bradi_63 Bradi5g20270

MDTDHLAITRPILSDDEVRASKAREEVHNKARHRSESAVKVILSLQFLEVTAFFG
VYLSLIVYLQDVLHGDSASNVSTVSSWAGVCYLMPVLGAAIADSYWGKYKTTLVSLSIS
VLGMAMLTTSATLPSLRPPPCAHNGHCPPATPTQSLLFFSGIYLCGIGIGASKAVFISFAA
EQFDDDASERGAGSKSKASYFSWYYAVANMGMLTAGTLLVWVQDKVSWGLGYGICA
SLVAAAVVSLAATAPVYRMLPPAGSPLKGVLQVLVAFSRKVKLTVPRDAGELYEGEDV
KNPSLHSPARERLQHTDQFRCLDRAAIVTAEDLEDGDHRPWTLCTVTQVEELKTLLRLV
PIWLTSAVYFVANTQAQTTFVQQGTKTDSRITIGAVSISIPAASLTSIQTVCAAAFVALYN
RAVAPAAPFKPLQLMGLGHATAGIAVAMAACTEARRLRIAMEGESAAAAAMGIAWLL
PQYVVMAVSDASLSVGQLEFFYDQAPATMRGASTAFYFLSLSLGNLINSQLVTLVASVT
AAGGRTGWFPPELDDGHLDYYFLLVVAVAVVNFAVFIALVRNYTPKRVR

Brachipodium distachyon Bradi_64 Bradi5g20300

MDADHRSLTRPILAGDEASGSNRSSEARELKVHEANHCSDKALKIILCLQFLEVS
AFYGIYLSLIVYLQDVLHGDSASNVATVSSWAGAGYLMPVLGAAVADSFWGKYKTVL
AGLTISVVGMAMVTTSATLPSLRPPPCAQQSAYCAPATLRQELLFFSGIYLCAVGIGAAK
AVFISFAAEQFDDGDGRKSSYFSWYYTAANMGMLTAATLLVWVQDKVSWGFGYGICA
SFVVVSVVGLAATVPMYRILPPAGSPLKGVLQVLVASSRKVKLTVPRDAAELYEGEDV
KNPLLHSPLHERLQHTDQFRSLDKAAMVTDEDLEGGDHRPWRLCTVTQVEELKTLLRLI
PIWLTSAVYFLANTQAQTTFVQQGTKTDSRITIGAVSISIPAASLTSIQTVCVAACVTLYN
RAVAQSSPFTPLRLMGLGHATAAASVAVAACTEARRLRIATEGDSAAAAAMGIAWLLP
QYVVMAVSDASLSVGQLQFFYDQAPETMRGASTAFYFLSVSLGNLINSQLVTIVASVTA
AGGRTGWFPPELDDGHLDYYFLLVVAVATVNFGVFVALAKNYTPKRVRQSRLDSLSSS

Brachipodium distachyon Bradi_65 Bradi5g20310

MDAMERGQSSPRLPKSRGSKIDEESLKVPLIEAKKKTGSRAPAVVLGFECLESTA
FNGIATNLVLYLERVLHGSSLGSASNVTTWIGTSYLTPVFGAMLADTFWGNYNTILVSL
VVYLLGMMLVTFSAFLPTTALCGVGSSCHPVLGSHTVAFAGLYLVAFGSGGVRAALLP
FGAEQFDDDNAVDRERKMSFFSWFYIAVDFGMIVSGLFLVWVQQNVSWGLGFGIATAC
IALAFAGFVLATPMFKRRMPSGTPLKSLCQVVVAASRKVALRVVPSEAANLYEVSDKIE
HEQPRIAHTDEFTFLDRAAMIVASDLAEVTANDAGAGAGSSSSSWRLCTVTQVEELKIL
MRLLPIWATSIVLSAAYAQLQTTFVQQGNAMDTRVMSFSLPAASMVSFEVICVLAWVLI
YDFVILPALRSFSPASGEPSQLQRMGAGRLLMAVAMAAAALLEMKRLDAAAGGGSVSI
AWQMPQYFVLAGGEVFCYIAQLEFFYNEAPESMKSMCTSFALLTVALGSYMSSLIYGVI
NMLTATDGRPGWIPDNLDEGHLDYFFWVMAALCTLNFVVYSAFARNYQVKTVVS

Brachipodium distachyon Bradi_66 Bradi5g22260

MADTETPFLQQLTAGDTDEDEDPPPLAGVSDFRGRPVRRASSGGWRSALFVVVV
EIAGSFAYFGVSANLITYLTGPLGQSNAAAAAAVNAWTGTGTLMPLLGAFVADSWLGR
YRSIILACTLYVLGYGMITLASTLPALRPPPAGDPSPTQVAFFYGSLYLIAVAQGADKPCG
VAFAADQFDPGHPGERAARGSLFNWWYFSMAAGITVAVAVMSYVQENVGWGVGFGA
PCFVMLAAFAAFLAGSPTYRLLHTPDDAAKTSSSPFARLARSLLAAIKTKKKHQQQLEV
EDESSEAARSVLRLMPIWAACLAYGVVNAQIMTLFNKQGRTLDRRVRIFDDLELPPAAL
QALGPATILLFVPIYDRLLVPALRPGALTPLRRVGTGMALSALTVCVAALVEARRLDTA
RQHGLVTVHAGGSTATVPMSWAWLVPQYVTIGVADVFAVVGMQEFFYDQMPGELRS
LGLAMYLSVMGIGGFISSAMISVIDRVTSSGGGDSWFADDLNRGHLDYFYWLLAGLSA
AELVMYLCLARSYVYSNRRLLR

Brachipodium distachyon Bradi_67 Bradi5g27190

MGDAEVPFLLTVDGADGDTETKEEPPLAWVTDFRGRPVFRSSSGGWRSALFLIG
TYMFLDLLQLLVLNSYLICLCMLCTHLRINGEVQKGFTFNHTYAVVELGGTFTYYGVSA
NLITYLTGPLGHSNAAAATAVNVWAGTASFMPLLGAFVADSWLGRYRSIVLAWTLYAL
GYGMMTIASSLPVLLPSSPNHNDSSSRPWSMQAALFYASLYLIALAYGPDKPCGLVFAA
DQFDPYHPKECAARRSFFNWWYFSIAIGIAVSFAVVSYIQENLGWEIGFGTLFAIVLCAFS
VFLLGTPTYRFYSATLGIESPFVRLARSLAALVRNSSFSLLGQKRHHHQHEDEATTGKFE
EARHVLRLLPIWATCLAYGVVLAQVSTIFIKQGRTLDRRILDGLELPSAALQTFGPAAILV
FVPIYDRLLVPALRYATGNPSGLTPLQRVGTGLALSLATVSMAALVEARRLGIAREHGL
MDDAGATVPMSWVWLAPQFVMIGVADSFVAVGLQEFFYDQMPCGLRSLALALYFSVI
GIGNFISGALVCLIDRITGSGGGDSWFADNLNRAHVDYFYLLLAGLSAAGLALYLYFASS
YVYKCTATRASAQGKNLPVLQTCTSVVEF

Carica papaya Carpa_01 evm.TU.contig_28770.2

MAEKMTWSVADAVDYKGFPADKSKTGGWVPAALSLGIEICERLSTMGIAVNLV
TYLEGTMHLASATSANIVTDFMGTAFLLCLLGGFLADSFLGRYKTIAIFATVQTLGTGLL
AISTKLPELRPHPCQTVEVTRCKQATGTQMGVLYLSLYLIALGTGGLKSSVSGFGTDQFD
EKDEKEKSQMAYFFNRFFFVVSTGTFMAVTVLVYIQDEVGRSWGYGICSISMFVAILIFL

SGTRKYRYKKSQGSPVVQIYQVIVAALRKKSVELPANSTMLYEDLPENKRIHHTNQFSF
LDKACVITEDDYGNNGSLAANPWKLIPVTRVEEVKMMIRLLPIWATTIIFWTTYAQMITF
SVEQASTMERSVGNFQIPAGSLTVFFVAAILITLAIYDRFVMPLWKKWKGKPGFSNLQRI
AIGLFLSAMGMTAAAIAEIRRLSVAKTFGLNTTTTTTTTKPLPITVFLLIPQFFLVGAGEAF
IYTGQLDFFITQSPKGMKTMSTGLFLTTLSLGFFFSSLLVSVVKAVTGNGNRQGWVGENI
NNGRLDYFYGLLAALSFINFGLFVLCAYWYKRRTDKNVEDMKIIVVDDENKGNSSL

Carica papaya Carpa_02 evm.TU.supercontig_1.1

MEIEKREEKRVADHEHGKRQKGGLVTMPFIFANEACEKLAVVGFNANMISYLTT
QLHMPLTKAANTLTNFGGTASLTPLLGAFLADSFAGRFWTITISSIIYQIGMIILTLSAILPK
LRPPPCKGEQTCQEADTGQLAILYVSLLLGAIGSGGIRPCVAAFGADQFDESDPKQTTKI
WRYFNWYYFVMGGSILVAVTVLVYIQDNVGWGWGLGVPTIAMFLSVVAFIFGYPLYR
HLDPAGSPFTRLVQVGVAAFRKRKVAMVSDPILLYTNEELDAAISLGGKLFHTCQMKFL
DKAAIVTEEDNIKHGQPPNPWRLDTVHRVEELKSVIRMGPIWAAGILLITAYAQQNTFSL
QQAKTMDRHLTTHFQIPAGSMSVFTMLSMLSTIVIYDRFLVRIARRFTGLDRGITFLHRM
GIGFVISVLATLVAGFIEQKRKQAAIANGLLDKPQSIIPISVFWLVPQYSLHGIAEAFMSIG
HLEFFYDQAPESMRSTATALFWTAISAGNYTSTLLVSLVHKYSAGPDGSNWLPDNNLN
KGKLEYFYWLITALQVANLIYYICCAKIRNVRLNYWYT

Carica papaya Carpa_03 evm.TU.supercontig_112

MEEDDTYTKDGTVDYKGNPANKKTTGTWKACPYIIGNECSERLAFYGMSTNLV
LYFKHRLNQSTATASRNNLNWGGTCYLTPLIGAFLADAYLGRYWTIACFSIIYVFGMTL
LALSASVHGIRPVCYSKENCKDPTSTQTAVFFVALYLIALGTGGIKPCVSSYGADQFDDT
DETEKKHKGSFFNWFYFSINIGALIAASVLVWVQDNVSWGWGFGIPAIAMAIAIVSFFSG
TRLYRNQKPGGSPVTRLCQVVVASLRKYKIEVPADKSLLYETADSESNIPGSRKIDHTKD
LSFFDKAAVEIQLDNKRSSVDPWRLCTVTQIEELKAIIRLLPVWATGIIFSAVYSQMGNLF
PLQGERMDTRVGNSNFRIPPASLSIFDTLSVIFWVPVYDRIIVPITRKFTGHKNGLTQLQR
MGIGLFISIFSVVAAAILEIIRLKIVRKHNYYDLKEMPLSIFWQVPQYFIIGCAEVFTFIGQL
EFFYEQAPDAMRSFCSALSLTTVALGSYLSSLLVTIVTAVSTRNGKLGWIPDNLNHGHV
YNFFWLLAVLSVINLGIFILISRWYTYKRPLGTLR

Carica papaya Carpa_04 evm.TU.supercontig_130

MDEENGTLIPNSAEYQRQPAGWKTMPFILGTEMFERLASFGLVANFMVYLQREY
HMDQVKAATIINVWYGITNFTPLIGAFISDVFIGKYRTIIIGAFASLLGMMIMTTTALVPQ
LRPPPCPSEQEQNNQCTASTNMQLSLLILSMLWLAIGAGGVRPCSIPFSVDQFDQSTTEG
RRGVGSFFSWYYTTQTIVLLISQTLVVYVQNDISWALGFEIPTAFMLGAITLLLVGSKIYI
FVKPEGSTFSSITQVFVAAYRKQQLTLTTEGDDIIFYDPPLETPLLSNKLHLSNEFRCLNK
AAVVSENEVDVDGNPINPWRLCSIQQIEDVKFLMRTIPISVTSIIAFLAFNQQQTFAVSQA
EKMDRHIIGINYEIPAGSLRTITLITMAIWLPFYDTVLVPPLQRLTRQEGGITCLQKVGVG
NIFAILTMVVSGFIEKKRRDLAILKGAADGVAPMSVMWLVPQLILMGLFEVYGMVGLTE
FYNKEFPNHMRSIGTSMLYLITALASYVSSLVD

Carica papaya Carpa_05 evm.TU.supercontig_130

MDEESGNLLSDSEECQRQPAGWKIMPFILGNETFERLASYGLIANFMVYLQREY
HMDQVKAATIINAWYGVTNFTPLIGAFISDVFIGKFQTIIFGSFTSLLGMMIMTATALVPQ
LRPPPCPIEQQQNNRCIAATNTQLSFLILSMLCLAIGTGGVKPCSVPFSIDQFDQSTSEGQR
GVIRFFNWYYTTQTIILLISQTLVVYVQNDISWALGFGIPTVLMLGAIVLFIVGSPFYVCV
NPKGSTFSSIIRVFIAAYRKRRLTLPTDGDEVISRNPPLNTHLLSHKLPFTDEFRFLNKAAI
TSENEVDVDGNLINPQKVCSIQQIEDVKRLIRIIPIGVTSIIGFLASNQQQTFAVSQAQKMD
RHIMSINYEIPAGSISVISLITIGIWLPFYDTVLLPPLRRLMKHEDGITVLQKVGIGNIFAAL
TMMVSGLVEQKRRDLAILNGTSNGVAPMSVMWLATQLVLMGFSQVHCIVGLTEFYNE
EFPDHMRSIGNSMLYLTTSLASYISSLIVTIVRDCNDNWLTENVNTSKLDYFYYLIAGLIT
LNFFCYLFCACRYQYKNX

Carica papaya Carpa_06 evm.TU.supercontig_139

MALTESDGSLELSCNAEDGVSSEKQEEMSSPGSNRGGWVTFPFMAGTLMGLTIA
MGGWATSLVVYMIEKFNVKSINATQIYNIIAASTSLFPVIVAIISDSFVECYSFIWASALVS
TLGITLLALTAILDPLRPQSCENGSNFCPTPSKLQFGVLFSGIALASIGLAGSRFTIATMGA
NQFDHATDQGIFFNWFAITLYGSIVLGGTILVYIEENVSWPLGYSLCIFVNIIGLAIFLSGSR
YYRPVKPQGSPFKSIARVLIATIRKWKVSISSSEDYYHEKNSQEVEKLASVPTKSFRFLNH
AAVCIEGDTKPDGSVAKIWRLCSVQQVEDLKTILRIFPVISSNFLLCTAVPTLGTLTVLQA
LTVDRHLGPHFKFPAGSMFVVILTSTSISITLIDRFFYPMWKKMTHQTLRPLQRIALGHM
FNMTGMGVAALVESKRHKVARSHGIVHQPGSSVPMLVLWLMPQLLVVGIGEAFHFPG
QVTFYYQQFPKSLKSTSTAMVSLVVGIAYLLSTVVIDLVRRITVWLPDNINNGKLDNVY
WLFATIEMVNFGYFLICAKCYSYQNMEK

Carica papaya Carpa_07 evm.TU.supercontig_139

MADGEAQTSASSGRKRGGWITFPFITGALAGLTLCSGGWIGNLIVYLIQEFNVKS
VDAAQISNMIYGCTSFFPVIGAIIADSFLGSFSVISNFSSISLLGMVLLVLTATVDCLKPQP
CEIGSTSSCTSSPSKFQFLVLYGGIILAAIGLGGTRFTMATMGANQFEKATDRGIFFNWFF
FSLYVSAVVSLTVIVYIEDNVSWGLGFGISLAANFIGLAIFLLGNWFYHHDKPQGSPFMD
MARVVVAAIRKRKVVFSSETKDYYQEGSETMTVEATTPTDTFRFLNTASVKVEGDIKPD
GSNAKPWRLCSVQQVENLKILIRIFPLWSSSIFLATPIAIQTSFVVLQILTMDRHIGPHFKIP
AGSILVLVLFSTSVSITLVDRLLCPMWQKLTHRSLTPLQRIGVGHVLNVLSMAVSAFVES
ERLRVAHSHNVQALSGSNKVPMLAAWWLFPQLVLVGIGEAFHFPGQVALYYQEFPLPL
KNTATSMISLIIGIAFYLGAALIDLVRGVSSWLPDDINNGRLDNLYWALVVVGVFNFGY
YLVCSSLYKYQNVENMVEVDNTSDK

Carica papaya Carpa_08 evm.TU.supercontig_139

MNGTVLSADGEAQLSDTGSKRGGWITFPFIVGAVAGSALCGAGWISNLIVYLIQE
FNMKRIDAAQVSNMVSGFTNLFPLIGAIIADSFLGCFAVVLLFSSISLMGMVLLVLTATL
GYLKPEPCEIGSTSSCTGGPSKSQFLALYAGIFLAAIGLGGTSFTIATVGANQFKKAKDRA
TFFNWFFFTLYVSATVSSTVIVYIEDNVSWGLGFGVCLAANVIGLATFISGKRFYHRVRP
QGSPFKDIVRVIVAAIRKRKVVISSESEDYYHKHDETLSVESRKPKDSFRFLNAAALITEG

DIKPDGSILKPWRLCSVQQVENLKVIIRIFPLWSSSIFLSTPIAILLSLTVLQALTMDRNIGQ
NFKIPAGSFPVFVLFSTSVSLLLIDRLLFPMWHKCTHRYPTPLHRIGVGHVLNVFSMIVAA
LVESKRLKIAHSHNVQAMSGSNTVPIMAWWLFPQLVLVGIGEAFHFPGQVALYYQEFPL
PLKSTGTTLISLIIGISFYLSTALIDLLRRISSWLPDDINNGRLDNVFWTLVVVGVLNFGYY
LICSSLYKYQNVEKEVEDVYISEQ

Carica papaya Carpa_09 evm.TU.supercontig_14.

MAGRQKQKGLGNSCVLLIVVAGMERFAFKGVASNLVTYLTDIVDMSNSSAAKT
VNSWCGFTSMLPLLVAPLADSYWDRYSTILASSFLYVVGLVAVTSTALARAWSPSNSKI
SSSFLFWSLCLISLGQGGYNPSLQAFGTDQLDNDEELPSDTADQKSTKKSLFFQWWYFG
VCTGSLLGVTLMAYIQDTFGWVLGFAIPTIAMIVSIAFFSCGSRIYAYRAGGNLNVKLFQ
RLTQAIKARTSKLLSSRITLSDDNSNVVELELQEKPLCPSNLVSRKDLDENPSTEAYVLQ
NLRIIIRLLPIWTMLLMFAVIFQQPATFFTKQGMTMKRNIGSKFKIPPATLQSAITLSIILLM
PLYDKILIPATRLIARDEKGITVMQRMGVGMFLSIIAMVIAAVVETKRLKMSKKMGILN
MESETVNLSIFWLLPQYILLGISDIFTVIGMQEFFYNEVPVKMRTMGFALYTSVFGVGSFL
SALLISLIELFTSSRDRKGWFSDNMRETRLDKYYWLLAIASAVSLLLYIVLCKCFKSRSDF
EDENCK

Carica papaya Carpa_10 evm.TU.supercontig_165

MSLLTLAVSVHSLRPPSCGQGIKKEDCTKQASSLQLGIFYSALYIIAIGTGGTKPNI
STMGADQFDDFEPNERIHKLSFFNWWMFSIFFGTLFSNTFLIYIQDTVGWTLGYAIPTLG
LFVSIVVFLVGTPFYRHKLAVGSPFTRMAKVLVAAVNKWKVSVPDDPKQLYELGLEDY
SNSGMFRIDHTPSLRFLDKAAVKTGSSSPWMLCPVTQVEETKQMIKMLPVLLATFIPST
MLAQVTTLFVKQGTTLDRSMGPHFEIPPACLTAFVTIFMLISLVIYDRYFVPTIRHYTKNP
RGITLLQRMGIGFVLHIIVMIIASFAERKRLSVAKEHGLFVKDDKIPLSIFILLPQFALMGV
ADTFVEVAKLEFFYDQAPEGMKSLGTSYFTSSLGIGHFISSLILTAVSDITKSHGSRGWIL
NNLNISHLDYYYAFLAFLGFINLIFYVFVAKSFVYNVDVDTNSRKDFQEAMEASHVS

Carica papaya Carpa_11 evm.TU.supercontig_17.

MDEAHQLNIWEGYVDWKNKPAKRGLHGGMLAASFVLVVEILENLAFLANASN
LVLYLSRFMHFTPSSSANIVTNFMGTAFLLALLGGFLADAFFTTYHIYLISAAVEFMGLLI
LTCQSHIHSLEPATCLKTNASTLCQEVNGQNAVILFAGLYLVALGVGGIKGSLPAHGVE
QFDETTIQGRKQRSAFFNYFVFCLAFGALIAVTIVVWVEDNKGWKWGLGISTATILISIPI
FLLGSPFYRSKVPAGSPITTMFKVLAAAIYNKSKPRTSSNAVIGTETSSSPRTETSNGEDT
NTKEMGPSQNPREGLTFLNSALTKKPIHPMLQCTQQQVEDIKIVLRIIPIFMSTIMLNCCL
AQLSTFSVQQAATMNTKIGSTIVPPASLPVFPVIFIMILAPVYNHIVAPFARKVTKTEMGIT
HLQRIGMGLLLSIIAMAVAALVEIKRKRVAAELGLTNSTKPLPITFLWVALQYLFLGSAD
LFTLAGMMEFFFNEAPLSMRSLATALSWASLAMGYYLSSVLVSIVNGITSAYRHTPWLF
GSNLNHYHLERFYWLMCVLSGLNFLHYLFWASRYKYRSTWPMN

Carica papaya Carpa_12 evm.TU.supercontig_17.

MEDKEFVEGKEDWKGRRAIKYKHGGTTSSLLILATFGFESMATLSLAVNLVTYF

TGVMHFELADAANELTNYMGTGYILSILVAVLADTYIGRFKAVIISALLELLGLGLLTVQ
AHYPKLRPPTCDIYNQTCKKVEGGNSALLFIGLYLLAFGAGGIKAALPTHGADQFDEKD
PAETKQMSTFFNLLLLALCIGGAVSLTLFVWVQDNKGWDWGFSLSTVGIFLAIIIFFTGW
PMYRIQPVTGSSALTEIIQVYVAAIRNRNLKLPDDPLEFYEIDQDKEAALDTEFLPHRDVL
RFLDKAAIIRKESGNEQIEKDSSSQINPWKLCRVTQVENAKIILSMLPIFCCTIIMTLCLAQ
LQTFSIQQGLTMDTSIASFHIPPASLPIIPVGFLIIIIPFYDQIIVPFLRKLTGIPTGITHLQRIGV
GLLLSAISMAIAALIEVKRKSVARHYDMLDAKPVLQPLPISTFWLSIQYFVFGIADMFTY
VGLLEFFYSEAPKPLKSISTCFLWTSMAVGYFLSTILVQVVNAATKNITRSGGWLAGNNI
NKNHLNLFFLLLSILSLVNFCVYLIVAKRYQYRPQPLVSTKP

Carica papaya Carpa_13 evm.TU.supercontig_17.

MAFLLTGFGLLIIGAGGVRPCNLAFGADQFNPNTESGKRGIDSFFNWYFFTFTFA
QVISLTFVVYVQSNVSWAIGLGIPAALMLIACLVFFSGSRIYVKVKASGSPLTSVAQVIVV
AIKKRKLNHVHQPWLTLYNYIPPKFMNSKLAYTDQFRFLDKAAIMTPQDQKNPDGSPA
DPWILCSMQQVEEVKCLLRVIPIWASAVIYYVAIVQQHTYAVFQALQTDRHLGGSKFQI
PAASYYVFLMLSLTIFIPIYDRVIVPFLRRITGKENGITILQRMGIGIFISAITMFVSGIVEER
RRTIALTKPTLGVVPRRGKISSMSGLWLIPQLALAGLAEAFGSIGQVEFYYKQFPENMRSI
AGSLFFCGMAGSSYLSTLLISIVHRTTKGAKTGNWLSEDLNKGRLDYYYYLIAGLGMLN
LCYFLVCAKWYKYKGGNNCTFEANTESTKQSDI

Carica papaya Carpa_14 evm.TU.supercontig_17.

MERAAMAVDKDEPKIKYRGWKAMPFIIGNETFEKLGIIGTLSNLLIYLTSIFHMKS
ITAATIINVFSGTTNFGTFVAAFLCDSYFGRYNTLGFSIIACFLGSLVIQLTAAIPKLHPPPC
GKEGSICEGANAGQLAFLMMGLVLLIIGAGGIRPCNLAFGADQFNPKSESGKRGIDSFFN
WYFFTFTFAQMVSLTVVVYIQSNVSWSVGLAIPAALMLLGTIVFFMGSKIYVKVKATGS
PMTSVVQVIAVAIKKRRLRPLKQPWLSLHSFIPQKFVNSKLPYTDQFRFLDKAAMVTPQ
DQINPDGSSANPWKLCSMQQVEEVKCLLRVIPIWVAAGMYYTAIIQQMTYAVFQALQT
DRRIGSSNFEIPAASFVVFLMLSMTMFIPIYDRLLVPFLRRITGKEGGITLLQRMGTGMFIS
ILCMLTSAIVEERRRTIAFTKPTIGVADRRGAISSMPGLWLVPQLALAGLAEAFTAIGQVE
FYYKQFPENMRSIAGSLYYCGIGFSSYVSSLLISIVHQTTGGASTGNWLPEDLNKGRLDY
FYYMIAALAVINFGYFLLCSSWYQYKVAKSDTSEVNEESR

Carica papaya Carpa_15 evm.TU.supercontig_17.

MEMDGKEPSEKNHNLSSDHSTKVVKFRGWKAMPFIIGNEVFEKLGIIGTLSNLLV
YLTAVFNMKSITAATIINVFGGTTNFGTFIAAFLCDSYFGRYKTLGFSIIACFLGSVVMQL
TSAIPSLHPAPCSNGPDTLCKGPTTGQVLFLMTGLGLLIIGAGGIRPCNLAFGADQFNPNT
ESGKKGIDSFFNWYFFTFTFAQMVSLTLIVYIQSNVSWTIGLAIPAALMLLGTIVYFAGSR
IYVKVKASGSPLGSIAQVIAVSIKKRKLTPPKQPWLELYNYIPPKFMNSKLGYTDQFRYL
DKAAIMTEEDKLNPDGSPADPWKLCTMQQVEEVKCLVRVMPIWVAASFYYIAVIQQMT
YPVFQALQSDRRLGSNNFEIPAASYVVFLMLGMTIFIPIYDRILIQFFKRITGKKGGITLLQ
RIGIGMFISVICMVVSAFIEERRRHIALTQPTLGMAKRRGAISAMPGLFLIPQLMLAGTGE
AFTAIGQVEFYYKQFPENMRSIAGSLYYCGLGLSNYLSTFLISVIHRTTRNASTGNWLPE

DLNDGRLDYFYFTIAGLQLVNLVYFLICSNWYKYKGAGNNEDDNDEGGNNGEKKKQN
IHV

Carica papaya Carpa_16 evm.TU.supercontig_173

MEGGRTQSNNKKKAGGDHQSMWVSNNNMGEEITTVDWRGRPSNPDKHGGMR
AAAFVLGLQGFEIMGIAAVGNNLITYVINEMHFSLSKSANVVTNFVGTVFLLALLGGYL
SDSYLGSFWTMLIFGFIELSGFILLSVQAHLPQLKPEKCNMMINGGSSQCEEAKGFKALIF
FVALYLVALGSGCVKPNMIAHGADQFNPKTSKSKLSTYFNAAYFAFSMGELIALTVLV
WVQTHSGMDVGFGVSAAAMAMGLICLVSGTLYYRNKPPQGTIFTPIAQVFVAAILKRK
QTSPSAPHLLHGNQNNNVSSLSSSLPHTHRLRFLDKACIKLVNQDGTNIKESPWRLCTVT
QVEQVKILISVVPIFACTIVFNTILAQLQTFSVQQATSMNTQLTKSFHIPPASLQAIPYIILIF
IVPLYDKFFVPFARKFTGHESGITPLQRIGFGLFAATFSMIAAAIMEKRRRDSAVDSGKIL
SIFWITPQFLIFGLSEMFTAVGLIEFFYKQSAKGMQAFLTAMTYCSYSFGFYLSSLLVSMV
NKITSGSSNHGWLSENDLNEDRLDLFYWMLAVLSFVNFLNYLFWARWHSKSTDSTPSIS
QISGANHGEDFNNYTAFDSAKKMGDIESPP

Carica papaya Carpa_17 evm.TU.supercontig_177

MAASGVSESRLPLLDDTVDGSVDYKGRAVSRFSSGGWRSASFIIGVEVAERFAY
YGIESNLINYLTGSLGQSTAAAAANVNAWAGMCSLLPLLGAFVADSFLGRYRTIVVASA
IYILGLGLLTLSAILPSISSSGCENTNKIVSCSHQFQVILFFFSLYLVGIGQSGHKPCVQAFG
ADQFDGQNPEECKAKSSFFNWWYFSLCAGTLVALWMLNYIQDNLSWALGFGIPCITMT
IGLVIFLLGTKTYRFVIKGDERNPFLRIGRVFILAIKNWRTSSSAIAIEEEAHGTLPDKSSCQ
FRFLNKALLAPDGSKEYGKLCSVNEVEEAKAVLRLGPIWATSLVYAIVFAQPPTFFTKQ
GVTMDRSITPGFSIPAATLQSFVSLAIISFLPIYDRIIVPIARSFTRKPAGITILQRIGAGLFISA
ISMLIAALVEIKRLRTAQECGLVDMPNVTIPMSVWWLVPQYALAGVSNVFTMVGLQEF
FYDQVPNDLRSVGLSLYLSIFGVGSFLSSFLISAIEKATGGDGRDSWFANNLNRGHLDYF
YLLLAGLSFAALAVYMYFAKSYIYNKGNRT

Carica papaya Carpa_18 evm.TU.supercontig_177

MPLSDSVSGGLESQSPLLQDTVDGSVDYKGRPVLRSSSGGWRSAFFIFGVEIAER
FAFYGIGLNLISYLTGPLGQSTADAAANVNLWSGTASLLPLLGALLADSFLGRYRTILMA
SIIYISGLAILTLSAMLPTLGSPDCKNTDGVTTCSSRLQVILFFFSLYIVAVGQSGHKPCVQ
AFGADQFDVQDPEECKAKSSFFNWWYFALCAGTTLTLLVSTYIQDNLNWALGFGIPCIS
MVIALVIFVLGTRNYRFSMERNEQSAFVRVGRVFVIAFKNWCTTSLSIAVQEEIYETLPQ
KSSQQFKCLNKALHSPDGSREYWEVCSIEEVEEAKSVLRLIPIWITNLVYAIVFAQTSTFF
TKQGVTLDRSITAGFQIPPASLQSFIGFAIAIFIPAYDQILVPVARKFTQNPAGITMLQRIGT
GMCLSVICMVIAALVETKRLDTAREHGLIDNANATIPMSIWWLVPQYVILGICDVFTVV
GLQEFFYDQVPSELRSVGMSLYLSIFGVGSFLSSFLISAIDKASGREGLVQIIDSMQLKLY
N

Carica papaya Carpa_19 evm.TU.supercontig_177

MTLSDSVSGGLESHIPLLHDTVDGSVDYKDRRVHRSSSGGWRSAFFIFGVEIAER

FAFFGIGLNLISYLTGPLGQSTADAAANVNLWSGTASLLPLLGALIADSFLGRYRTILVAS
VIYISGLAFLTLSAMLPSLGFSDCKNPNGVNSCSSQLQVILFFFSLYIVAVGQGGHKPCVQ
AFGADQFDVQDPEECKAKSSFFNWWYFSLCAGTIFTLFVSTYIQDNLNWALGFGIPCIA
MVIALVIFILGTRTYRFSMERNEQSAFVRVGRVFVIAFKNWRTTSLSIAVQAENCGTLPH
QSSQQFKCLNKALVSPDGSREYGEVCSIDEVEEAKSVLGLIPIWATNLVYAIVFAQISTLF
TKQGVTLDRSITGGFKIPPASLQSVMGITIVIFIPIYDQILVPVTRKFTQNPAGITMLQRIGT
GMCLSVICMVTAALVETKRLHTAREHGLIDNANANATIPMSIWWLVPQYVILGICDVFT
VVGLQEFFYDQVPSELRSVGMSLYLSIFGVGSFLSSFLISAIDKASGGEGKDSWFSNNLN
RGHLDYFYWVLAGLSFVEFIVYLCFARSHVYKERTEHECVSICN

Carica papaya Carpa_20 evm.TU.supercontig_19.

MEEKGYTQDGTVDIRGRPVLASKTGRWKACAFLVGYEAFERMAFYGIASNLVN
YLTTQLHEDTVSSVRNVTNWSGSVWITPILGAYIADSYLGRFWTFTISSLIYVLGMVLLT
MAVSLKSLKPTCMNGVCNKASKLQISFFYTSLYIIAIGAGGTKPNISTFGADQFDDFNPSD
KKLKVSFFNWWMFSSFLGALVATIGLVYIQENLGWGLGYGIPTVGLLLSLFLFYIGTPM
YRHKARSTKSPARDLVQVLITAFRNRKLSLPGNPSELHEFEIQQYISTGKRQVQHTPMFR
FLDKAAIKENNRVSENSGSNPACTVTQVEGTKLVFGMMLIWVVTLIPSSIWAQINTLFVK
QGTTMDRRIGPDFQVPAASLGSFVTLSMLLFVPMYDRFFVPLMRKKTGNPRGISLLQRL
AIGYMIQVAAVGIAYCVEVRRMHVIKVHHAMNPKDIVPMNIFWLLPQYVLLGIADVFN
ASGLLEFFYDQSPQDMQSLGTTFFTSGIGIGNFLNSFLVTMVDKITGMGGRKSWIGDNLN
DCHLDYFYAFLLLISTLNLGGFFWASSKYIYKTELDHSEAFTQMDLKPLDTTTLGLQV

Carica papaya Carpa_21 evm.TU.supercontig_23.

METVPTKTDDQQSSSKKKGGLRTMPFIIVNETFEKVASFGLHANMILYLKNEYH
MSNAAGANVLFLWLAISNLTPTFGAFFSDSYLGRFRVIALASLVTFMGMSTLFLTAVIPQ
ARPPYCDVQLEEICKSARPPHLALLFLSFGLMAIGAGGVRPCSLAFGADQLDKPENPNN
ARILQSFFNWYYASVGISVMISVTVIVYIQDKAGWAVGFGVPVVLMFLSVAMFLLGSSL
YVKVKPNRSLFTGFVQVISATWKNRHLALPPTISNGICYYQGDSINLLVPSDKLRVLNKA
CIIKNPEKELDADGFAVAQWSLCSVKQVEELKALIKVLPIWSTGIMIAVTISQHSFPVLQA
TTMDRRLVAGFKIPAGSFSLFAIITLTIWVAIYDRVLVPFISKFTKRPRGLSFKQRMGIGLV
ISCLSTSTAALVERNRRAAALKQGLANNPLGLVNMSAMWLAPQYCLSGLAEAFNAIGQI
EFYYSQFPKSMSSIAVSLFSLSMAMGNLVGSVIVGVLNHVTHNPSWVTNNLNQVGLMG
LAKVNKFVIKTKPTIN

Carica papaya Carpa_22 evm.TU.supercontig_271

MSRFMRRASMTDSSSVAAVMTDSDHGDPEKAISADQKPSKGGWNAAIFIIFVEM
AERFAFYGLAGNLITYLTTDLGEGVAEAAKNINTWIGLSALFPFFGGFLADSFLGRFKTIL
FSSFVYLTGMVILVLSVSTVGEQYRKAVFFTGLYILAVGEGGHKPCVQTFAADQFDETS
PEEKNAKSSFFNWWYLGIVFGSSAAILVVIYVQDRVGWTAGFSVLAGAVGLALGLFLA
GVRRYRKQIPVGSPVTKMAQVFVAAARKWRVTETRGICYQDEEDDDKGTTLAPTHQFR
FLDKAAIIDNTDNSNKTRNRWRLCSMNQVEEVKLVIRLIPVWLCCLMFSATLVQLHTFF
TKQGSTMVRSIGSHFTLPAASIQCLIGLTILVFVPIYDRIFIPVIRKITGHPSGLTILQRIGVG

LFLSVLNMAVSGLVEAKRVNVARDHGLTDMPRAIVPVSVWWLLPQYVISGIADVFTVI
GLQELFYDQMPTGMRSFGAAAYMGVIGVGSFLNSAIISVVQSVTSKHGDKWLVDNLNR
AHLDYFYWVLAGLNALNLCVYIWISKGFVYKKVHWEDQTEDEELSSSNGSM

Carica papaya Carpa_23 evm.TU.supercontig_271

MERSAGGVSRNGEHGKPNKKSKAKGGWNAAIFIIFVETTLRFAFYGLAGNLIVY
LTTELGQGVAEAAKNVNTWVGISFLFPIFGALVADSFMGRFKTIILSCVIYLVGTILLTLS
VSIVPTHYREPVFFTGLYILAIGEGAHLPCVQTFAADQFDESSLEEKKAKSSFFNWWFLGI
VFGASAAILIVIYVEDRVGWTAGFSITSVAIALSLGVFLVGINRYREQIPVGSPITKMVQV
FVAAARKWRIKESYGVVYDKNEGFATLLSTDQFRYLNNATLLDDVDITSTCRRKWRLCS
VNQVEEVKLVIRLIPIWLSCLMFSAAMVQIHTFFTKQASTMTRSIGAHFILPPAFLQSLVG
LAIFISVSVYDLVFVPFARKITGHPSGITVLQRIGVGLFLSILCMVISALIESKRISTAKYCN
LMDTPKVAVPIRVWWLLPQHVISGIAEMFTIVGLQEIFYDQMPEGMRSFGAAAYMSVIG
VGSFINNIIISIVQTISSKHGDKWLIDNLNRAHLDYFYWVMAGLGTLNLCIYIWISRGFVY
KKVHFNSTEDEEMEL

Carica papaya Carpa_24 evm.TU.supercontig_324

MEDSSHQTQLNVHQPTRTRRKGGLVTMPFIIANEAFEKVASYGLVPNMILYLMK
DYKLGVAKGTNIIFFWSAATNFMPLLGAFLSDSYLGRFSTIAFASFSSFSGMLLLWLTAM
IPAAKPPPCDLSSGNCKSPTPSQMSLLIFSFILISIGSGGIRPCSLAFGADQLDNKHNPKNQR
VLESFFGWYYASASVSVLIAFTGIVYIQDHLGWKVGFGVPAILMILATLLFILASRLYVK
RPPNKSLFTGLAQVVVAAYRNRHLSFPNEQDSRGSYHNKKDSQLLAPTQKLRFLNKGCI
TRNPEQDISPDGSARNPWRLCTIEQVEELKALIKVLPIWSTGIVMSINVSQSSFQLLQANS
MNRHIGSSFQIPAGSFGMFTIIALALWVVLYDRVILPLASKIRGKPVKIAVKLRLGMGLF
VSCMAMVISAMVESFRRRKAIHQGLAENSQAVVGMSAMWLVPQYVLHGLAEALTGIG
QTEFFYSEFPKSISSIAGALFGLGMAVANLLASLIVSIVDDVTSKGGKESWVSDNINKGH
YDYYYWLLALLSFLNVLYFLLCSWAYGPAVDELRNIRVADNGLMKEEAELSDVSKGLE
EKDEDHKVNI

Carica papaya Carpa_25 evm.TU.supercontig_352

MEKTKGNSRRDSMARAEEEISVDWRGRPCKPNKHGGMSAAIFILGLEAFEMMAI
AGVGNNLITYVLKEMHFPLPKSANIVTNFIGTVFLLSLLGGFLSDSYLGSFSTIFLFAFVEL
SGFILLAVQAHVAELRPPSCSEPGDECVEAKGYKALIFYGALYLVALGSGCLKPNIISLG
ADQFRAQSKKLSTYFNAAYFAFSTGQLVALTLLVWLQTNYGMDVGFGVSAAAMAAAL
VIFISGSCRYRNNLPRGTIFTPIAQVFVAAVTKRKQVCPSNTEMLHGSHRNPQNATSSTV
TNLLHTEKLRFLDKACIKTQNHGSGNDVVEESPWRLCTVTQVEQVKILISVIPIFACTIIFN
TILAQLQTFSVQQGTAMNTRLTSTFQIPPATLQSIPYLILIFVVPLYETLFVPVTRRITGKDS
GISPLQRVGAGLFTATFSMVAAALVEAKRRKTAVQENSTLSIFWIAPQFVIFGVSEMFTA
VGLIEFFYKQSVEGMQAFLTAMTYCSYSFGFYLSSILVSMVNKITSSSSSGGGGWLSDND
LNKDRLDLFYWMLAGLSMVNFFNYLFWSTWYSYNPSLSLSTSCATRDSADEDLENQTI
TSSKYVGADNTIT

Carica papaya Carpa_26 evm.TU.supercontig_38.

MGSSREIRSMDETSPASLDGDDSFQRKKLSVFFIESDNRRMAFGRGYTGGTTPVN
IHGKPITDLSRTGGWLAAAFIFGNEIAERMAYFGLSVNMVAFMFYVMHRPFASSSNAVN
NFLGISQASSVLGGFLADAYLGRYWTIAIFTTIYLAGLTGITLCATMKVMVPNQDECDQL
SSLLGNCQPAKSWQMLYLYTVLYITGFGAAGIRPCVSSFGADQFDENKKNYKTHLDRFF
NFFYLSVTIGAIIAFTLVVYIQMKHGWGSAFGSLAVAMGLSNLVFFAGTPLYRHRLPGGS
PLTRIAQVLVAAFRKRSVKFSSSDLIGLYEIPGKHSAIKGSRKIAHTDNFRCLDKAALQLE
EDQDQTNPSPWRLCTVTQVEEVKILAKLIPIPACTIMLNVILTEFLTLSVQQAYTLNTHLG
RLKLPVTCMPVFPCLSIFLILSLYYSLFVPISRRITGHPHGASQLQRVGIGLAVSILSVAWA
GVFERYRRNYAIKHGYEFNFLTPMNKLSAYWLLIQYCLIGIAEVFCIVGLLEFLYEEAPD
AMKSIGSAYAALAGGLGCFVASTLNTIIKTVTGDREGSQRSWLSQNINTGRFDYLYWFL
TVLSVINFIAFLYSAKVYKCRAHEKDEQEQSRKF

Carica papaya Carpa_27 evm.TU.supercontig_41.

GAVEKKIIEKEEEICTLDGSVDRQGRPAVRGRTGTWVAGILILVNQGLATLAFFG
VGVNLVLFLTRVLGQDNAEAANNVSKWTGTVYIFSLLGAFLSDSYWGRYKTCVIFQAIF
VIGLVLLSISTYLFLLKPSGCGVEQTPCRSHSSFGIALFYLSIYSIALGNGGYQPNIATFGA
DQFDGEDTKEAHSKIAFFSYFYLALNLGSLFSNTILGYFEDEGMWVLGFWASTASAALA
LILFLLGTPRYRHFNPKGNPLFRFSQVLVAAIRKCRVQMESKENHRFQLHQNDQDETRKI
VHTQGFRLLDRAAVLTSKDCEEKDKNGVYNPWRLCSVTQVEEVKCILRLLPIWLCTILY
SVVFTQMASLFVEQGAAMKTTVSSFHIPPASMSSFDIISVAVFIFIYRRVLDPVFARIKTK
GKGLTELQRMGIGLVIAIMSMICAGGVEIFRLKYAGKKCESASCLSIFWQIPQYVLIGASE
VFMYVGQLEFFNGQTPDGLKSFGSALCMTSISLGNYVSSLLVIIVMKISTRDDMHGWIPG
NLNKGHLDRFFFLLAALTTADLVIYIICAKWYKYIKFQGNINNGDLQV

Carica papaya Carpa_28 evm.TU.supercontig_44.

MVMKMEEGIDDYTKDGTVDLRGNPVLKSKRGRWKACSFIVVYEVFERMAYYG
ISSNLVLYLTRKLHEGTVTSANNVTNWVGTIWMTPVLGAYVADAHLGRYWTFIISSAIY
FSGMSLLTLAVSVPGLKPPPCCESINGGGDCKKASTLQLAVFFGALYTLAIGTGGTKPNI
STMGADQLDDFDPKEKSLKLSFFNWWVFSIFFGTLFANTILVYIQDNVGWTLGYALPTL
GLAVSISIFLAGSPFYRHKLPTGSPFTKMARVIVAALKKWSLPLPTDPTQLYELDSEEYA
KNVKFKIDPTPTLRFLNKASIKTGSIDPWILCSVTEVEETKQMIRMLPILVSTFVPSTMMA
QVNTLFIKQGTTLNRRVGNFNIPPASLVGFVTASMLVTVVLYDRLFVKIMRRWTKNPRG
VSLLQRMGIGMTLHIMVMTTASFMDRYRLSVARKNGLIENGGQVPLTIFILLPQFILMGA
ADAFLEVAKLEFFYDQAPESMKSLGTSYSTTTLGVGNFISSFLLSTVSEITQSHGRQGWIL
NNLNASHLDYYYAFFAILNCVNFLFFLFVVRFYVYKAEVSDSMDVLAKQLELMSSVKE
SNQQQLKPSLVQ

Carica papaya Carpa_29 evm.TU.supercontig_475

MDLPQTQGKTLPDAWDYKGRPAERAHTGGWTSSAMILGVEAVERLTTLGIAVN
LVTYLTGTMHLDNATSANTVTNFLGTTFMLCLLGGFVADTFLGRYLTIAIFVTVQAMGV
TILTISTIIPSLKPPKCNMETGSSCIQASGKQLTVLYLALYLIALGTGGLKSSVSGFGSDQF

DDSDPKERTHMTNFFNWFFFLISIGSLGAVTILVYIQDNLGREWGYGICACAIVIGLLVFL
SGTRRYRFKKLVGSPITQIATVFVAAWRKRNEELPADTSLLYNIDDAENVGKKKKQKLP
HTDQFRFLDKAAIKGQDTRLENKWSLSTLTDVEEVKQVIRMLPIWATTIIFWTVYAQCV
TFSVSQATTMDRHIGKSFQIPPAALTGFFVISTLVTVPVYDRLMVPVARKVLKNPHGLTP
LQRIGIGLVFSIIAMAAAALIEIKRLRTARLHDLLDNQEAEIPMSVFWLVPTFFFVGSGEA
FTYIGQLDFFLRECPKGMKTMSTGLFLSTISLGFFVSSLLVSIVHKLTGSHPWLADNLNR
GRLYDFYWLLASLSALNFAVFLVCAKWYVYKEKRLLAEGIELEEADVGFHA

Carica papaya Carpa_30 evm.TU.supercontig_48.

MGFIANMVSMYLYFYNVMHFSVSGAANTLTNFLGTTFLLTVVGGFISDTYLNRF
TTCLLFGALEVLALVMVTIQAHSDHLHPSSCGKTSCVKGGIAVMLHASLGLLALGAGG
VKGSLPPLGADQFDQKNPKEEKALASFFNFLLLSTTLGAVVGVTGIVWVSTKKAWYLG
FTISTVAAFVGFIVLAIGKNFYRLLPPIESPLIRIAQVIVVAIKNRKLTLPDNADELYEIIDEK
EQKGERISHTNQFRWLDKAAILHKNKESTKWVVCSVTQVEEVKIITRMLPILGSTIIMNT
CLAQLQTFSMQQGSTMESHLGSLEVPTPSIPVIPLVFMSILVPIYEYGFVPFARKITNHPSG
ITQLQRVGIGLVLSIISMGVSGIIEVKRRNQSIKNRLQPISLFWLSFQYAIFGIADMFTLVGL
LEFFYKEAPTCMKSLSTSFTWLSLSFGYFLSSVFVEIINSVTRRITPNRQGWLYGLDIDKN
HVDLFYWFLAILSSLNFINYLYWASWYKYKSQDPNFESQLQSSTEEEAAPNHNVNIDQA
TTNIEEAPSYEKKGLEKDINFA

Carica papaya Carpa_33 evm.TU.supercontig_5.2

MTSGARENDKKKKKKMSSLWPFCSAKCFQNPSSEVAEPDKADSVSPVVKKQPG
GWKTMPFILGNETLERLATIGLLANFMVYLMREFHMEQVAASNVLNIWSGITNFAPLLG
AFISDAYVGKFPTIAVASLASFMGMVIVTLTAGIPTLHPPSCKPTAGNCIGPNRLQLGVLL
TGLGFLTIGSAGIRPCSIPFGVDQFDQTTEEGIKGVNSFFNWYYTTFTIVLLITQTLVVYIQ
DSVSWVWGFGIPTGLMVASIVMFVVGYRIYVHAMPEGSIFSGIAQVCVAAFKKRRLKLP
SEQHDNKINGGGLFYDPPLNGSTVLFKLPLTNQFRFLNKAAMIVEGDELKPDGSPANKW
RLTSIQNVEEVKCLIKIIPIWASGIISFTAMSQQGTFIVSQAMNMDRHLGHNFQIPPGSISIIS
MITVGIWLPFYDRFMVPALRKLTKHEGGITLLQRIGIGIVFSVLAMVVAGLVEKERRAAA
ISHPNSPMSVMWLAPQLIVLGLCEAFSALGLIEFFNRQFPEHMRSIANSLLFCSFAGSSYL
STLLVNTVHAVTGGHGRPDWLANDINSGRLDYFYYLVAGLGVLNFIYFLYVARRYRYK
LKNLLVGETPFLDVDLSSSKP

Carica papaya Carpa_34 evm.TU.supercontig_5.2

MDEENGTLLSDSAEYQRQPAGWKAMPFILGNEMLERLASFGLMANFMVYLQGE
YHMDQVKAATILNAWYGAANFTPVIGAFISDIFIGKFQAIVFGSFASLLGMVIMTITALVP
KLRPPPCSPEQQQNHQCVASTNAQLSFLILGMLWLAIGAGGVRPCSLPFSIDQFDQSTSE
GRTGSSSFFLWYCTTQTVVLLISQTLIIYIQNDISWGLGFGLPTAFMLSAIILFLIGSKFYIYI
KPEGSTFSSLAQVLVASYRKHHLTLLAEEDNIVFYNPPLKRALLSHKLHLTNQYSFFNKA
AIIKENEVNIDGTLINPWKLCSIQQVEDVKCLIRIIPIGISSIIGFLASSQQQTFIISQAQKMDR
NIMGISYQIPAASLNAISLIAVAVWLPLYDIILVPLLRKITKHEGGITVLQTVGIGNILAALT
MVISGFIEKKRRDLVILHKIDNGVSPMSAMWLAPQLILMGLSQVYGMVGLTEFYNKEFP

DHMKSIGNSMLYLTTSLASYVSSLVITIVHNFSGDINGAGNWLTDDVNTSKLDYFYFLIA
GLSALNFICFLFFALRYNYKAHI

Carica papaya Carpa_35 evm.TU.supercontig_56.

METQQSSKGRDEAREDVDDGEKWVYDSSVDYKGRTPLRAATGAWKASLFIIAIE
FGERLSYFGIATSLIIYLTKVMHQDLKTAAKNVNYWSGVTTLMPLLGGFLADAYLGRFS
TVLASSVIYLVGLVLLTMSWYVPSLRACDTQVCQEPRRVHEMVFFLAIYLISIGTGGHKP
SLESFGADQFDDNHAWERKQKMSYFNWWSSGLCCGLVLGVTVIVYVQDHIGWGAADI
ILTLAIAFSLVIVIIGRPYYRYRVPTGSPLTPMLQVLVAAIAKRNLPFPSNPAQLYEVPESQ
KTHGRLLAHTKKLKFLDKAAIVEGEEVSAEKSSSWRLATVTKVEEMKLLLNMIPIWLAT
LPFGICVAQASTFFIKQGTTLDRNVNGFSLPPASIYSLSAIGMIVSVIIFDKIAVPILRKTRG
NERGIKILQRIGIGMLFSIATMVVAALVERKRLKVVEKDLAKGSLSMSVFWLAPQFIIIGI
GDSFTLVGLQEYFYDQVPDSMRSLGIAFYLSVIGAANFISSLLIIVIDHVTEKSGQSWFGK
DLNSSRLDKFYWLLAAITAANLWVYVYLAKQYSYKSVQKSTVAVADCYERDEEAGIRP
MA

Carica papaya Carpa_36 evm.TU.supercontig_56.

MEEEDIYTKDGTTDFRNNPAIKTKTGTWKACPYILGNECCERLAYYGINTNLVN
YLKNQLNQSNVVAINNVTNWSGTCYVMPLIGAFLADAYLGRYWTIATFSTIYVIGMTVL
TMSASIHGLKPICHENNVCHPTKLQTAVFFLGLYLIALGTGGIKPCVSSFGADQFDDSDE
AEKKKKSSFFNWFYLSINIGALIAASVLVWIQTNVGWGWGFGIPAVAMAIAVVSFFSGT
RLYRNQRPGGSPLTRICQVLVASIRKFRVQVPANESLLYETADEESSVKGSRKLDHTKQL
SFFDKAAVETPLDRVKSSINPWRLCSVTQVEELKSIIRLLPVWATGIVFSAVYSQMGTLF
VLQGNTMDLHLTKSFQIPSASLSLFDTISVIFWVPIYDRLIVPLASKFTGHKNGFTQLQRIA
IGLVISIFAMLAAGSLELFRLDLVRKHNYYQVKNIPMSIFWQVPQYLIIGCAEVFTFIGQL
EFFYDQAPDAMKSLCSALSLTTAALGNYLSSLLVKIVSDVSSRHGSHGWIPDNLNYGHL
HYFFWLLAVLSFINLGFYLLVARCYTYKRPLNNN

Carica papaya Carpa_37 evm.TU.supercontig_56.

MDDYDNYTHDGTVDMKKNPANKKTTGNWKACRFILGNECCERLAYYGMSTNL
VNYLITRLGQGNVAASNNVTNWGGTCYITPLFGAFLADAYLGRYWTIAIFVMIYVSGM
TLLTLSASVPGLKPSCSGDVCNPKAGQTAAFFVALYMIALGTGGIKPCVSSFGADQFDET
DEYEKKKKSSFFNWFYFSINVGALIASSVLVWIQMNVGWEWGFGIPAVAMAIAVMFFF
AGSRYYRLQLPGGSPLTRIFQVIVASFRKLNVEVPRDKSLLYETPDEESNIKGSRKLEHTD
KFKFFDKAAVETPNDQLKSVANPWSLCTVTQVEELKSIIGLLPIWASGIVFATVYSQMST
MFVLQGNTMDQHIGPHFEIPSASLSLFDTVSVLFWAPIYDQFIVPLARKFTGHDRGFTQL
QRMGIGLVISIFAMVVAGILEVVRLHYVREHGFFDVKQIPMSIFWQVPQYFLIGCAEVFT
FIGQLEFFYDQAPDAMRSLCSALSLTTVALGNYLSTVLVTIVTKVTTKGGKLGWIPDNL
NRGHLDYFYWLLAILSLLNFFVYLWIAKCYTYKKTAGSTH

Carica papaya Carpa_38 evm.TU.supercontig_56.

MERRSDTDEPSSSSSSSSSSTPPPSKKLPGGWRSIKYILGNETFEKLASMSLIANIA

VYLKTKYNMEGVFLVNVVSIWSGSSNVTAILGALIADTWLGRFRTLLFGSIASFLGMIFM
TFTAAIPDLRPPTCTTLPNCTQPNNWQLTFLFVGMSFLAIGAGGIRPCNIAFGADQFDTTT
KKGKAQLESFFNWWYFSFTVALLIALTGVVYIQTNVSWPLGFAIPASCLLLSIIIFIIGHHT
YIIMKPQGSIFIDMARVITAACRKRRLTTSGNSLYDPPLQELPGLTKLPYTDRFKCLDKAA
IFADESEIDGKGFPKNNWRLCSLQQVEELKMLIGMAPVWVAGIGFLMAMDLQNSIGILQ
AIQTNKKIGLFNVPPGWMGLSSMITLSLWILLYERIWVPQSRKLSGKNKRMTMKQRINM
GILMSIICPLVAATVEKRRRELALRNGTFESPMSITLLLPQFALSGLLEAFGAVALMEFLA
TKLPETMRTVSGAIFFLSLSMASYLNSVCVNIIFKITSRKGGTPWLGGQDINKNTLENFYY
FVAGLGCLNILYFNLFGHQYVSNQGKATGHRSVPESSNEKEKLETV

Carica papaya Carpa_39 evm.TU.supercontig_6.4

MNMQGKLKEEEESRTQDGSVDFQGRPAIRGKSGNWVAGFIILLNQGLATLAFFG
VGVNLVLFLTRVLQQNNADAANNVSKWTGTVYIFSLVGAFLSDSYWGRYKTCAIFQVI
FVIGLASLSLSSYLFLIRPKGCGDEQTPCGGHSNMEIGLFYISIYLVALGNGGYQPNIATFG
ADQFDEEHPREGHSKVAFFSYFYLALNLGELFSNTILVYFEDEGMWALGFWASTASAFL
ALVLFLGGIPRYRHFRPSGNPFFRFCQVLVSAINKWKIEIPEEEQELYDLDANDCSMNGN
RKILHTHGFKFLDRAAFISSRDMDDQRQIHPNPWRLCPITQVEEVKCILRLLPIWLCTIIYS
VVFTQMASLFVEQGAAMKITVSNFRIPPASMSSFDILSVAIFIFLYRRVLDPLVSRTRKKG
SKGLTELQRMGIGLVIAILAMVSAGIVECYRLKYANSDCLHCEGSSSLSIFWQIPQYAFIG
ASEVFMYVGQLEFFNAQTPDGLKSFGSALCMTSISLGNYVSSLLVTMVMKISTEDHMA
GWIPGNLNRGHLDRFYFLLAALTTVDFLVYIVCAKWYKCIKLESKCGEDEQQQQLQV

Carica papaya Carpa_40 evm.TU.supercontig_75.

MENKMSWTVGDAVDYKGFPADKSKTGGWVCAVMILGIEICERLSTMGIAVNLV
TYLIGTMHLPSSASANVVTDFMGTSFLLCLLGGFLADSFLGRYKTIAIFAMVQVLGTGAL
AVATKLSQLRPPPCHANEVCKQASGFQMGILYIALYLIALGTGGLKSSVSGFGTDQFDE
KDEKEKSQMAYFFNRFFFFISTGTLMAVTVLVYIQDAVGRSWGYGICSASMLIAVFIFLA
GTKKYRYKRSQGSPVVHIFQVIAAAISKRKMDLPYSVGSLYEDTPEGLRILHTDQFHCLD
KAAIIREGDFDNMSGSGPNPWKLCSVTRVEEVKMVVRLLPIWATTIIFWTTYAQMITFSV
EQASTMERSIGSFQIPAGSLTVFFVAAILITLAINDRFIMPLWRKWKGKQGFSSLQRIGIGL
VLSTFGMAAASMVETKRLSVSKTVDRNTEILPITVFWLIPQFFLVGSAEAFIYTGQLDFFI
TQSPKGMKTMSTGLFLTTLSFGFFLSSFLVSVVKKVTSNTNEQGWLADKINYGRLDCFY
GLLAILSVINFVIYVICAMWLKPKTPPKIGVQMETIKASSTEEIC

Carica papaya Carpa_41 evm.TU.supercontig_8.9

MLVSMATQITESEDQFKVWRGKNLEPKRHGGIRAASIACVVEVLENMVFLCNAS
NFVTYFIKSMHYPLATASNMVTNFAGTSFLLTLFGGFICDSFLTRFTTFILFCSLELLGLVL
LTIQAQTPRLQPAVGKTPSSSQLAFLYTGLYAMATGVGGVKASLPAHGADQLDRSNQR
LISAFFNWFFFGLCMGGFLSCTIMVWIQENKGWNWSFRISAVALSLALVIFAAGFPIYLF
KLPSGSPFTRIFKVLVAAIRKRRHSISDAEMNLHALSPVTRAQKKFRFLDRALMDENISE
NDVEEARTFIGLLPIFASTIFMSCCLAQLQTLSVVQGNLMNRKLGHNFTIPAQSLTVIPLTI
MLSFIPLYEHVVKMFGNRVSSKFNVFKPLKRIGLGLMLASVAMAIAAGVEDKRRRVAT

SDSHKIISVFWLGWQYLLLGVSDMLTLGGMLEFFYSEAPASMRSISTSLSWVSTSMGSFL
SSVLVSIANSVSGRYGKEWLGGNDLNHNRLDLFYTLLCVLNFINFFNYVFWAKRY

Carica papaya Carpa_42 evm.TU.supercontig_92.

MELAENKADSAKKQENEEEEEEKEEEHGRRKKLGGIKTMPFILANEVCDRFATT
GFHANMITYLTQVLNLPLVQASNTLTNFSGTASFTPLIGALIADSVAGRFWTIIVGSIIYEL
GLISITISAVVPSLQPPPCPDQKNCREASSLQLWVLYISLLLTSIGTGGIRPCVVAFAADQF
DMKKSSVESRKWNFFNWYYFCMGMATLTALTVVVYIQDNVGWGWGLGLPAIAMALS
IIAFVIGASLYKKLKPGGSPLVRLAQVVVAAVKKRKAVAPTDAGLLYQNKNLDAAISVH
GRLVHTDQFKWFDKAAIVTEREATNLDQPNLWRITTVHRVEELKSIIRMLPIWAAGILLV
AASSHQHSFTLQQARTMNRHLSRSFEIPPASLSVFGIITTLVGLVLYERLFVPLARRLTGD
PTGVTCLQRMGIGFAVNILATLVSSLVEMKRKSVAASQNLLDEPTAVIPISVFWLVPQFC
LHGVAEVFMSVGHLEFLYDQSPESMRSTAVALYWFAISVGNYIGTLLVSLVHKYTGER
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Carica papaya Carpa_43 evm.TU.supercontig_99.

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Cucumis sativus Cucsa_02 Cucsa.037110

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Cucumis sativus Cucsa_03 Cucsa.047240

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Cucumis sativus Cucsa_04 Cucsa.054900

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Cucumis sativus Cucsa_05 Cucsa.061550

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Cucumis sativus Cucsa_06 Cucsa.066620

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Cucumis sativus Cucsa_08 Cucsa.114400

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Cucumis sativus Cucsa_09 Cucsa.129410

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Cucumis sativus Cucsa_13 Cucsa.139080

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Cucumis sativus Cucsa_15 Cucsa.144070

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Cucumis sativus Cucsa_16 Cucsa.161350

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Cucumis sativus Cucsa_22 Cucsa.197520

MNDYWQHCRFGEEAQRLNLWEDYVDWRKRPAVKGRHGGMLAASFVLVVEVL
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QYLFWASRYTYRSINGGEX

Cucumis sativus Cucsa_23 Cucsa.200660

MGFVANMTSLVQYFLFVMHFDLQTAANTLTNFMGSAFLLSLLGGFLSDTYINRL
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Cucumis sativus Cucsa_24 Cucsa.203590

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YNLDNVASAYVFQIWGGTTNFAPLAGAFLADAYLGRFYTLLFGSVASLLGMGVLTLGA
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Cucumis sativus Cucsa_25 Cucsa.213360

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Cucumis sativus Cucsa_26 Cucsa.213410

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Cucumis sativus Cucsa_27 Cucsa.232540

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Cucumis sativus Cucsa_28 Cucsa.237780

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Cucumis sativus Cucsa_29 Cucsa.255640

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Cucumis sativus Cucsa_30 Cucsa.255650

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Cucumis sativus Cucsa_31 Cucsa.255660

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Cucumis sativus Cucsa_32 Cucsa.255670

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Cucumis sativus Cucsa_33 Cucsa.257150

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Cucumis sativus Cucsa_34 Cucsa.285370

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Cucumis sativus Cucsa_35 Cucsa.285460

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Cucumis sativus Cucsa_36 Cucsa.292790

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Cucumis sativus Cucsa_37 Cucsa.302000

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Cucumis sativus Cucsa_38 Cucsa.307950

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DDMI

Cucumis sativus Cucsa_39 Cucsa.309410

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KKAAET

Cucumis sativus Cucsa_40 Cucsa.313420

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Cucumis sativus Cucsa_41 Cucsa.320700

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Cucumis sativus Cucsa_42 Cucsa.321620

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EEQENFKV

Cucumis sativus Cucsa_43 / CsNITR1 Cucsa.337560

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Cucumis sativus Cucsa_44 Cucsa.339350

MERFVFKGVASNLVTYLTDVMKMSNSSAAKTVSSWCGFTSMLPLVVAPLADSY
WDRYSTILGSAFLYVLGLVALTSTTLARTWSPTNTASSFLFSSLYLISLGQGGYNPSLQAF
GADQLDHDDAELPTINAKTPSDEKPKKKSLFFQWWYFGVCSGSLLGVTIMSYIQDNFG
WVLGFAIPMCAMVSSVALFSCGTKIYRYKRDVEEDEVEKRRFVKVMEIFKATASRLMC
WRSVVTTTLSIHKSEDDVELELQETKPLCHENSGAIMKAMVNKNNTTIIPRERVCVPHK
VKLVLRLLPIWTMLLMFAVIFQQPATFFTKQGMTMERTIGADFKIPPATLQSAIAISIILLM
PLYDKVLIPITRLFTGTKKGITVMQRMGIGMFLSTIAMILAALIEAKRLTMTKNASSLSIL
WLLPQYIILGISDIFTVVGMQEFFYSEVPVSMRTTGFALYNSVFGVGSFCSAIMISVVELL
TSVEGKPNWFSDNMKEARLDKYYWLLAFCSGLSFVLYVIWCKCFRTSRIDEEETEY

Cucumis sativus Cucsa_45 Cucsa.359270

MDQQNSATMQSLNTELQQQQQQRDEEEEEEEAISKSSKKGGLLTMPFIIVNESLE
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FGSIATFLGMLLLWLTAMVPSTKPPACDQLHPETCRSPTAAQMALLAVALTLMSIGAGG
VRPCTLAFGADQIDRRDNPNNKRMLERFFGWYYASASFSVLIALTGIVYIQDHVGWKV
GFGVPAGLMLFATVLFFAASSIYVKQKATKSLFSSFAQVVVAAFKNRKFPLPTSPASTK
WFYHKDSLFTQPSDKLRFLNKACVVKNPEQDIAGDGTAADPWSLCTVEQVEELKTLIK
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LASKIRGKPVHFGVKSRMGAGLICSAMSMALSAIVENIRRRKAIAQGIVDDLDAVVDMS
ALWLIPQHCLNGLAEALNAIGQTEFYYSEFPKTMSSVASSLFGLGMAVANLLASAIMST
VDNVTSKGGKESWVSKNINKGHFEKYYWLLAILSVINVLYYVVCSWAYGPSVDQRRTA
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Cucumis sativus Cucsa_46 Cucsa.362690

MHGQLYFQFYSISSPSLITLNSNLRFPSNFSINQQWNHFFFRAMESKPDLKSNDEL
QVADLHLLENGQERFQSSSLEDGALTDQNDKTTANRRKVGGWNCGMLLLVNQGLITL
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QLVFIVGLIALSLLTHISLLKPNGCGKIGQLCDPHSLTELSIFYISIYLIALGNGAPEPALATF
GVEQFDDKDPKENRAKTSFYSYFYVSINMGCLIAETILVYIENLGHWMVGFWICAVCGL
LAYLLFLSGTPRYRQSKPCGNPISRFSQVLMASVKKMNLPMPSNGEGLYEGLGKKGTRR
MLHTEGFKFLDRAAILTAEEANLICNHGQTPNPWKICPVTQVEEVKCILRLLPVWLCTIF
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Cucumis sativus Cucsa_47 Cucsa.365360

MEMEKKEKHMERKKGGLITMPFIFANEICEKIAVVGFNTNMISYLTKQLHMPST
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KAGEICKEATGGQLGILYVSLLLTALGSGGIRPCVVSFGADQFEEGDPKRGTKTYKYFN
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ISIFATLIAGFVEQKRKHVAFTHGLIDHPTSIIPISVFWLVPQYSLHGMAEAFMSIGHLEFF
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Cucumis sativus Cucsa_48 Cucsa.377420

MGSQEDDRAILEEGLLQNESSTLYTGDGSVDFHGNPVLKQNTGNWKACPFILGN
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Cucumis sativus Cucsa_49 Cucsa.383440

MGVEEGLADDYTQDGTVDLKGNPVRRSKRGGWRACSFVVVYEVFERMAFYGI
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SGMSLLTMAVSLPTLRPPPCADPTSGHCEKASSLQLAVYFGALYILAIGTGGTKPNISTIG
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GIFVAGIPFYRHKVPAGSPFSRMGKVLVAAIRKRKLPLPRDVKELYELDLEEYTKKRKFR
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Glycine max Glyma_01 Glyma01g04830

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VVYIQDSVSWKIGFAIPTVCMFCSIIMFFVGTRIYVHVKPEGSIFTSIAQVLVAAYRKRKV

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Glycine max Glyma_02 Glyma01g04900

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AGSATYKNKIPSGSPLTTILKVLVAALLNICTYKNTSSAVVNMASSPSNPHSGRMESKLE
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Glycine max Glyma_03 Glyma01g20700

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Glycine max Glyma_04 Glyma01g20710

MDQKENDGIRKKGGLITMPFIFANEVCEKLAVVGFNTNMNSYLTTQLHMPLTKA
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DNKISNLWRLNTVHRVEELKTIIRMGPIGASGIFLITAVAQQHTFFLQQAKTMDRHLTKT
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Glycine max Glyma_05 Glyma01g25890

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ADQFDDNNAKERRQKMSFFNWWNSGLCSGIILGVTVIVYVQDHVNWGVADIILTGVM
AVSLLIFLIGRSSYRYRTPIGSPLTPMLQVLVAAISKRKLPYPSNPTQLYEVSKSEGNNERF
LAHTKKLKFLDKAAIIENEGNIAEKQSPWRLATVTKVEELKLIINMIPIWVFTLPFGICAS
QTSTFFIKQGAIMNRKIGNGFVVPPASIFTLAAIGMIVSVIIYDKLLVPVLRKLTGNERGINI
LQRIGIGMIFSVITMIAAALVEKKRLEAVEMNGPLKGSLSMSALWLAPQFLIIGFGDGFAL
VGLQEYFYDQVPDSMRSLGIALYLSVIGAASFLSSLLITIVDHVTGKSGKSWIGKDLNSS
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Glycine max Glyma_06 Glyma01g27490

MGDVTKSHDVGEDSLYTEDGTVDIYKKPAIKKKTGNWKACRFILGNECCERLA
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DQFDENDDFERKKKSSFFNWFYFSINIGSLIASSVLVWIQMNVGWGWGFGVPTVAMVIA
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YSQMSTMFVLQGNKMDQHIGQHFTIPSASLSLFDTLSVIFWAPVYDRMIVPFARKFIGHE
QGFTQLQRIGIGLVISIISMIVAGILEVVRLDIIRKNNYYDLETVPLSIFWQVPQYFLIGAAE
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Glycine max Glyma_07 Glyma01g40850

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AVFQVIFVIGLMSLSLSSYLFLLKPKGCGNESVNCGKHSKLEMGMFYLSIYLVALGNGG
YQPNIATFGADQFDEEHSKEGHNKVAFFSYFYLAFNIGQLFSNTILVYFEDEGMWALGF
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Glycine max Glyma_08 Glyma01g41930

MSSLPTTQGKPIPDASDYKGRPAERSKTGGWTASAMILGGEVMERLTTLGIAVN
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TILTISTIIPSLHPPKCNGDTVPPCVRANEKQLTALYLALYVTALGTGGLKSSVSGFGSDQ
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VFLSGTRKYRFKKRVGSPLTQFAEVFVAALRKRNMELPSDSSLLFNDYDPKKQTLPHSK
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MTTFSVAQATTMDRHIGKTFQIPAASMTVFLIGTILLTVPFYDRFIVPVAKKVLKNPHGF
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EAFMYMGQLNFFLRECPKGMKTMSTGLFLSTLSLGFFFSTLLVSIVNKMTAHGRPWLA
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Glycine max Glyma_09 Glyma02g00600

MAYYGISSNLILYLTRKLHQGTVTSSNNVTNWVGTIWITPILGAYVADAHLGRY
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TKNPRGITLLQRIGIGLIIHIVIMVVASLTERYRLRVAKEHGLVENGGQVPLSIFILLPQYV
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NQVIPRD

Glycine max Glyma_10 Glyma02g02620

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Glycine max Glyma_11 Glyma02g02680

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Glycine max Glyma_12 Glyma02g38970

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TRLYRIQKPGGSPLTRMCQVIVASIRKSKVQVTNDDRSAFYEIEQDSESAIQGSRKLEHT
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Glycine max Glyma_13 Glyma02g42740

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TPLTVTQVEGFKLVFGMVLIWLVTLIPSTIWAQIYTLFLKQGITLDRKLGPNFQIPAASLG
SFVTLSMLLSVPIYDRYLVPFMRRKTGNPRGITLLQSLGIGFSIQIMAIAIAYVVEVRRMH
VIKAKHVVGPKDLVPMTDVFNAIGLLEFFYDQSPEDMRSLGTTFFTSGIGVGNFLNSFLV
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Glycine max Glyma_14 Glyma02g43740

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KL

Glycine max Glyma_15 Glyma03g27800

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Glycine max Glyma_16 Glyma03g27830

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YLL

Glycine max Glyma_17 Glyma03g27840

MPLVSASVTLTNFNGTSSFTPLFGALIADSFAGRFWTIVVASFIYELGLIVITVSAIL
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VGHLEFLYDQSPESMRSTATALYCITTAIGNYVGTLLVTLVHKYSGNERNWLPDRNLNR
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Glycine max Glyma_18 Glyma03g32280

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Glycine max Glyma_19 Glyma03g38640

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Glycine max Glyma_20 Glyma04g03850

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MAKV

Glycine max Glyma_21 Glyma04g39870

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Glycine max Glyma_22 Glyma04g43550

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Glycine max Glyma_23 Glyma05g01380

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Glycine max Glyma_24 Glyma05g01430

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FAIRYIIX

Glycine max Glyma_25 Glyma05g01440

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Glycine max Glyma_26 Glyma05g01450

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GV

Glycine max Glyma_27 Glyma05g04350

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Glycine max Glyma_28 Glyma05g04810

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Glycine max Glyma_29 Glyma05g06130

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Glycine max Glyma_30 Glyma05g26670

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Glycine max Glyma_31 Glyma05g26680

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Glycine max Glyma_32 Glyma05g26690

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Glycine max Glyma_33 Glyma05g29550

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TGGNSEE

Glycine max Glyma_34 Glyma06g03950

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Glycine max Glyma_35 Glyma06g15020

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Glycine max Glyma_36 Glyma07g02140

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Glycine max Glyma_37 Glyma07g16740

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Glycine max Glyma_38 Glyma07g17640

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Glycine max Glyma_39 Glyma07g40250

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DTHLTKSFNIPPASLQSIPYILLIVLVPLYDTFFVPFARKFTGHESGIPPLRRIGFGLFLATFS
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Glycine max Glyma_40 Glyma08g09680

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WQIPQYFLLGAAEVFTFVGQLEFFYDQSPDAMRSLCSALSLLTTSLGNYLSSFILTVVTY
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Glycine max Glyma_41 Glyma08g12720

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SLYLLAFGSAGLKASLPSHGADQFDERDPKEAMQMSSFFNGLLLAVCIGGAVSLTFNVY
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HPAVTGGNSEE

Glycine max Glyma_42 Glyma08g15670

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Glycine max Glyma_43 Glyma08g40730

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NNN

Glycine max Glyma_44 Glyma08g40740

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Glycine max Glyma_45 Glyma08g47640

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Glycine max Glyma_46 Glyma09g37220

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Glycine max Glyma_47 Glyma09g37230

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Glycine max Glyma_48 Glyma10g00800

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Glycine max Glyma_49 Glyma10g00810

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Glycine max Glyma_50 Glyma10g28220

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Glycine max Glyma_51 Glyma10g32750

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Glycine max Glyma_52 Glyma10g44320

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Glycine max Glyma_53 Glyma11g03430

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Glycine max Glyma_54 Glyma11g04500

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Glycine max Glyma_55 Glyma11g23370

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Glycine max Glyma_56 Glyma11g34580

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Glycine max Glyma_57 Glyma11g34600

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Glycine max Glyma_58 Glyma11g34620

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Glycine max Glyma_59 Glyma11g35890

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Glycine max Glyma_60 Glyma12g00380

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Glycine max Glyma_61 Glyma12g28510

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Glycine max Glyma_62 Glyma13g17730

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Glycine max Glyma_63 Glyma13g23680

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Glycine max Glyma_64 Glyma13g26760

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Glycine max Glyma_65 Glyma13g29560

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GNSKK

Glycine max Glyma_66 Glyma13g40450

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Glycine max Glyma_67 Glyma14g05170

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Glycine max Glyma_68 Glyma14g37020

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Glycine max Glyma_69 Glyma15g09450

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Glycine max Glyma_70 Glyma15g37760

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Glycine max Glyma_71 Glyma17g04780

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Glycine max Glyma_72 Glyma17g10430

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Glycine max Glyma_73 Glyma17g10500

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Glycine max Glyma_74 Glyma17g12420

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Glycine max Glyma_75 Glyma17g14830

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Glycine max Glyma_76 Glyma17g16410

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Glycine max Glyma_77 Glyma18g02510

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Glycine max Glyma_78 Glyma18g03770

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Glycine max Glyma_79 Glyma18g03780

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Glycine max Glyma_80 Glyma18g03790

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Glycine max Glyma_81 Glyma18g03800

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Glycine max Glyma_82 Glyma18g07220

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Glycine max Glyma_83 Glyma18g16370

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Glycine max Glyma_84 Glyma18g16440

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QFDLTTAEGRHGSSSFYTLYYTTQTLIMLINQTLLVYIQDSVSWTLGFALPTVFILISIILLF
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Glycine max Glyma_85 Glyma18g16490

MLAMEGNKKTKQYGLDSATSWFGSCISSCSSSEKVSTHRKLPRTASESSVTNPM
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GVLLMGLCFLTIGSAGVRPCSIPFGVDQFDPTTDEGRKGINSYFNWYYTTFTMVLLVTQ
TVVVYIQDSVSWRIGFGIPTVCMLCSIIMFFVGTRVYVHVKPEGSIFSGIAQVLVTAYKK
RKLNLPMSEEKPDGVFYDPPLIGITVVSKLPLTKEFRALNKAALIMEGELNPDGTRVNQ
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VSVISLITIALWLPFYDRILVPKLRKMTKHEGGITLLLRIGIGMVFSILSMVVAGYVEKVR
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Glycine max Glyma_86 Glyma18g41140

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LLVALTVVVYIQTNISWFLGFVIPTVCFAFSLTIFLWGLNTYVRSKPKGSIITDLVKVAVA
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DSWRLCSVQQVEELKSILATLPVWLAGIICFFSMGQASSFGILQALQTNKSIGPNFSVPPA
WMGLVPMIALSLWIFLYEKIYVPWTMKATKRGKRLSIENRILIGILFSIACMVVSGLVEV
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Glycine max Glyma_87 Glyma18g41270

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KIGNGFEIPPASIFTVAALGMVVSVAIYDKILVPVLRRLTQNERGINILQRIGFGMLFSIAT
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Glycine max Glyma_88 Glyma18g49460

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Glycine max Glyma_89 Glyma18g49470

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CGNKELPCGSHSSYQTILFYVSIYLIALGNGGYQPNIATFGADQFDEGDTREQHSKIVFFS
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Glycine max Glyma_90 Glyma18g53710

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LSVTIGAIVAFTVVVYVQMKFGWGSAFGSLAIAMGISNMVFFIGTPLYRHRLPGGSPLTR
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Glycine max Glyma_91 Glyma18g53850

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EAKCVLRMLPVWLCTIIYSVVFTQMASLFVEQGDVMNNKIGNFHLPAASMSVFDICSVL
LCTGIYRQILVPLAGRFSGNPRGLTELQRMGVGLIIGMLAILAAGATEFERLKHITPGEKA
SSLSIFWQIPQYVLVGASEVFMYVGQLEFFNGQAPDGIKSFGSSLCMASISLGNYVSSLL
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Glycine max Glyma_92 Glyma19g30660

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EFLFEQAPESMRSSATALYCITTAIGNYMGTLLVSLVHKYTGKENNWLPDRNLNRGGLD
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EEKRELTKDE

Glycine max Glyma_93 Glyma19g35020

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SIEEYASNGRNRIDRSSSLSFLDKAAIKTGQTSPWMLCTVTQVEETKQMTKLIPLLLTTIIP
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NPRGITMLQRLGIGLVMHVFIMIIACFAERRRLKVARENHLFGLHDTIPLTIFILLPQYALG
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Glycine max Glyma_94 Glyma19g41230

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NVMDLKLGSLTVPAPSIPVIPLVFISVLVPLYELFFVPFARKITHHPSGITQLQRVGVGLVL
SAISMAVAGIVEVKRRDQGRKDPSKPISLFWLSFQYGIFGIADMFTLVGLLEFFYRESPAS
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Glycine max Glyma_95 Glyma20g22200

MIYLHLSLEDGRSVVEKWFRNSDTTPQTDCSAKTGTYIKCISNLVVQGDKEVKEE
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PFARKITHHPSGVTQLQRVGVGLVLSSISMTIAGIIEVKRRDQGRKDPSRPISLFWLSFQY
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Glycine max Glyma_96 Glyma20g34870

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MAQINTLFVKQGTTLDRHLGSFKIPPASLAAFVTVSLLVCIVLYDRFFVKIMQRFTKNPR
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Manhiot esculenta Medes_01 cassava4.1_003447m.

MDTSEIKAAPDTPVTFVGNSESTSSKKLGIYFIESDNRRMAFGRGYTGGTTPVNIH
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DGADPSPWKLCTVTQVEEVKILLKLIPVTACTIMLNLVLTEYLTLSVQQAYTMNTQMGH
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Manhiot esculenta Medes_02 cassava4.1_003811m.

MEMEGRRGSNKEENKSSVVVSYEETTMDWRGRVSNSNKHGGMRAATFILGLQ
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SVIPIFACTIVFNTILAQLQTFSVQQGNSMDTHLTKSFKIPPASLQSIPYIILIVVVPLYDTFF
VPFARKFTGHESGITPLQRIGGGLFFATFSMVAAAIMEKKRRDAAVNSDKILSIFWITPQF
LIFGLSEMLTAVGLIEFFYKQSLKGMQAFLTAITYCSYSFGFYLSSLLVSLVNKITSSDSSK
TGWLGDNNLNKDRLDLFYWLLAVLSFLNFLNYLFWARWYSCNPSPSFTQQDETHEENY
LNHCSFSSSKNIGDESIP

Manhiot esculenta Medes_03 cassava4.1_003830m.

MEKMEELAASEQGELMTTHQHTPKRRKGGLITMPFIIANEAFEKVASYGLVPNM
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LFFIASPLYLKQKASTSLFTGFAQVLVAAYKNRKIPFPPRDSDSKYHHKKNSESIAPTDNL
RFLNKACIIRNPEQDLALDGSASNPWSLCTVERVEELKAIIRVIPIWSTGIMMSINVSQGTF
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LGTMIKEEGKVVEGEELSRL

Manhiot esculenta Medes_04 cassava4.1_003848m.

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PIFACTIVFNTILAQLQTFSVQQGSSMDTHLTESFKIPPASLQAIPYIILIIVVPLYDTFFVPF
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SFNASKNIGDESIP

Manhiot esculenta Medes_05 cassava4.1_003929m.

MEKVEEKGPASGREDYTEDGTVDLKGRPVLRSKTGGWRACSFIVGYEIFERMAY
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AIYLSGMILLTLAVSLPALRPPSCGPSIKEEDCDLKATALQKGIFYAALYTIAAGTGGTKP
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TVGLAVSIAVFFVGSPFYRHKLPSGSPFTKIVQVLVAALRKQNVAVPDDPKELHELNLEE
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MYAQVHTLFIKQGTTLDRSMGPHFEIPPACLTAFVTIFMLISLVIYDRYLVPAVRPYTKNP
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DTFVEVAKIEFFYDQAPEGMKSLGTSYFTSSLGIGNFLSSFLLKTVAGITKKDGHKGWIL
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KEEMKPGQS

Manhiot esculenta Medes_06 cassava4.1_003974m.

MAPNEVVLKEREENFSPTDATAVNTNSDGNRQRKATLKIKNCLTWKTSGGWKA
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DSYWGRYLTCALFQLIFVLGLVLLSLSSWIFLIKPSGCGDEVVACTPASPVGIAIFYLSTY
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GEWTLGFLVSLGSAVIALVSFLLGTPGYRYVIPCGNPLPRVAQVFIASAKKWDVIPSNAD
DLYEVEGPESAIKGSRKILHSAEFEFLDKAATITEDDLMRQNDPWRLCTVTQVEEAKCV
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EMEKQEDDVLGKV

Manhiot esculenta Medes_07 cassava4.1_004026m.

MATGETIGEKERVSMEVHGKETHSPTMDNNHEDALDEEPNYRGWKAMPFIIGN
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VRPCNLAFGADQFNPKTESGKKGINSFFNWYFFTFTFAQMISVTLIVYVQANVSWAIGL
AIPAILMLIACILFFSGSKIYVKVKANGSPLNSVAQVIVVAIKKRRLKPVEQPWLSLFNYT
SPKSINAKLPYTDQFRFLDKAAIRTPEDKINPDGSAADPWKLCSLQQVEEVKCLLRVFPI
WVSDVIFFTAIVQQQTYAVFQAVQSDRRLGSSNFKVPAASYGVFVMLSLTIFIPIYDRILV
PFLQRLTGKEGGITVLQRIGIGIALSSLTMLVSALVEEQRRTTALTKPTLGTAPRRGEISSM
SSLWLIPQLALTGLAEAFGSVGLVEFYYKQFPENMRSIAGSLFFCGMAGSSYLSSLLITIV
HKTTNWLPEDLNKGRLNCYYYIIAALGVLNFVYFLICAKWYKYKEGMRDTIEINQQVK
PIKA

Manhiot esculenta Medes_08 cassava4.1_004032m.

MPIYMVPGRPVKQQGMKMEKMEEKGLHAKRQKGGLATMPFIFANEACEKLAV
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GGRLLHTKQMKFLDKAAIVTEEDNLKAGETPNLWRLNTVHRVEELKSIIRMGPIWAAGI
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SLHGIAEAFMSIGHLEFFYDQAPESMRSTATALFWTAISVGNYVSTLLVTLVHKFSAGPD
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GVVELTNKA

Manhiot esculenta Medes_09 cassava4.1_004034m.

MACLEMSKEGKFKENQEECTLDGTVDWHGHPAIKKKSGQWVAGIIILLNQGLAT
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KGCSANGNRRILYTHGFKFLDRAAFISSRDMDDKRQGGHNPWRLCPITQVEEVKCILRL
LPIWLCTIIYSVVFTQMASLFVEQGAAMKTTISNFRIPPASMSSFDILSVALFIFLYRRVLD
PLVSRIRNSKSKGLTELQRMGIGLVIAITAMVSAGIVECYRLKYARRDCTHCQGSSTLSIF
WQVPQYALIGASEVFMYVGQLEFFNAQTPDGLKSFGSALCMTSISLGNYVSSLLVTMV
MKISTVDHMPGWIPGNLNKGHLDRFYFLLAGLTTIDLAVYMACARWYKCIKLEGKSME
NDDEDEDNFKV

Manhiot esculenta Medes_10 cassava4.1_004044m.

MVFGDWLYSCTKCFQKPSTSASDSSAEEKQGNSLSSSSSSSDNNSKIIQKKKPGG
WRAMPYILVFHMEQVSAANVINIWSGITNFAPLIGAFISDAYVGKFRTIAFASCAAFLGM
LTVTLTAWLPYLHPPKCHPEEGHPLVHCKSPTAVQLGVLLMGLGLLSIGTGGIRPCSIPF
GVDQFDPTTEDGIKGINSFFNWYYTTFTVVVLITLTVVVYIQDSVSWVLGFGIPTVLMLC
SIVVFFIGTRIYVHVKPEGSFFSDIAQVFVAAYRKRRVKLPDDDGGQEVDGVFYDPPVKN
TVVSKLPLTNQFRFLNKAAMIEKNDLNPDGSCANQWRLCSIQQIEEVKCLFKITPIWASG
IVSLTAITQQGTFTVSQALKMDRHLGPKFQIPAGSIGIISMITVGIWLPFYDRIIVPALRRIT
KHEGGITLLQRIGIGIVFSILAMVVSGLVERDRRAVANDGAHIMSVMWLTPQLVVMGLC
EAFNIIGQIEFYNKEFPEHLRSMANSLFFCSFAGSSYLSSLVITVVHKTTRTKDHPDWLTE
DLNAGKLDYFYFLLAGMGGLNFLYFLLCAGRYRYKISSNVKIEDESYHDVELSLSKKIPS

Manhiot esculenta Medes_11 cassava4.1_004093m.

MAAMDVHNSANEVALKEREENISSTDAVTVVGNRNEHRLRRKSSGGWTAASIL
LANQGLATLAFFGVGVNLVLFLTRVLGQDNAVAANNVSKWTGTVYMCSLIGAFLSDSY
WGRYLTCALFQIIFVSGLLLLSLSSWIFLIKPRGCGNEVIACRPPSPVGIAIFYLSIYLVAFG
YGGHQPTIATFGADQFDEEKPKEKTSKEAFFCYFYFALNFGSLFSNTILVYFEDSGEWTL
GFLASLGSAVIALVSFLVGTPGYRYIKPCGNPLPRVAQVFVASARKWDVVPANSDELYE
VEGPESAIKGSRKILHSDEFDFLDKAATITEEDMLHQSDPWRLCTVTQVEEAKCVLKLLP
IWLCTIIYSVVFTQMASLFVEQGNVMSSNLGKFHLPAASMSAFDICSVLICTGIYRQILVP
LAGKLSGNPRGLTELQRMGIGLIIGILAMVAAGITEIQRLKHVIPGQKISSLSIFWQIPQYV
LVGASEVFMYVGQLEFFNGQAPDGIKSFGSSLCMASISVGNYVSSLLVNMVMKITARNN

KPGWIPADLNTGHMDRFYFLIAILTAFDFLIYLFCSNWYKPINLHETEMDKQEDDVLGR
A

Manhiot esculenta Medes_12 cassava4.1_004125m.

MENGNDHAQDQQKSIEKDEEPVINYRGIKAMPFIIGNETFEKLGTVGSSTNLVVY
LNTVFNLKSVTATTLVNIFNGTTNLAPLLGAFLCDTYFGRYKTLGFASVASFLGMSALA
LTAAVPTLHPPKCVGKESSQCVGPSIWQLAFLLCGFGLIAIGAGGIRPCNLAFGAEQFNP
NTESGKRGMSSFFNWYYFTYTFAVMVSVTGIVYVQSDVSWAIGLAIPAFLMFLSCAVFF
IGTKIYVIVKPEGSPITSVVQVLVVSVKKRGLKLPQNPAVSLFNYVPAKSINSRLSHTEQF
SFLDKAAIVTEKDEINLDGSAANPWRLCSIQQVEEVKCMVRIIPIWASAIIYHVPLIQQQT
YAVLQALQLDRRLGTGSFEIPAATFIIFTMLALTIWIPIYDRILVPFLQRLTGKEGGFTLLQ
RMGIGILLSVLCMFVSGLVESHRRDIALSKPTLGISPKGGAVSSMTWLWLVPQLALAGLS
EGFNYVSQIEFYYKQFPENMRSIAGSSFFAGLALANFLSGLLVSTIHKITSATKSGDWLSE
DLNKGKLDHFYYVIGVLGTVNMAYFLLCAKWYRYKVREDDGSVEMSNKSSVKHHV

Manhiot esculenta Medes_13 cassava4.1_004197m.

MESKGQGHTQDGTVDLHGRPVLASKTGKWKACAFLVGYETFERMAFYGIASNL
VNYLTTQLHEDTVSSVRNVNNWSGSVWITPILGAYIADTYVGRYWTFTVSSLFYVMGM
ILLTMAVSLKSMRPTCINGVCNKASTSQVAFFYSALYIVAIGAGGTKPNISTFGADQFDD
FNPHEKKLKVSFFNWWMFSSFLGALFATLCLVYIQENMGWGLGYGIPTAGLLLSLFIFY
LGTPLYRHKVRKTKSPTRDLIQVPIASFKNRKLQLPSDPSELHEFELQHYIDSGKRQLYPT
LIFKFLDKAAIKDINTSDNSSPPCTVTQVEGTKLVLGMTLIWLVTLIPSIIWAQVNTLFVK
QGTTMDRSLGSNFQIPAASLGSFVTLSMLLSVPMYDRFFVPYMRKKTGNPRGITLLQRL
GIGFAIQVSAITIAYAVELRRMHVIRLHNIMGPKQIVPMSISWLLPQYILLGVADVFNAIG
LLEFFYDQSPEDMQSLGTTFFTSGIGVGNFLNSFLVTIVDKITGRGSGGKSWIGNNLNDC
HLDYYYGFLLVISTLNLGAFVWASSRFIYKKEIIAVDNEGCVQVEGKNLDTSTLDLQV

Manhiot esculenta Medes_14 cassava4.1_004213m.

MEDKEEKSAPSTAEDGIKYRGIKAMPFIIGNETFEKLGTIGTLANLLVYLTSVFNM
KNITATLLINVFNGTSNVAPLVGAFLSDSYFGRYKSLAFASICSLLGMTVLTLTAAISKLH
PPKCDAKQSGTCVEPTACQFAFLLSGFGFLVLGAGGIRPCNLAFGADQFNPATESGKQGI
NSFFNWYYFTFTFAMMISATFIVYIQSNISWTIGLAIPACLMFMSCALFFLGSKLYVKVKP
EGSPITSLLQVLVAAAKKRRLDLPDNPALSLFDYIPANSINSRLLYTNQFRWLSKSAITTS
EDQINFNGSAANPWKLCSIQQVEEAKCVLRVIPIWASAIIYFVAIIQQQTYVVFQALQSDR
RLGNTGFQVPAASFIVFSMLSLTIWIPIYDRILVPSCRKLTGKEGGITILQRMGIGIVLSIIT
MLVSAVVEERRRHLALTTLTLGTAPKGGAISSMSALWLAPQLTLAGLTEAFNSIGQMEF
YYKQFPENMRSVAGSFLFLGIAGSSYVSGFLVSIVHHITARSPGEDWLAEDLNKGKLDRF
YYMIAALGVVNFGYFLTFAKWYRYKDSNCSSFELSLEAKQQSQKHLV

Manhiot esculenta Medes_15 cassava4.1_004234m.

MEPRKVAEARRMDEDKWVYDSSVDHKGRVPLRSSTGVWKGSLFIIAIEFSERLS
YFGIATSLIIYLTKVMHDDLKTAARSVNYWSGVTTLMPLLGGFVADAYLGRFSTVFVSS

FIYLLGLILLTTSQFVPSLKACNVDVCQEPRKAHEVTFFIAMYLISIGTGGHKPSLESFGA
DQFDEDHSEERKKKMSYFNWWNFGLCCGLLLGVTLIVYVQDHMGWGVADIILTGVMA
LSLVIFILGRSFYRYRLPSGSPLTPLLQVLVAAIKKRNLPNPSNPADLYEVPKSHKDQGRL
LCHTQKLKFLDKAAILEDTENAAEKQSPWRLATVTKVEEMKLILNMIPIWLATLPFGICV
AQAATFFIKQCTTMNREISNGFLIPPASIYALTAIGMIFSVTIYEKVLVPILRRVTGNERGIK
ILQRIGIGMLFSILTMVVSALVERKRLSVVEKNPMKGSLSMSVFWLAPQFLIIGIGDGFTL
VGLQEYFYDQVPDSMRSLGIAFYLSVIGAANFISSMLITIVDHVTEKYGKSWFGKDLNGS
RLDNFYWLLAAITAANMVTYVLLARRYSYKNVNRSVAVADCSVDDWANSVA

Manhiot esculenta Medes_16 cassava4.1_004247m.

MEPSKDGEARSIDKEKWVYDSSVDHKGRIPLRASTGVWKASLFIIAIEFSERLSYF
GIATSLIIYMTKVMHEDLKTAARSVNCWAGVTTLMPLLGGFVADAYLGRFSTVLVSTIT
YLLGLILLTLTQFVPSLKTCEADVCPEPRKVHEVIFFIAIYLISIGTGGHKPSLESFGADQFD
DDHIEERRKKMSYFNWWSFGLCSGVLLGVTLIVYVQDHMSWGAADIVLTVVMALSLVI
FIVGRPFYRFRVPKGSPLTPMLQVLVAAMKKRNLPNPSNPDDLYEAPKSQMDQGRLLC
HTHKLKFLDKAAVLEYKENAAEKQNPWRLATVTEVEEMKLILNMIPIWIATLPFGICVA
QASTFFIKQCTTMNRKIANGFLIPPASIFALAAIGMIISVTIYEKVLVPVLRRLTRNERGIPI
LQRIGIGMLFSIASMVVSAMVERKRLSVVEKDPLKGSLSMSVFWLAPQFFITGIGDGFTL
VGLQEYFYDQVPDSMRSLGIAFYLSVIGAANFVSSLLITVVDHVTEKYGKSWFGKDLNS
SRLDNFYWLLAGIATTNMIIYVLLAKQYSYKNVNRKVAVGDCSGDDWISSVA

Manhiot esculenta Medes_17 cassava4.1_004274m.

MGSVEEQTFLLEDGLLEQNKSNGLYTGDGSVDLHGNPILKEKTGNWKACPFILG
TECCERLAYYGISTNLVTYLTNKLHEGNVSAARNVTTWSGTCYITPLIGAVLADAYWGR
YWTIAGFSTIYLIGMCTLTLSASVPALKPPECTGSLCPPASPAQYAVFFFGLYLIALGTGGI
KPCVSSFGADQFDDTDSKERVKKGSFFNWFYFSINIGALVSSSFLVYIQDNAGWGLGFGI
PALFMGIAIASFFSGTPLYRFQKPGGSPITRMCQVLVASFHKRNLEVPKDSSLLYEAQDG
SSAIEGSRKLEHSNELKYLDKAAVISDTEAKNEDFSNPWRLCTVTQVEELKILVRMFPIW
ATGIVFSAVYAQMSTMFVEQGMLMDTTIGSFTIPPASLSTFDVISVICWVPIYDRFIVPIAR
KFTGKERGFSDLQRMGIGLFISVLSMSAAAVVEIRRLQLAKELGVVDENATVPLCIFWQI
PQYMLVGAAEVFTFIGQLEFFYEQSPDAMRSLCSALSLLTTSLGNYLSAFILTMVTYFTT
VGGKTGWIPDNLNKGRLDYYFWLLAGLSVVNMFIYIVWAKKYKQKKAS

Manhiot esculenta Medes_18 cassava4.1_004310m.

MGSVEERTSLLEDGPLEQDKSNDVYTGDGSVDLHGNPVRKEKTGNWKACPFIL
GTECCERLAYYGIATNLVTYLTNKLHEGNVSAARNVTTWAGTCYITPLIGAVIADAYW
GRYWTIAAFSTIYLIGMCTLTLSASVPALKPAECVGSLCPSASPAQYAVFFFGLYLIALGT
GGIKPCVSSFGADQFDDTDPKERVKKGSFFNWFYFSINIGALISSSLLVYIQDNAGWGLG
FGIPALFMGIALASFFSGTPLYRFQRPGGSPITRMCQVLVASFHKRNLEVPRDSSLLYETQ
ASVIEGSRKLEHSNELTCLDKAAVISDAEAKSNVFSNQWRLCTVTQVEELKILVRMFPIW
ATGIVFSAVYAQMSTMFVEQGMLMDTTIGSFTIPPASLSTFDVISVICWVPIYDGIIVPIAR
KFTGKGRGFSELQRMGIGLFISVLSMCAAALVEIRRLQLVKELGLVDEDAAVPLSIFWQI

PQYMLVGAAEVFTFIGQLEFFYEQSPDAMRSLCSALSLLTTSLGNYLSSFILTMVTYFTT
AGGKPGWIPDNLNKGHLDYYFWLLAGLSVLNMFVYVVCAKKYKQKKAS

Manhiot esculenta Medes_19 cassava4.1_004356m.

MESKGYTQDGTVDLRGRPVLASKTGKWKACAFLVGYEAFERMAFYGIASNLVN
YLTTQLHEDTVASVRNVNNWSGSVWITPILGAYIADTYLGRYWTFTVSSLLYVMGMML
LTMTVSLKFMKPTCINGVCNKASSSQIAFFYSALYAIAIGAGGTKPNISTFGADQFDDFDP
QEKKLKVSFFNWWMFSSFLGALFATICLVYIQENLGWGLGYGIPTVGLLLSLFIFYLGTP
LYRHKVRKTKSPARDLIQVPIAAFRNRKLPLPNDPSELHEFEQQHYIDSGKRQVHHTLVF
RCLDKAAIKNINTSASSPPCTVTQVEGTKLVLGMIMIWLVTLIPSTIWAQINTLFVKQGTT
LDRSLGSNFKIPAASLGSFVTLSMLLSVPMYDRWFVPFMRKKTGNPRGITLLQRLGIGFV
IQVTAIAIAYAVEVRRMHVIRLHHSMGPKEIVPMSIFWLLPQYVLIGIADVFNAIGLLEFF
YDQSPEDMQSLGTTFFTSGIGVGNFLNSFLVTMVDKITGRGGGKSWIGNNLNDCHLDY
YYGFLLIVSTLNLGAFVWASSRFIYKKEIIKVNEGEEKTLDTSPLGLQV

Manhiot esculenta Medes_20 cassava4.1_004364m.

MDGKISWTVADAVDYNGLPADRSKTGGWVPAALVLGIEVCERLSTMGIAVNLV
TYLTGTLHLASATSANIVTDFMGTSFLLCLLGGFLADSFLGRYKTIAIFAAIQALGTGML
ALVTKLSQLRPPPCLTNHSCVQANGFQMGILYIALYIIALGTGGLKSSVSGFGTDQFDEK
DEREKAQMAYFFHRFFFISLGTLLAVTVLVYLQDEVGRSWAYGICSVAMFVAILIFFCG
TKRYRYKKSVGSPIVHIFQVIVAAIKKRNMNLPYNISSLYENTPEASRIQHTDQFHFLDKA
AIIAEGDFENTGAAPNPWKLCSVTRVEEAKMMVRILPIWATTIIFWTTYAQMITFSVEQA
STMERSIGSFQIPAGSLTVFFVAAILITLAIYDRLIMPLWKKWKGKPGFSNIQRIGIGLVLS
TFGMAAAALAERKRLSVAKAVGGNTSTLPLTVFLLIPQFFLVGAGEAFIYTGQLDFFITQ
SPKGMKTMSTGLFLTTLSLGFFVSSFLVMVVKRVTGTDGGQGWLADNINYGRLDCFYG
LLAILGVVNFVVFLVCALWYKPSNGNTKSGLQMENIGNGSLAEEKC

Manhiot esculenta Medes_21 cassava4.1_004369m.

MEEKGVHAKRQKGGMVTMPFIFANEACEKLAVVGFNTNMISYLTTQLHMPLTK
AANTLTNFSGTASLTPLIGAFCADAFAGRFWTITVASILYQIGMTSLTLSAILPNLRPPPCK
GDYCKEANTGQLAVLYASLLLTALGSGGIRPCVVAFGADQFDETDPKQSTKTWKYFNW
YYFVMGVSILLAVTMLVYVQDNVGWGLGLGIPSIAMFLSIIAFIVGYPLYRNLDPAGSPF
TRLLQVSVAAFRKRKLPMVSDPMLLYQNEELDAPISIGGKLLHTKHMKLLDKAAIVTEE
DQLKAGQTPNLWRLNTVHRVEELKSVIRMGPIWAAGILLITAYAQQSTFSLQQAKSMDR
HLSKSFQIPAGSMSVFTMTSMLTTIAIYDRFFVPFARRFTGLERGITFLHRMGIGFVISILA
TLVAGFVEIKRKHVAAANGLLNSHESIPISVFWLVPQYSLHGIAEAFMSIGHLEFFYDQA
PESMRSTAMALFWTAISFGNYVSTLLVTLVHKFSAGPDGSNWLPDNNLNKGKLEYFYW
LITLMQAINLVYYLICAKMYTFKPIQIHTKEVSDSKDDGVAVELTNKV

Manhiot esculenta Medes_22 cassava4.1_004492m.

MPVASASTSTSTSDSPDVQAPILYDTVDYKGLPVNKSYSGGWKSASLIIGVEVAE
SFAYYGISSNLIAFLTGPLGQSTATAAENVNAWSGTASLLPLLGAFVADSFLGRYRTIVV

ASVIYLLGLALLTLSAMFPSHSDSDCPISSTITSCSPHPFQVVLFFSALYLVALGHGGHKP
CVQAFGADQFDGQDPEECKAKSSFFNWWYFCMSLGILVTILTLIYIQDNIGWALGFGIPC
VAMVIELFIFLLGTKTYRYSVKVEKNSAVRRIGRVFLTTIRNWRIYPSAIAYEEEACEMLR
HHHPQQLKFLNKALLAPNGLKGDGKVCSLSEVEEAKAVLKLTPIWVTCLPYAVVFAQP
STFFTKQGATMYRTISKGLEIPPAMLQCFSSLAIISSIAIYDRVFVPIARALTGKPSGISMLQ
RIGTGMFLSAFLTAIAALVEMKRLEVAREHGLVDLPGVTLPMSVWWLVPQYVLCGVSN
VFTMVGLQEFFYDQVPKELRSVGLSLYLSIFGIGSFLSSFLISAIEKCTGGQGHDSWFANN
LNRAHLDYFYWLLAGLSMVQFVAYLYFAKNYVYNR

Manhiot esculenta Medes_23 cassava4.1_004502m.

MAITSASSSDSPDIRAPLLYDTVEGSVDYKGRSVYKFNSGGWRSASFIIGVEVAER
FAYYGIASNLITFLTGPLGQSTATAAENVNAWSGTASLLPLLGAFVADSFLGRFRTIIVAS
LIYILGLGLLTLSAILPSFSASDCPSTNISTKCSANPIQVVLFFFSLYLVALGQGGHKPCVQ
AFGADQFDGQDPKEYKAKSSFFNWWYFCMCSGTLVTLLFLNYIQDNLNWALGFGIPCI
MMVIALILFLLGTKTYRYSVKVEEKSAFLRIGLVFVSAIKNWRTSPSALALEEETRGMLP
HQSSEQFKFLNKALLTPNGSKETGKVCSLSEIEEAKAVLRLVPIWATCLVYAVAFAQSST
FFTKQGVTMDRSISPGFKVPPATLQSFISLAIVLFIPIYDRIFVPIARALTGKPSGITMLQRIG
TGMFLSALSMAIAALIETKRLEVAREHGLIDKPNVTVPMSIWWLVPQYVLFGLADVFTM
VGLQEFFYDQVPSELRSVGLSLYLSIFGVGSFISSFLVSAIEKATGGEGHDSWFANNLNR
GHLNYFYWLLAALSVVQLFVYLYFAKNYVYNR

Manhiot esculenta Medes_24 cassava4.1_004524m.

MDEANRLSTWEGYVDWKNGPALRGRHGGMLAASFVLVVEVLENLAYLANASN
LVLYLSKFMHFSPSSSANIVTNFMGTAFLLALLGGFLADAFFTTYRIYLISALIEFMGLLV
LTLQARFPSLKPPPCVPGDTVISCEEVDGLKKMMLFAGLYLVALGVGGIKGSLPPHGAE
QFDETTPQGRKQRSAFFNYYVFCLSCGALIAVTFVVWIEDNKGWQWGFGISTATILLSIPI
FLLGSPTYRCKVPKGSPITTILKVIVAAIYNVCKPGSPSNAVTGMDTSSSYTTETSEGEDN
HAKRGAPSQENLMFLDRAVMNKNVNPKLQCTAKEVEEVKIVLRILPIFMSTIMLNCCLA
QLSTFSVQQASTMNTKLGSLKVPPASLPVFPVIFIMILAPIYNHIIAPFARKITKSEMGITHL
QRMGTGLFLSIVAMAVAALVEIKRKRVVANYELTDSAEPLPTTFLWIAWQYLFLGSADL
FTLAGMMEFFFTEAPLSMRSLATSLSWASLAMGYYLSSVLVSIVNAVTGACRHTPWLF
GNNLNHYHLERFYWLMCTLSGLNFLHYLFWACRYKYK

Manhiot esculenta Medes_25 cassava4.1_004536m.

MGEEDIYTKDGTVDYRGNPANRKETGTWRACPFIIGNECCERLAYYGMSSNLVL
YFKHVLNQQSATAAKNNSDWSGTCYTTPLIGAFLADAYLGRYWTIATFSIIYVIGMTLL
AMSASVPGLKPKCYAKNDCDPTDGQSAACFVALYLIAVGTGGIKPCVSSYGADQFDDT
DEVEKKHKGSFFNWFYFSINVGALIASSVLVYVQNNWSWGWGFGIPAIAMAIAVVSFFS
GTRLYRYQKPGGSPLTRLCQVIVASIRKYKVVVPADKSLLYETADAESNIKGSRKVEHT
TYFSFFDKAAVETEKDHVKDSVNPWRLSTVTQVEELKSIIRLLPIWATGIIFAAVYSQMS
NLFVLQGDQMNKFVGNSNFEIPSASLSVFDTLSVIFWVPIYDRIIVPFARKFTGNRYGLTQ
LQRMGIGLFISIFAMVSAAVLEDIRLGIVKRHDSYDIKQVPISVFWQVPQYFLIGCAEVFT

FIGQLEFFYQEAPDAMRSLCSALSLTTVALGNYLSSLLMTITTSISTRNGKPGWIPDNLNY
GHVDYFFWMLAVMSVLNLGAFLFISKWYTYKTPIGTLR

Manhiot esculenta Medes_26 cassava4.1_004551m.

MDRSLSSGPESEISISGAGKRSGSWVTFPFIIGTFSCLTLAGAGWLFNIIVYLIKEFN
VKSIDAAQISNVVNGGSNLVPLVAAIVADSFLGSFSVVAVSSCVSFVGLVLLASTALVDS
LRPKPCEDGSSPCQTPSKLQYAILYGAFVLASIGMGGSRYTLATMGANQFDNPKAQGIFF
NWFFFMFYLVSLISATAIVYIEDNVGWGLGLGLCVAANFIGIVIFLVGTRFYRRDKPQGS
PFTSLARVVVAAIQKRKVLLSSRNEDYYYDHDTKPKELAAPMSKSFRFFNRAALKSEGD
IKPDGSIAKPWRLCTVSQVEDFKTLIRIFPIWSTSIFLGTPIAMQSGLNVLQALTMDRHLG
QHFQIPAGSFAVVVLLSASIFLSIIDRFLFPLWLNMTHKSPTPFQRIGVGHILNVLAMAVS
ASLESSRLRLAHHHNQASSVVPMSALWLFPQLILIGIGEAFHFPGQVALYYQEFPTSLRST
ATAMISLIIGISFYLSTALIDLIRKVTGWLPDNINDGRLDNVYWVMVGIGVLNFGYFLGC
AKLYKYQNVEKLQGVSISAICIVELEFGI

Manhiot esculenta Medes_27 cassava4.1_004569m.

MAEEDLYTKDGTVDISGKPANRKRTGNWKACRFILGNECCERLAYYGMSTNLV
NYLQDRLNQGNVTASNNVTNWSGTCYITPLIGAFLADAYLGRYWTIAIFVIIYIFGMTFL
TISASVPGIKPACDKNSCHPTTAQSAACFVALYLIALGTGGIKPCVSSFGADQFDEADDN
EKKKKSSFFNWFYFSINIGALIASSVLVWIQMNVGWGWGFGVPAVAMAIAVVFFFSGST
LYRLQKPGGSPFTRIFQVIVASFRKLHVQVPADSSILYETADKESNIQGSRKLEHTDKLTF
FDKAAVETQDDSIKGSADPWRLCTVTQVEELKAIVRLLPVWASGIVFATVYSQMSTMF
VLQGNTMNQHMGPHFKIPSASLSLFDTLSVIFWAPVYDRIIVPYARKFTGNERGFTQLQR
MGIGLVISIFSMITAGVLEVIRLKYVQKNNYYDLKYIPMSIFWQVPQYFLIGCAEVFTFIG
QLEFFYDQAPDAMRSLCSALSLTTVALGNYLSTLLVTIVTNVTTRHGKLGWIPDNLNRG
HLDYFYWLLAILSLLNFFVYLWIAKWYTYKKPTGLAN

Manhiot esculenta Medes_28 cassava4.1_004884m.

MLAASFVLVVEILENLAYLANASNLVMYLSEYMHLSPSRSANNVTNFMGTAFLL
ALLGGFLSDAFFTTYLIYLISAAIEFLGLVILTVQARSPSLKPPACNPANPNLPCEEVDGAK
AAMLFLGLYLVALGVGGIKGSLPAHGAEQFDESTPQGRKHRSTFFNYFVFCLSCGGLIA
VTFVVWIEDNKGWEWGFGISTIAIFLSIPIFLAGSAIYRNKIPSGSPFTTIFKVLIAAAINAST
SSTPSNAVANLNASPFNVTQADQDSKQNSKEMAPTDETATKSFSCLNRAVVKTPVHSAL
ACTVQEVEEVKVVIKILPIFACTIMLNCCLAQLSTFSVQQAATMNTRLGSLKIPPASLPIFP
LVFIMILAPIYDHFIIPFARKVTKSEMGISHLQRIGIGLVLSIVAMGVAAVVEIKRKRVATN
SGLLDSTDPLPITFFWIAFQYLFLGSADLFTLAGLLEFFFTEAPTGMKSLATSLSWASLAM
GYYLSSVIVSLVNNVTDNSTHRPWLSGNNINHYHLERFYWLMCVLSAVNFLHYLFWAN
WYKYRSTRGN

Manhiot esculenta Medes_29 cassava4.1_006984m.

MDGIQDRHEHTKNLSVAAPRNPSKGGWNSAIFIIAIGEGGHKPCVQTFAADQFNE
ENPEEKAAKSSFFNWWYLGIVIGATTAVLLVIYVQDNVGWTEGFGILAGAVAVALIIFL

VGIKRYRTQAPVGSPFTAVAQVLIAAARKRRVSESRQGWGICYEDDEKDVADQLEGQP
RVRTLARTNQFRFLDKAMIIDNIDASSNPRNPWRLCTLNQVEEVKLVLRLIPIWLSCLMF
TAIIVQTHTFFTKQGSTMIRSIGPNFQLPPASLQSIIGLTILIAVPIYDSFFVPMARKITRHPS
GITMLQRIGFGLFLSILEMAVSALIEAKRISIARDHGLMDNPQAIVPMNVWWLLPQYMIS
GIADVFAVIGLQELFYDQMPEAMRSMGAAAYLSILGIGSFINSATISLVQAITSRCGDVW
LGDNLNRAHLDHFYWVLAVLSALNLCAFIWVANRFVYKKVEGEETEEEKGVDS

Manhiot esculenta Medes_30 cassava4.1_007688m.

MIAVGAGGIRPCNLAFGAEQFNPNTESGKRGMSSFFNWYYFTYTFAVMVSVTGI
VYVQSDVSWAIGLAIPAILMFFSCAVFFLGTRIYVIVKPEGSPMTSVAQVLVVAVKKRGL
KLPQNPDFSLFNYIPPKSINSNLPHTNQFRFLDKAAIVTEKDEINMDGTAANPWRLCSIQQ
IEEVKCMIRIIPIWASAIIYHVPLIQQQTYAVLQALQLDRRLGSGNFEVPAATFIIFTMLAL
TIWIPIYDRILVPFLQRLTGKEGGFTLLQRMGIGILLSVLCMFVSGLVEGHRREIAHTKPTL
GISPKGGGVSSMSWMWLVPQLALAGLSEGFNYVSQIEFYYKQFPENMRSIAGSSFFAGL
ALANFLSGFLVSTVHKVTASTKSGDWLSEDLNKAKLDHFYYVIGVLGILNLAYFMLCA
KWYRYKVREDDNSVEMSKKTKDSVKHHV

Manhiot esculenta Medes_31 cassava4.1_007763m.

MLFLGLYIVALGVGGIKGSLAAHGAEQFDESTPQGRKQRSTFFNYFIFCLACGGLI
AVTFVVWLEDNKGWVWGFGVSTIVIFLSIPIFLAGSPTYRNKIPSGSPLTTIFKVLIVAAIT
TFISSTPSNAIANLNASPISPTKASEESKENSKEMAPGTETLTKSFSFLNRALVKRQVHSSL
ECTVQQVEEVKVVIKILPIFSCTIMLSCCLAQLSTFSVQQAATMNTELGSLKVPPASLPFF
PVIFIMILAPIYDHFIIPFARKVTKSEMGITHLQRIGIGLVLSVIAMGVAALVEIKRKRVAT
NSGLLDSNDPLPITFFWIAFQYLFLGSADLFTLAGLMEFFFREAPTSMRSLATSLSWASLA
MGYYLSSVIISIVNNLTGNSTRRPWLSGDNINYYQLERFYWLMCVLSAVNFLHYLVWA
NWYKYRSTRSGYQSQFTHST

Manhiot esculenta Medes_32 cassava4.1_009972m.

MESIAKSSFFNWWFFSMCSGILVARLILIYIQDNLNWTFGFGIPCIVMVIALFIFLL
GSKTYRYSIKVEEKSAFQRIGQVFVATIRNWCSSSSIISLEEEVCQSLPHHSSNQFKFLDK
ALFECSLNEVEEAKALFRLIPIWASCLLFGVVDAQFSTLVTKQGATMERSISPGFDIPPAS
LQSLPTLTIILFIPIYDRIIIPRARNLTKNPSGITMLQRIGTGMFFSALCMAIAAVVEMKRLK
VAREFGLVDKPNVTVPMSIWWLIPQYVVDGVADVLTSVGMQEFFYDQVPRELRSVGLS
LYISTFGVGSFISSFLISIIERLTGGEGRDSWFTNNLNRAHLDYFYWLLAGLSTVQFVVYL
YFAKKYVYKR

Manhiot esculenta Medes_33 cassava4.1_021001m.

MGTFLLWLTTVIPQARPPPCVQFSDGCPSATTLQLLFLYLSFGLISVGAGGVRSSA
LAFGADQLRKGENIKNAQILESFFSWYYAIASFAVVIAMTCVVYIQDVMGWKAGFGVP
VVLMIMSPLLFLLASPFYVKSRPKSSLFTRFAQVVVAAYKNRSLPLSSQVTNEAYHNWK
DTVILAPSDKLRFLNKACIIRNPLEDLTPDGRASDPWSLCTVDQVEELKAIVKIIPIWSAGI
IMAVTVSQSSFLVLQASTMDRHMTSNFEVPAGSLNVFLVISLVVWISLYDRVIIPLASKL

KGQPVRLSLKQRMGIGILLSSASMVALAVVECIRRETAIREGFIDDPNAVVHMSAMWLL
PYNILGGLAEAFGAIGQNEFYYTELPKCMSSIAVTLVEMGFSAANLVASFIMTSIDYFTK
RGGEGSWVSSNINRGHYDYYYWLLASLSLINFLYYLVCSKAYGPCNAERDNHPDESTSE
GID

Manhiot esculenta Medes_34 cassava4.1_021661m.

MEGLENMAFVSNAISLVTYFNGYMNFSLTKSATSLTNFMGTSFLLTLFGGFISDT
FISRFKTCVLFGCIELLGYGILTVQAHFHQLRPVPCKVVEKHQCEAANGSQEAMLFTGLY
LVAFGTSGVKSALSALGADQFDENDPKEAVHLSSFFNWFLFSLTAGAIIGVTFLVWISTN
RGWEWSFAVCTVAVLLAVLFLSMGKSLYRINVPKGSPILRFAQVFAAAIRNRNLPIPEKT
DELHEIHDKQEEILERTDQFRFLDRAAIVRTNNGASTSMAPGPWRLCTVTQVEETKILLR
MLPIILSTVFMNTCLAQLQTFTIQQSTTMDTSFIGFHIPGPSIPVIPLLFMFFLIPIYDRIFVPL
VRKITGIPTGIRYLQRIGVGLVLSAISMAVSGIVETHRKSVANEHNMVDSTEPLPMSVFW
LGFQYAIFGAADMFTLVGLLEFFYAESSAGMKSLSTAISWCSLAFGYFLSSAVVEIVNKA
SGGWLASDNLNRDKLNYFYWLLAGASVVNFVFYLVCASWYRYKKVEVKKVESSGEG
DAKGKVELIQV

Manhiot esculenta Medes_35 cassava4.1_021961m.

MEQKNMQAKRSRRGQKGGIITMPFILVNEICDKLAVVGFGTNMLNYLTKQLHLP
LTRAANTLTNFNGTASLTPLLGAFIADAYAGRFWTITFASTIYLLGMITLTISATLPQLRPP
PCQPNQVCQEANGVQLGILYLSLLLKSLGSGGIRPCVAAFGADQFSGEDPKQKMTTWSF
FNWYYFVMGGSILLASTVLVYVQDYVGWSWGLGIPTISMFLSIVIFVVGYPLYRILDPAG
SPYTRLLQVTVAALRKRKVSMVSDPNFLYKNEELDASISADGMLNHTEQFKFFDKAAV
VTEEEKLKPLERPNLWRLNTIHRVEELKSVIKMLPIMAAGILFFTASAQQHTFSLQQANT
MNKHLTNSFQIPAASMSVFTSTSMLATIALYDRIFVPFLRKFTGLDRGINFLQRMAIGFAI
SILATLVAGFVEVKRKHMALASGLTNSNSTTFPVSVFWLVPQYSLHGISEAFMAVGHLE
FFYDQAPESMRSTATALFWTANSAGNYASTLLVSLVHKFSARPDGSNWLPDDNLNMG
KLENFYWLITCLQVVNFVYYLVCIKYYTFKSLQGPSIEIGEPKEEIELESQA

Manhiot esculenta Medes_36 cassava4.1_023046m.

MELPRRADSVEVDGEKWVCDSSVDHKGRVPLRAHTGAWKASLFIIAIEFSERLS
YFGLATSLIIYLTKVIHQDLKTAAKSVNYWSGVTTLMPLFGGFVADAYLGRFSTVLVSSL
IYLLGLIVLTMSQFLPCLKACEDATCHNAGRVHEIVFFFAIYLISIGTGGHKASLESFGAD
QFDDDHCEERKKKMSYFNWWNLGLCFGVLLGVTLIVYVQDHMSWGVADIILTIAMAL
SLVIFIIGRPFYRYWAPSGSPLLPMLQVLVAATRKRNLPHPNNPAELYQVSELDHGRLLC
HTEKLKFLDKAAILEGTENSAEKQSPWKLATVTKVEEMKLILNMIPIWLTSLPFGICVAQ
CSTFFIKQATMLNRKIGNGFEIPAASIYSLSAIGMIISVTMYEKILVPTLRRKTGNERGIKIL
QRIGIGMVFSVATMVVAALVEKKRLSVAEKVPLKGSHPSISVFWLAPQVLIIGIGDGFTL
VGLQEYFYDQVPDSMRSLGIAFYLSVIGAANFLSSLLITVVDHVTEKYGKSWFGKDLNS
SRLANFYWLLAAITAANLFFF

Manhiot esculenta Medes_37 cassava4.1_023155m.

MDTIHSSGDPLDKSFMQPSMEKFVEQQSQADNEEETQPTTLVSNGCVDYRGRIA
DKRTTGGWKASPFIIANEVAERLAFFAIAVNMVAFLVSEMRQSLPAAATHVTDWMGAA
YVLTILGAFLADAYFGRFKTIIVFSCIYAVGMVLLTLSASIDSLRPPPCTAKPCTKATDGQ
NTFLFFALALIALGTGGIKPCVSSFGADQFDEADKKEVRKKFAFFNWFFFAINMGALLGI
TIMVYIKEKKGWGWGFGVPTGAMMVSIIILAAGIRHYRFQKPMGSAFTRFLQVMVAST
RNHLRGVKLGAEVQLYEVNGEESDIRGARKLPHTRQFTFLDKAAVVTDPEANTGNRWK
LCTVTQVEEFKSLIRILPIWASTIALSISFTQLATFFTSQANIMDRKLSSNFTIPAGSVTVFS
AINALILVPIYEKLIVPIISKYTGHQRGITSLQRMGVGLFVSIFALASAALVEKKRRDSYSP
SDMSVFWLFPQYFLIGTAEVFTYVGQLEFFYDEATDGTRSISSALFLSEIGIGSWLSTAIV
KIIERTTGGEEKGWLRDNLNKSRLDYFYWILTAINGFNFFIYLWVAWRYKGRSRATRSVI
DESLFKAIGDGGAEKREDNKGEIQSIAF

Manhiot esculenta Medes_38 cassava4.1_023252m.

TLTSVDVSECENTKNGTSCSPPTFQAILFFFSLYLVAVGQGGHKPCVQAFGADQF
NGLDPKESVAKRSFFNWWYFSYSAGINLSVIVVVYIQEKLNWVLGFGIPCILMFAALVV
FLLGSRTYRYSIKGNERNPFIRIGRVIVRAARNWRSAPFGVAADEETYMDDQNFEQFKFL
NKALLARDGSMEDQEKCSVSDVKETKALLSLIPIWATCLAYAIAFAQSATFFTKQGVTM
DRTIFAGFQIPAASLQTFIGFAIILSIPIYDRIFVPLASSLTGNLSGIAMLQRIGTGMIISTLSM
VIAALVEKKRLKIAEEHGMVDLPNATIPMTIWWLVPQYVLCGVADVFTIVGLQEFFYDQ
VPEGLRSVGLSLYLSVLGVGQFLSSFLVSVIDKATSKDGQDSWFSNNLNRAHLDYFYWL
LAALSVIGFLAYLIFARSYIYRKGNE

Manhiot esculenta Medes_39 cassava4.1_023378m.

MAEEADLHTKDGTTDFRGNPAIKKKTGTWKACPYILGNECCERLAYYGINTNLV
NYLKFQLNQTSVVAINNVTNWSGTCYVMPLLGAFLADAYLGRYWTIASFSIIYVLGMTL
LTLSASVHGLKPSCDHTNVCHPTWLQTAFFFLGLYLIALGTGGIKPCVSSFGADQFDDSD
ETEKKKKSSFFNWFYFSINIGALVASSVLVWIQTNVGWGWGFGIPAVAMAIAVVSFFSG
TKLYRNLKPGGSPLTPICQVLVASFRKFRVQVPDNESLLYETVDEESDVKGSRKLDHTR
QLSFFDKAAVETPSDLVKGSVDPWRLCTVTQVEELKSIIKLLPIWATGIIFSAVYSQMGTL
FVLQGNTMDLHMSRSFEIPSASLSLFDTISVIFWVPIYDRVIVPIARKFTGHKNGFTQLQRI
AIGLVISIFAMLVAGSLELVRLQEVKKHNYYKLKHIPMSVFWQVPQYFIIGCAEVFTFIGQ
LEFFYEQAPDAMRSLCSALSLTTAALGNYLSTLLVNIVTDLSTRNGSPGWIPDNLNYGHL
HYFFWLFAVLSLLLAVLSLVNLGFYFFVARSYTYKRMLRDSH

Manhiot esculenta Medes_40 cassava4.1_024513m.

MDSDLPQTLGKTIPDAWDYKDCPAERSKTGGWGSAAMILGGEACERLTTLGIVV
NLVTYLTGTMHLGNATSANTVTNFLGTSFMLCLLGGFIADTFVGRYLTIAIFATVQALGI
TVLTISTAVPSLRPPKCVNDTGCVPANSKQLTILYLALYMYALGTGGLKSSVSGFGSDQF
DETDDKEKKQMTSFFNWFFFLINIGSLGAVTILVYIQDHVGRKWGYGICACAIVLGLIVY
LSGTRQYRFKKLAGSPLTQIATVFVAAWRKRHLEMPSDPSFLYDVDFIEEGHKNKQRLP
HSKQLRFLDKAAIKDPKINVVNKWNLSTLTDIEEVKLVLRMLPIWATTIMFWTVYAQM

TTFSVAQATTMDRHIGKSFQIPAASLTVFFVGSILLTVPVYDWVIAPIAKKVLKNQYGLT
PLQRIAVGLVFSIVAMIAAALCELKRLRAARSNGLTNDPTAEIPLSVFWLVPQFFFVGSG
EAFTYIGQLDFFLRECPKGMKTMSTGLFLSTLSLGFFVSSLLVSIVHKVTAHGPWLADNL
NQAKLYNFYWLLAILSALNFLIFLVCYKWYVYKDERLAESGIELEELDEPAMH

Manhiot esculenta Medes_41 cassava4.1_025050m.

MSSTLHHPLLPPHPNTSTQISMDRSTVSPIITQHAHEHTAKVSAAPTKSFKGAWTS
AIFIIFVEVAERFAFYGLSGNLITYLTNDLHESTADAAKNINTWIGVSSIFPIVGAFLADSFL
GRFKTILLSTMIYLTGLVLLTLTVSVIPMNHRKSVFFLALYVLAIGEGGHKPCVQTFAAD
QFDEQKPEEKSAKSSFFNWWYLAIVVSATSAVLLVIYVQDNVGWTEGFGILAGAVAVA
LVIFLAGMKKYRKEAPVGSPYTALVQVLIAAARKRRVNETLEGWGICYEDDDKDGADL
EVVGQPRARTLARTEQFRLLDKAMIIDNMDASSNTRNPWRLCTLNQVEEVKLVLRLIPI
WLSCLMFTAVVVQTHTFFTKQGSTMIRSIGPNFQFPPASLQSLIGITILVAVPLYDRVFVP
MARKITGHPSGITMLQRIGIGLFLSILQMAVSALVEAKRVSTARDHGLMDNPKAIVPMS
VWWLLPQYMLSGLADLFTVVGLQELFYDQMPEAMRSMGAAAYLSILGIGSFINTAAISA
VQAITSKYGSVWLEDNLNRAHLDYFYWVLAVMSALNLCVYIWVAKGFVYKKVEGEET
EKEERSDEP

Manhiot esculenta Medes_42 cassava4.1_025742m.

MVLGDWLYCCKRCFQKPSTSASASSSPESMEPTEETQGNVSSSVNGNSNIIQEKK
PGGWRAMPYILGNETFERLATFGLLANFMVYLMREFHMEQVTAANVINIWSGITNFAPL
IGAFISDSYVGRFTTIAFASCAAFLGMVTVTLTAWLPYLHPPKCYPDQHPFGPCESPTAL
QLGILLLGLALLSIGTGGIRPCSIPFGVDQFDPTTEDGMKGINSFFNWYYTTFTVVILITLT
VVVYIQDTVSWVIGFGIPTVLMLCSIVLFFIGTNIYVHVKPEGSIFSGIAQVFVAAYTKRK
LKLPDDGALEVDGVFYDPPLKETVLSKLPLTNNFRFLNKAAMIEKNDLNADGYCANEW
KLCSIQQIEEVKCLLKIGPVWASGIISFTSMSQQGTFTVSQALKMDRHLGPKFQIPAGSIS
VISMITIGIWLPLYDRVMVPCLRKITKHESGITLLQRMGIGIVFSILSMVVAGLVERDRRA
VAISHPGGAPMSVMWLAPQLVIMGLCEAFNFIGQIEFYNKEFPEHMRSIANSLFFCSFAG
ASYLSSLVITVVHKSTRTKDHPDWLTNDLNAGKLDYFYFLLAGMGSLNFLYFLFCAHR
YRYKITSLQIEDKSKHDVELSLSKKIPT

Manhiot esculenta Medes_43 cassava4.1_026151m.

MIEIRDDVPSSSPLEQHIPSSSSPPAARNLGGWKAIRYILGNESFEKLASMSLIANM
TVYLQNKYHMGGASNVNVTTIWSGSSNVTSLLGAFLADTYLGRFRTLLFGTISSLLGMV
LMTLTAAVPQLTPPKCEGESHCLQPEKWQLGFLFVSLGFLSIGAGGIRPCNIAFGADQFD
TTTAKGRANLESFFNWWYFFFTIALLVALTGVIYIQTDVSWVIGLVIPTACLCISISIFLIGR
HTFICKKPQGSIFADMLKVITAAYRKRQLNIALGSQLSFYDPPINDSDFHLKLSPTDRFKF
LDKAAIITDPSELDAQGRPKNTWRLCSLQQVEQLKCLAALLPVWVSGIACFIPMDQHNA
FGILQAIQMNKSLGSHFKIPPGWMGLTSMIALSIWIFIYEFVFIRQAKKLTGKDKGFTVAQ
RIKIGIVMSILCMLVAAIVEKKRRDSALKHGSFASPITVAVLLPQFILSGLIEAFAAVAMM
EFYTTQMPESMRTVAGAVFFLSLSISSYVGSLLIYIIHHLTGKNEKSPPWLGGHDLNKNR
LDYYYYVIAGLGAVNFLYFNFFASRYAVNSSVGEVELEKSNCHSKLHGDEEKGLEIHLR

Manhiot esculenta Medes_44 cassava4.1_026543m.

MEPQKLAETRRVDEEKWVYDSSVDHKGRVPLRAQTGIWKASLFIISIEFSERLSY
FGLATSLIIYLTKVIHQDLKTAAKTVNYWSGVTTLMPLFGGFVADACLGRFSTVLVSSII
YLLGLILLTMSQFVPSLKACEDSMCHEARKAHEMVFFLAIYLISIGTGGHKPSLESFGAD
QFDDDHCEERKKKMSFFNWWNFGLCSGLLLGVTLIVYAQDHMSWGAADVILTVIMAL
SLAIFIIGRPFYRYRAPSGSPFTPMLQVLVAAIRKRNLPSPSNPAELYQVSMMDHGRPLCH
TKKLNFALLVNYKLNCRFLDKAAILEGTENSTEKQSPWRLATVTKVEEMKLILNVIPIWL
ATLPFGICVAQAPTFFIKQGTTLNRKIGAGFEIPPASIYSLAAIGMIISVTIYEKILVPTLRKI
TGNERGIKILQRIGIGMVLSIATMIVAAMIERKRLSVADKDPVNGSLSMSVLWLAPQFLI
VGIGDGFTIVGLQEYFYDQVPDSMRSLGIAFYLSVLGAANFLSSLLITVVDNVTEKYGKT
WFGKDLNSSRLDNFYWLLAFMAAANFFVYVFLARRYSYKPVQRNVVVAACPNHNGK
NNNNDQGDSMA

Manhiot esculenta Medes_45 cassava4.1_026931m.

TNFLGTSFILCLLGGFIADTFLGRYLTVAIFATVQAMGITVLTISTALPSLRPPKCV
NDTGCIPANSKQLTVLYLALYMYALGTGGLKSSVSGFGSDQFDETDPTERKQMASFFH
WFFFLINIGSLGAVTVLVYIQDNVGRKWGYGICGCAIVLGLILFLSGTRRYRFKKLAGSP
LTQIATVFVGAWRKRHLEMPSDPSFLYDLDVIEEGGKKNKQKLPHSRQFRFLDRAAIKD
PETNVIDKWNLSTLTDVEEVKMVIRMLPIWATTIMFWTVYAQMTTFSVSQATTMDRHI
GKSFEIPPASLTVFFVGSILLTVPVYDKLVVPIVKKVLKKPNGLTPLQRIAVGLIFSIIAMIA
AALCERKRLRAATLHGLVNDPTAQIPLSVFWLIPQFFFVGSGEALTYIGQLDFFLRECPK
GMKTMSTGLFLSTLSLGFFFSSLLVSIVHK

Manhiot esculenta Medes_46 cassava4.1_027108m.

MALEQGVDDYTKDGTVDLRGNPVLRSKRGGWRACSFVVVYEVFERMAYYGIS
SNLVVYLTKKLHEGTVKSSNNVTNWVGTVWMTPVLGAYVADARLGRYWTFVIASLIY
LSGMCLLTLSVSLGALRPPPCKDTNVDNCQKASALQVAVFFGALYTLALGTGGTKPNIS
TIGADQFDDFDPKEKGQKLSFFNWWMFSIFFGTLFANTVLVYVQDNVGWTLGYALPTL
GLLISVAIFLAGTPYYRHRLPTGSPFTRMARVIVAALRKWNVAIPNDPKELYELDLEEYA
NKGKFRIDSTPTLRYLNKAAVRTGSSDPWMLCSVTQVEETKQMLRMIPILIATFVPSTM
VAQINTLFVKQGTTLDRHIGSFKIPPASLSAFVTLTMLISVVLYDQYFVRIMRRWTNNPR
GITLLQRMGIGMVFHIIIMITASLIERHRLSVAKKHGLVESGGQIPLTIFILLPQFVLMGMA
DAFLEVAKLEFFYDQAPESMKSLGTSYSTTSLGVGNFLSSFLLSTVARITKNHGHHNGWI
LNNLNASHLDYYYAFFAILNFVNLIFFFVVIKFYVYKAEVSDSMEVLAEELKGIRLRASS
QEVSNTS

Manhiot esculenta Medes_47 cassava4.1_027940m.

MEATEAEYNSLSKREKGKGGFRACSFVFVMVALENMGFIANMVSLVLYFLGVM
FFDTASSSNTLTNLMGATFLLTVVGGFISDTYLSRLTTVLIFGVIEILALIMMTIQAHAKSL
QPTYCGPGRSSCVEGKTAVMLYASLALLALGSGGVRGVLPSLGADQFDQNDPEEAKAL
ATYFNWIILSTVLGATIGVTGIVWVSVNDAWYKGFMISTIATFVGFAVLLLGKPFYHQR
KPGESPFIRIAQVIVLVFKNRRLSLPARPDELYEISEKDTISLEGKIAHTDQFRFLDKAAIVP

KDLNIAPWRVCTVTQVEEVKILTRMLPILFSTMIMNTCLAQLQTFSVQQGYEMDKNLGK
LKVPAPSVPVIPLLFMVILIPAYEFLFVPFARKITGHPSGITQLQRVGVGLVLSAISMAVAG
IVEVKRRDQMHKDPAHPISLFWLSFQYGIFGIADMFTLVGLMEFFYKEAPSGMKSLSTSF
TFLSLSFGYFLSSVFVSIINKVTERVTPSKKGWLHGEGIDDNNLNLFYWFLAVLSCINFVN
YLFWASWYKYKVDDVDCIKPDLIRSTDGLLLTKVENTPDLSVVKAEVEENTKEKVVET
SEAEAPSSDLQPKDDKENQQTHEQETRSGN

Manhiot esculenta Medes_48 cassava4.1_027976m.

MTSDLPETLGKTIPDAWDYKGRPAERSKTGGWGSAAMILGGEACERLTTLGIIV
NLVTYLTGTMHLGNATSANTVTNFLGTSFMLCLLGGFIADTFLGRYLTIAIFATVQALGI
TTLTISTAVPSFRPPKCVKDTDCIPANSKQLTILYLALYMYALGTGGLKSSVSGFGSDQF
DETDDKEKNKWQVSSIVTVLVYIQDNVGRSWGYGICACAIVLGLIVYLSGTRQYRFKKL
AGSPLTQIVTVFVAAWRKRHLKMPSDQSFLSDVDFVEEGDKNKQKLPHSKQFHFLDRA
AIKDPKINVVSKWNLSTLTDIEEVKLVLRMLPIWATTIMFWTVYAQMTTFSVAQATTMD
RHIGKSFQIPAASLTVFFVGSILLTVPIYDRVVAPIAKKVLKNPYGMTPLQRIAVGLVFSM
FSMIAAALSELKRLRAARSNGLTNDPTAAIPLSVFWLVPQFFFVGSGEALTYIGQLDFFL
RECPKGMKTMSTGLFLSTLSLGCFFSSLLVSIVHKVTANEPWLADNLNQAKLYDFYWLL
AILSALNFLMFLVCSKWYVYKDERLAELGIELEELDEPAMQEILV

Manhiot esculenta Medes_49 cassava4.1_027979m.

MIFLGAANEICDRFAATGFHANMITYLTQQLNLPLVKASNTLTNFGGTASFTPLIG
ALIADSFAGRFWTIIVGSIIYELGMISITVSAVFPSLRPPPCPSQLNCKEASSSQLWVLYISL
LLTSLGTGGIRPCVVTFAADQIDMTKSSVASRGWNFFNWYYFSMGMATLTALTIVVYV
QDNVGWGWGLGIPTIAMALSIVAFVFGSPLYVKLKPGGSPFVRLTQVIVVAVKKRKLV
APHDPAMLYQNKELDAAISVNGRLLHTNQFKWLDKAAIVTDDEKTGSKTPNLWRLAT
VHRVEELKSLIRMLPIWAAGILLVTASSHQHSFVIQQAFSMDRRLSHSFEIPPASLSIFSVL
TMLTGIVLYERLFVPFARRFTGNPSGITCLQRMGIGFFINIIATIVSALVEMKRKEAAAHH
NLLDDPKAIIPISVFWLVPQFCLHGVAEVFMSVGHLEFLYDQSPESMRSTAAALFWIANS
LGNYIGTLIVTLVHNYTGQNNNWLPDRNLNRGRLDYYYWLVTGIQVVNLVYYIICAWI
YTYKPLEEAIEEDGKTTNEEMQITCKLENEHGDREVELGMSTNEMVKIV

Manhiot esculenta Medes_50 cassava4.1_028638m.

MEPPERADSIEVDGEKWVCDSSVDHKGRVPLRAHTGVWKASLFIIAIEFSERLSY
FGIATSLIIYLTKVIHQDLKTAAKSVNYWSGVTTLMPLFGGFVADAYLGRFSTVLFSSLIY
LLGLTLLTMSQFLPCLKACEEAICHKARKVHEIVFFLAIYLISIGTGGHKASLESFGADQF
DDDHCEERKKKMSYFNWWNFGLCFGVILGVTLIVYVQDHMSWGAADIILIIVMALSLVI
FTIGRPFYRYRAPSGSPLKPMLQVLVAAVRKRNLPHPPNPAELYQVSKVDHGRLLCHTE
KLKFLDKAAILEGTENFAEKQSPWRLATVTNVEEMKLIINMIPVWLATLPFGICVAQCST
FFIKQATTLNRKIGNDFEIPAASIFSLAAIGMIISVTTYEKILVPTLRRKTGNERGIKILQRIG
TGMVFSIATMVVAALVEKKRLSVAEKDPLKGSRLSMSVFWLAPQYLIIGIGDGFTLVGL
QEYFYDQVPDSMRSLGIAFYLSVIGAANFLSSLLITVVDHVTEKYGNGWFGKDLNSSRL
ANFYWLLAAITAAN

Manhiot esculenta Medes_51 cassava4.1_028664m.

MVLVSNHGDKDGAHQDTALDFHGNPADKSKTGGWLAAGLILGTELSERICVMG
IAMNLVTYLVGDLHISSAKSATIVTNFLGTLNLLGLLGGFLADAKLGRYLTVAIFASITAL
GVTLLTLATTISSMRPPPCSDYRRQHHECIEANGKQLALLYAALYTIALGGGGIKSNVSG
FGSDQFDSTDPKEEKAMIFFFNRFYFCISIGSLFAVIVLVYIQDNVGRGWGYGISAGTMVI
AVAVLICGTAWYRFKKPRGSPLTVIWRVLLLSWKKRNLPYPSHPSLLNDYHNSRVPHTQ
KFRCLDKASVIEDNISAGGNKNNPWIVSTVMEVEEVKMVLKLIPIWSTCILFWTVYSQM
TTFTIEQATFMDRKLGSLLVPSGSFSAFLIITILLFTSLNERLFVPLARNLTHNPQGLTSLQR
IGIGLVFSVAAMVAAAVIEKERRIIGVQRNSQISAFWLVPQFFLVGAGEAFVYVGQLEFFI
REAPERMKSMSTGLFLSTLSMGFFVSSLLVSIVDR

Manhiot esculenta Medes_52 cassava4.1_029616m.

MENKKQETNNEPAEEALNYAGIKAMPFIIGNETFEKLGTVGSSTNLAAYLTTVLG
MDSVRATMLINIFNGSAALAILAGAFLSDAYFGRYRTMGFACVTSFLGTLVLTLTAAVS
NLHPPKCVAGESNKCVGPTAWHFVLLLSASGFLVIGAGGIRACSLGFGADQFNPNTKSG
KRGITSFFNLYYLNYTFAVMVSQTLIVFVQSDVSWAAGLAIPAFFMFLSCVVFFLGRKIY
VVARPQGSPLTSVAQVLVAAARKRGLKLPKNPAFALFNYFPPKSVNSKLPHTDQFRFLD
KAAIITVDDEINWDGSATNPWRLCSIQQVEEVKCWVRVVPIWASTIISNIPIIKQHTYAIR
QALQLDRSLGTSGFKVPAAAYIIIPMLTVTIWLPIYGRILVPYLRNLTGKGGGLTLLQRM
GIGNFLSILCTLVAGLVEEHRKKLAFTRPTLGTALKGGSISSMSGFWLVPQLVLAGLADS
FNFVAQTEFYFKQFPENTRSIGRFFFFSSVAVTNYLSGFLVSIVHHATSGTKSGDWLAED
LNRGKLDCFYYMIAGMGVLNFIYYLLCAKWYRYRVAEENQMDLKSFIPSDL

Manhiot esculenta Medes_53 cassava4.1_029853m.

MEGLENMAFVSNAISLVTYFYGYMNFSLTKSATSLTNFMGTSFLLALFGGFISDT
FLSRFKTCVLFGCIELLGYAVLTVQAHFHQLRPIPCKGVAPDKMNQCDAANVGTSGVKS
ALPALGADQFDEKDPKEAAHLSSFFNWFLFSLTSGAIVGVTFLVWISTNQGWDWSFAVC
TIAVLFALICLCMGKSLYRINVPQGSPILRIAQVFVAAIRNRDLPIPEMTDDLHDIHDKEA
AGKQDEILERTDQFRFLDRAAIVRTNNGASTSITPGPWSLCTVTQIEETKILLRMLPIILST
VFMNTCLAQLQTFTTQQSTTMDTSFIGFHIPGPSIPVIPLLFMFVLIPIYDRIFVPLARKITGI
PTGVRYLQRIGVGLVLSAISMTVAGFVETHRKSVAVEHNMVDSVEPLPMSVFWLGFQY
AIFGAADLFTLVGLLEFFYAESSAGMKSLSTAISWCSLAIGYFMSSVVVTIVNKVSGGWL
ASNNLNRDKLNYFYWLLAGMSIVNFGIYLVCASWYRYKKVEVKPVENSSEGDAKRKIE
LVGV

Manhiot esculenta Medes_54 cassava4.1_029990m.

MEKVEKGNVSGKVTTHQHSSTRRRKGGLITIPFILANDSFERVASHGLLPNMVFY
LTKEYHMSVTQATTTIFLWNAATNFTPLLGALISDSYLGRFLTIGIGSTFSLLGTILMWLT
AMIPFLRPLQCNQMTQEICENPTTLQMAILVISMGLVSIGAGGIRPCSLAFGADQLVKRS
DSKNKGLLESYFGWYYACTAIAVLLSMTVVVYIQERYGWKVGYAVPAILMFLSVFLFF
VASPLYFKQKERTNLLTGFAQVLVAAYKNRKVPFPPKDAYNKYYHKKNSESSVPTENL
RFLNKACIITNPEQDLASDGSEPNSWSLCTVERVEELKVIIRVIPIWSTGIMISINVSQGSLQ

VFQAISMDRHLTPNFEIPAGTFAMFLIISVIAWIVLYDRVIIPLASKIKGEPVRLDVKLRMG
IGIFFSCMAMVVAGIVENIRRRKAIMEGHLNNPQAVVQMSALWLIPQFCFHGLAEAFNSI
AQSEFFYSEFPKSLSSIAGALSGLGSSVANLLATVILSVVNQSTSKGGKDGWVPDNINKG
RYDKYYGLLAIMSFLNLLYFVFCCWAYGPSKDQSSNFGDDDQEEEE

Manhiot esculenta Medes_55 cassava4.1_031202m.

MEAPSTTDEKNTTQKFKRKKGGLRTMPFIIANETFERVAGVGLLANMIVYLQNE
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GQIEFYYSQFPKTMSSIGVALFSLGMAFGNLIGSLIVTILTRATRNDEKVSWVSDNLNRG
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Manhiot esculenta Medes_56 cassava4.1_032202m.

MACLEMCKESSFKKDLEECTLDGTVDWHGHPAIKNKSGKWIAGIIILLNQGLATL
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IFQVIFVVGLLLLSLSSYLFLIRPKGCGDDLTPCGSHSSKEVGFFYLSTYLIALGNGGYQPII
ATFGADQFDEEDPKEGHSKVAFFSYFYLALNLGSLFSNTILGYFEDEGMWALGFWVSTG
SALAALILFLGGTARYRHFKPTGNRLARFCQVLVAAAKKCKVKMPEEAEDLYDVDGKE
HSVNGNRKILHTHGFKFLDRAAFISSRDMDDERQGSPNPWRLCPMTQVEEVKCILRLLPI
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GMIRNSKPKGLTELQRMGIGLVIAIMAMVSAGIVECYRLKYARRDCIHCEGSSTLSIFWQ
VPQYALIGASEVFMYIGQLEFFNAQTPDGLKSFGSALCMTSISLGNYVSSLLVTMVMKIS
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EKDNFKV

Manhiot esculenta Medes_57 cassava4.1_032282m.

MAEMKDVTGFRYSSLPSSSSPPAARNLGGWKAIRYILGNESFEKLASMSLIINMT
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N

Manhiot esculenta Medes_58 cassava4.1_032456m.

MKKKEAVYTQDGSVDGHGHPAIRDRTGTWFAGILILVNQGLATLAFFGVGVNL
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EEHPEEGHSKIAFFSYFYLALNLGSLFSNTILGYFEDHGMWALGFWASTGSAVLALVLFL
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VFMYVGQLEFFNGQAPDGLKSFGSALCMTSISLGNYVSSLLVTVVMKISATDDMPGWIP
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Manhiot esculenta Medes_59 cassava4.1_032703m.

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Manhiot esculenta Medes_60 cassava4.1_033185m.

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GIGLFFSCMSMVVAGIVENIQQSKAIMEGNINNPQAVLEMSALWLIPQFCLNGLAEAFNS
ISQSEFFHSEFPKNLSSIASALSGLGMAVANLLAIVVLSTVDQITTEGGKDGWVPDNINK
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Manhiot esculenta Medes_61 cassava4.1_034015m.

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AFGADQFDTRTESGRAQLTSFFNWWYFSFTVALVLALTVVVYVQTNISWVVGYAIPAG
CLFFSILVFLIGRHVYIMKKPQGSVFIEIFKVIVAAFKKRSLDLASGHSLYDPPLSGWDQG

EAKLDRTDKFKFYDKAAVIADPSELNEEGKPRNSWRLCSVHQVEQLKLLVGVVPVWFT
GIGCFITMDQMSTFGLMQAIQSNNSVGKFKIPPGWMGLSSMIALSIWIFIYEKIYLPAKRN
SKKDKRLTMRQRINIGIVMAILCMLVAAGVEKKRRELALKNGSLVSPLHLLLLIPQFSLS
GLIEAFSAVAIMEFFTTHLPESMRTIAGAIFFLSSSAASYLNTVLVNIVHHWTSKNGQTPW
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Medicago truncatula Medtr_01 Medtr1g010210

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LYVKVKPSESLLTNFARVVVVATKNRKLSLPDHDSDRYCQGHDSKLKVPTDSLRFLNK
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Medicago truncatula Medtr_02 Medtr1g043810

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FGSLFAFTVIVYIQDNVSWTLGYALQTTGFAISIITFLAGTPFYRHKLLSGSPINRMVKVIV
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PITQVEETKQILSVIPIWVATFIPSAMIAQINTLFVKQGSTLDRAIGNFDIPPSSLIAVTILTM
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NGGQVPLSIFILAPQFVLMGIAEALLEGAKIEFFYDQAPESMKSLGSSYSLTTTGIGSFLST
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Medicago truncatula Medtr_03 Medtr1g090040

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LLQRMGIGLVLHTIIMVVASVTENYRLRVAKEHGLVESGGQVPLSIFILLPQFILMGTAD
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LIE

Medicago truncatula Medtr_04 Medtr1g103280

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TPGESPILRIIQVIVVAFKNRKLQLPESNEQLYEVYKDATIEKIVHTNQMRFLDKAAILQE
NSESQQPWKVCTVTQVEEVKILTRMLPILASTIVMNTCLAQLQTFSVQQGNSMNLKLGS
FTVPASSIPVIPLIFLCTLIPIYELFFVPFIRKITHHPSGVTQLQRVGVGLVLSAISMTIAGFIE
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DDGKEKERHR

Medicago truncatula Medtr_05 Medtr2g005060

MDEGGSINNINIPIPKGESADEGIMNTTVDWRGRPSNPNNHGGTRAAAFVLGLQA
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ALLELSGFILLSAQAHFPELKPPPCSKLGGECIEANGLKALIFYIAIYMVALGSGCVKPNM
ISHGAHQFNQDQQSKKLSTYFNAAYFAFSLGELVALTILIWVQTHSGMDAGFAVSAAA
MAMGFISFISGTLYYRNKPPQPTIFLPIAQVFVAAILKRKKICPSSLQILHGRENRQHSDKL
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GSAMDTHVTKSFHIPPASLQSIPYIFLIVVVPLYDTLFVPFARKITGHESGISPLQRIGIGLF
LATFSMVSAAVMEKKRRDAAVNLNQTLSIFWITPQFIIFGLSEMFTAVGLIEFFYKQSLK
GMQTFFTAITYCSYSFGFYLSSLLVSLVNKITSTSSGGGGWLHDNNLNKDKLDLFYWLL
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Medicago truncatula Medtr_06 Medtr2g021270

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GIGTIAIFLGTVIFAAGLPLYRIQVATGNSVLLEIIQVYVAAIRNRNLHLPEDPKELYEIEQ
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STFWLSFQYFIFGIADIFTYIGLLQFFYSEAPKGLKSTSTCFLWTSMALGYFLSTIVVKCIN
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SSKE

Medicago truncatula Medtr_07 Medtr2g111450

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VSALVESKRLKLVHVHVEMSVLWLFPQLVLVGIGEAFHFPGQVTFYYQQFPQSLKNTST
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ISYKYENV

Medicago truncatula Medtr_08 Medtr2g111460

MDGKVEASSKEADESLSIGSKRGGWISFPFFIGMITGLSLASTGIVGNLIVYLISEF
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ADLKSDGSVKKSSWRLCTVQQVDDFKKIIGILPLWSSSIFLATPIAIQSCLVVLQALVMD
RSLGPHFKIPASSVSVIVLISAPIFLTFLDRVLLPGWHKVTRKMPMPLQRIGAGHVLTVLG
MVVSALVESKRLKLVHVHNVSMSVLWLFPQLVLVGIGEAFHFPGQVTFYYQQFPQSLK
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Medicago truncatula Medtr_09 Medtr2g122610

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Medicago truncatula Medtr_10 Medtr2g122630

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Medicago truncatula Medtr_11 Medtr2g122640

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Medicago truncatula Medtr_12 Medtr2g122680

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Medicago truncatula Medtr_13 Medtr3g012600

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KRTST

Medicago truncatula Medtr_14 Medtr3g092420

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AIAVITFCVGKPLYRYRKPEGNPLLPILQVLVAAIRKRDLCCPSNPALLYELQISDHSQGR
LLSHTSRFRFLDKAAIIEEKYGEQEVNPWRLTTVTRVEETKLVLNIVPIWLTLLASGACA
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Medicago truncatula Medtr_15 Medtr3g097370

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HEKELKASFFNWWMFTSFLGALIATLGLVYIQENLGWGLGYGIPTAGLILSLVIFYIGTPI
YRHKVRTSKSPAKDIIRVFIVAFKSRKLQLPSNPSELHEFQMEHCVIRGKRQVYHTPTLRF
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TLDRNLGPDFKIPAASLGSFVTLSMLLSVPMYDRLFVPFMRQKTGHPRGITLLQRLGIGF
SIQIIAIAIAYAVEVRRMHVIKENHIFGPKDIVPMSIFWLLPQYVLIGIADVFNAIGLLEFFY
DQSPEDMQSLGTTFFTSGIGVGNFLNSFLVTMTDKITGRGDRKSWIADNLNDSHLDYYY
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Medicago truncatula Medtr_16 Medtr3g148710

MGICRSMATQPRIQRRLGGKRAALFVYAMEGLENMAFVANAVSLITYFTGSMN
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RPIPCKDIAPIDMNQCEPANGSQAAILYTGLYLFALGTSGVKAALPALGADQFDDKDPK
EAAQLSSFFNWFLLSLTTGAIFGVTFINWISSNQGWYWSFTVCTIAVFLSILSICMGKSFY
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AAVGGNSTGSWNLCTVTQVEETKILVRMLPIILSTIFMNTCLAQLQTFSIQQSTTLDTNIL
GFKMPGPSLPVIPLLFMFVLIPLYDRVFVPLIRRITGIPTGIRHLQRIGIGLVLSAISMLVAG
FVETRRKSVAIEHNMVDSTEPLPMSVFWLGFQYAIFGAADMFTLIGLLEFFYAESSAGM
KSLSTAISWCSVAFGYFTSSVVVEVVNKVSGGWLASNNLNRDKLNYFYWLLSIISVINF
VFYLVCASWYRYKTVEDKQLGDSNDVDMVKV

Medicago truncatula Medtr_17 Medtr4g012490

MEDVNIKAGVNEEDGLYTEDGTIDIHKNPANKKKTGNWKACRFILGNECCERLA
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DQFDENDETERKKKSSFFNWFYFSINIGALIASSVLVWIQMNVGWGWGFGVPGVAMVI
AIIFFFIGSRWYRLQIPGGSPLTRICQVIVAAFKKLGQQVPDDKSLLYETTDVESNIKGSRK

LEHTNELKCLDKAAVETESDRIKDLPNPWRLCTVTQVEELKSVVRLLPVWASLIAFATV
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HGFTQLQRIGIGLVISIISMIVAGILEVIRLDIVRKNNYYDLETIPMSIFWQVPQYFLIGAAE
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Medicago truncatula Medtr_18 Medtr4g025010

MDGNEQDFTSQVVEEEGINSCTKDGSVDFYGKPALKNSSGRWRSATLLLVNQG
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CIIFQLVFIIGLVALSLSTHLFLLKPHRCEQIGELCESDTQNQFPLFYLSIYLIALGSGVSDP
ALPTLGADQFDEEEPKEQRSKASIYGYFYVALNLGSLVAETILAYIETTGHWVLGFWICT
CCAGVSFLVLLSGTLRYRHYKTFGNPFSKFSQLIVPFLKKMKFQIQSIGEDLYHDGIQGD
DTRVRRIHHANGLRFFDRAGIVSDEATEMLLGKGQKSYKWNFNSLTQSEAVTYILRVLP
IWICTIFSSSVFIQLLSLFVEQGSTMDRTFFKFQIPPSSMTAFDIISTSTFIILLDVLIIPLYIKV
MKRPPKLPSELQSIGIGLCITIITLIVAGFVEQRRLSFASNDGKEMSSLSIFWLIPQYMLLGI
AEAFVYVAQMNFFTSQTPDGLESLGMGLSMFSSALGCYVGNFFLTVVNKITSSGQGQH
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Medicago truncatula Medtr_19 Medtr4g136300

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TVQAHYPNLKPAICNLYDKNAVCEKISGNHEAFLLIGLYLLAFGSAGLKASLPAHGADQ
FDEKDPKETRQMSSFFNGLLLAICVGGSVSLTFNVWIQDNKGWDLGLGISTIAIVFAMIT
FAFGLPLYRIHVAQRTNPIVEILQVYIAAIRNRNLSLPADSGELYEIEQDKEALMEIEYLPH
RDIYRFLDKAAIERKSDVQLEKQENPSPWKLCRVTQVENAKIFLSMIPVFFCTIIMTLCLA
QLQTFSVQQGFTMDTRITKHFNIPPASLPIIPVVFLIFIIPFYDRICVPLLRKFTGIPTGITHLQ
RIGVGLILSCISMAIAAIIEVKRKNVARDNNMLDAVPGVQPLPLSIFWLSFQYFVFGIADM
FTYVGLLEFFYSEAPKGLKSTSTCFLWSSMALGYFLSSIMVQIVNSATKNVTASGGWLA
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Medicago truncatula Medtr_20 Medtr4g136330

MEEELVDGKVDWRGRRAVRHKHGGMKVSLLVLGAFAFESMATLALAVNFVSY
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GLPLYRIHAAQRTNCIIEILQVYIAAIRNRNLPHPADSEELYEIEHDKEAAVEIEYLPHRDIF
RFLDKAAIERKSDDLQSEKQEIPNPWKLCRVTQVENAKIILSMIPIFCCTIIMTLCLAQLQT
FSVQQGFTMDTRITKHFNIPPPSLPIIPIGFLVIIIPVYDRICVPVLRKFTGIPTGVTHLQRIGV
GLILSCISMAIAAIIEVKRKNVARDNNMLDAVPGVQPLPLSIFWLSFQYFVFGIADMFTY
VGLLEFFYSEAPKGLKSTSTCFLWSSMALGYFLSSIMVQIVNNATKNVTASGGWLAGNN
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Medicago truncatula Medtr_21 Medtr5g012400

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VALLMISTIIPSLSPPTCKEHTTCVKANNTQLTVLFLALYVTALGTGGLKSSVPGFGSDQF
DATDKEEKKHMVKFLNWYYFIVNLGSLMAVTVLVYIQDHQGRDWGYGICACSIVLAL
VVFLFGTCKYRYKKPVGSPLTQIAVVFVAAWRKRHLQLPSDSALLFNDDAILHEPPRIK
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Medicago truncatula Medtr_22 Medtr5g012420

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FLSGTRKYRIKQLVGSPLTQIAVVFVAAWRKRHMQLPSDSSLLYEEDDILCETPKTKKQ
RMPHSKQFRFLDKAAIKGIESGGTITIKEKWYISTLTDVEEVKMVIRMLPIWATTIMFWTI
HAQMTTFSVSQATTMDCQIGTFQIPAASMTVFLIGTILLTVPFYDRFIRPVAKKVLNNSH
GFTPLQRIGVGLVLSVISMVAAALIEMKRLKFARSHGFVDDPTAKMPLSVFWLVPQFFF
VGSGEAFMYMGQLDFFLRECPKGMKTMSTGLFLSTLSIGFFFSSLLVTLVNNVTGPNKP
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HA

Medicago truncatula Medtr_23 Medtr5g014360

MSCLELEVSKENKFKEETDFESESEELTLDGSVDFNGRPAIRAKSGRWSAGTIILL
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ALGFWLSAGCAFIALILFLVGTPKYRHFKPSGNPLARFCQVLVAASRKVKVEMPSNGDD
LYNMDTKESSTDVNRKILHTHGFKFLDRAAIISSRDHDNQKGTCSNPWRLCPVSQVEEV
KCILRLLPIWLCTIIYSVVFTQMASLFVEQGDAMKTTVYNFRVPPASMSCFDIISVAVFIFF
YRRILDPFVGKLKKSDSKGLTELQRMGVGLVIAVIAMVSAGIVESYRLKHADQDCRHC
KGSSTLSIFWQIPQYALIGASEVFMYVGQLEFFNAQTPDGLKSFGSALCMTSISLGNYVSS
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Medicago truncatula Medtr_24 Medtr5g039070

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VDQFDPTTEEGKKGINSFFNWYYTSFTVVLLFTQTVIVYIQDSVSWKFGFAIPTLCMLFSI
ILFFIGTKIYVHVKPEGSIFSSIAQVLVASFKKRKVKLPNEKHVDGIFYDPPLIGKAILSKLP
PTNQFRVLDKAALVMEGDLNPDGTIVNQWNLVSIQQVEEVKCLARTLPIWAAGILGFTA
MAQQGTFIVSQAMKMDRHLGPKFQIPAGSLGVISLIVIGLWVPFYDRICVPSLRKITKNE
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CEAFNIIGLIEFFNRQFPDHMRSIANALFSCSFALANYVSSILVITVHSVTKTHNHPDWLT
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HPKKYEDSK

Medicago truncatula Medtr_25 Medtr5g039200

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AGAKVYAYVEPEGSIFSRIAQVFVAAKCKRHVHIPDKGDTSGVFYDPPIENMEPKFPLTK
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SIFPMSQAMKMDKHLTQNFEIPPGWMIIVTMLTIAIVIPFYDKVISPTLTKMTNQDGGLT
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Medicago truncatula Medtr_26 Medtr5g039420

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GEQFDEATPNGRKQRSTFFNYFVFCLSCGALIAVTFVVWVEDNKGWEWGFAISTITIFVS
IPVFLAGSTTYRNKVPSGSPLTTILKVLIAATLNSCCTNKNSCSAVVNMSSSPSNPSTQAK
EQELHQTLKPTTPSQIPSESLKFLNKAITNKPIHSSLQCTIQQLEDVKLVFKIFPIFACTIML
NACLAQLSTFSVEQAATMNTTLFSSFKVPPASLPVFPVLFLMILAPIYDHIIPYARKVTKS
EAGITHLQRIGIGLILSIVAMAIAAIVEIKRQKIASHSNEKNPLPISFLWIGFQYLFLGSADL
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Medicago truncatula Medtr_27 Medtr5g068370

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QLRPPPCKGEEVCQEASSRQLAILYVSLLLSALGSGGIRPCVVAFGADQFDESDPNQKTR
TWTYFNWYYFVMGTAILVAVTVLVYIQDNVGWGWGLGIPTLAMFISIIAFIGGYPLYRN
LNPEGSPFTRLVKVGVAAFRKRKIPKVPNSTLLYQNDELDASITLGGKLLHSDQLKFLDK
AAIVTEEDNTKTPDLWRLSTVHRVEELKSIIRMGPIWASGILLITAYAQQGTFSLQQAKT
MNRHLTKSFEIPAGSMSVFTILTMLFTTALYDRVLIRVARRFTGLDRGITFLHRMGIGFVI
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FYDQAPESMTSTAMAFFWTSISLGNYISTLLVTLVHKFTKGPNGTNWLPDNNLNKGKLE
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Medicago truncatula Medtr_28 / MtNRT1-3 Medtr5g093170

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GFGSDQFDTNDPKEEKNMIFFFNRFYFFISIGSLFSVVVLVYVQDNIGRGWGYGISAGTM
LVAVGILLCGTPLYRFKKPQGSPLTIIWRVLFLAWKKRTLPIPSDPTLLNGYLEAKVTYT
DKFRSLDKAAILDETKSKDGNNENPWLVSTMTQVEEVKMVIKLLPIWSTCILFWTVYSQ
MNTFTIEQATFMNRKVGSLEIPAGSLSAFLFITILLFTSLNEKITVPLARKVTHNAQGLTSL
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EFFIREAPERMKSMSTGLFLCTLSMGYFVSSLLVSIVDKVSKKRWLKSNLDKGKLDYFY
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Medicago truncatula Medtr_29 Medtr6g009300

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KVMIKLLPIWTMLLMFAVIFQQPATFFTKQGMTMKRNIGSNFKIPPATLQSAITLSIILLM
PLYNRIFIPFAQLITRQEKGINVMQRMGIGMVLSIIAMIIAALVEMKRLAIGRQMRSEGLL
SEIVPISIFWLLPQYILLGISDIFTVVGMQEFFYGEVPKNMRTMGIALYTSVFGVGSFVSAL
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S

Medicago truncatula Medtr_30 Medtr7g005620

MVFMYVCMCMQMEPAGPPNNVNPDNIEVVEATEGNHVNGEVADGKSKGGWT
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EDQLYEVDGNVSAIKGSRKILHSQDIRFMDKAATRTVKDGNESGNQWRLCTVTQVEEA
KCVLRMIPVWLCTIIYSVVFTQMASLFVEQGDVMNNKVGKFHLPAATMSVFDICSVLV
CTGLYRQVLVPLAGKLSGNPKGLSELQRMGVGLVIGMLAMVAAGVTEFERLKQVQPG
QKQSNLSIFCQIPQYVLVGASEVFMYVGQLEFFNGQAPDGIKSFGSSLCMASISLGNYVS
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Medicago truncatula Medtr_31 Medtr7g006070

MDTCEIKSPEAPQQGTPCTSMSRKKLGIFFIESEDRRMALGRGYTRGSTPVNIHGK

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SVTIGAIIAFTAVVYVQMKLGWGSAFGSLAIAMGVSNMLFFIGTPLYRHRLPGGSPLTRV
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GPNPSQWNLCTVTQVEEVKILIKLIPIPACTIMLNVILTEFLTLSVQQAYTLNTHLGKLKL
PVTCMPVFPGLSVFLILALYYQTFVPLFKRITGHPHGASQLQRIGIGLGVSILSVAWAAIF
EKYRRNYAIKNEFEASFLTPMPNLSAYWLLIQYCLIGVAEVFCIVGLLEFLYEEAPDAMK
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Medicago truncatula Medtr_32 Medtr7g010100

MVNKELEVCTLDGSIDSHGHPAVRERTGTWFAGILILVNQGLATLAFFGVGVNL
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Medicago truncatula Medtr_33 Medtr7g012490

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WLLLIKPLGCGNEHTVCNEPTPLGTGLFYLSIYMVAFGYGGHQPTLATFGADQFDDDDK
NIQNTYLREAFFSYFYFALNVGSLFSNTILVYYEDSGMWTLGFGVSLASAIIALISFLAGS
RRYRYVKACGNPVIRVIQVFIAAARKWNVEPAKEDQLYEVDGHESAIKGSRKILHSQDI
RFMDKAATWTLKDGNESGNQWRLCTVTQVEEAKCVLRMIPVWLCTIIYSVVFTQMASL
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Medicago truncatula Medtr_34 Medtr7g046220

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SSYFNWYFFSICTGGLLATCVMVPIEQKYGWSTSFLILLFVTSLALCTFASGFALYTYKRP
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Medicago truncatula Medtr_35 Medtr7g070560

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QCTYIKLKPKGSVLCDLVKVVVASIRKHHIDIKKDSELSFYDPQLASNESEDSRNVKLSH
TNRFRYFDKAAVITNQNEIDSNGNSIDNWRLCSLQQVEELKAILSTLPIWLAGIGCFISMG
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Medicago truncatula Medtr_36 Medtr7g070570

MHESHSPQRQDALTLEGFSSSTRKKKGGWKSVKYILGNETFEKLASMSLISNLVV
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M

Medicago truncatula Medtr_37 Medtr7g070830

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LMGLILLTLSWFLPSLKPCDHTTTCNEPRKIHEVVFFLAIYLISIATGGHKPSLESFGADQF
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IIGRPFYRYRVPSGSPLTPMLQVLVAAFSKRKLPYPSNPDQLYEVSKSHGNKRKFLCHTK
KLRFLDKAAIIENDGNSIEKQSPWKLTTVTTVEEMKLIINMIPIWVFTIPFGISVAQTSTFFI
KQSAIMNRKIGERFELPPASIFTVAALGMIISVAIYDKILVPMLRKINQNERGINILQRIGFG
MFFTIITMIVAALIEKKRLEAVEKDPLSIFWLAPQFLIIGFGDGFTLVGLQEYFYDQVPDS
MRSLGIAFYLSVIGAANFISSVLITIVDHITKKNGKSWFGKDLNSSRLDKFYWLLAAITTV
NLFLFVFFARRYSYKNVQKVAVIDDSCKGKNDYGSVDNSEDRCPEVRRIREFNISLLVK
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Medicago truncatula Medtr_38 Medtr7g105690

MEIEKGIKNNMEMVEKEVETDSKKMNHPRRGGIRTLPFILANEVCDRFAGAGFH
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SITVSTILPHFRPPPCPTQVNCKEATSSQLLPLYMSLLLTSLGSGGIRPCVVPFSADQFDMT
KEGVASRKWNLFNWYFFIMGFASLSALTIVVYVQDNVGWGWGLGIPTIAMMISVISFVL
GSPLYKTVKPEGSPLVRLAQVVVAAVKKRKETLPDDPKFLYHNRELDAAISLEGSLLHS
NQYKWLDKAAIITEEEAKDSNAPPNLWNLVTVHRVEELKAIIRMLPIWASGILLIMSSSH
LGSFVIQQARSMDRHLTHSFQIAPANMSIFGVLTMMIGVMLYERFFVPFARRFTKNPAGI
TCLQRMGVGFVVNIIATIVSALVETKRKTVAAKFNLLDDPKAIIPFSVFWLVPQYCLHGV
AEVFMSVGHLEFLFDQSPESMRSSATALYCITTAIGNYSGTLLVSIVHKYTGKENNWLPD
RNLNRGRLDYYYYLISGIQVINLIYYIVCAWFYTYKPMGEVCERSKEEDLEQASANISIE
NLKDGKEEEKKGFTKDE

Medicago truncatula Medtr_39 Medtr7g105740

MEEEKGIRGNGKMVEKESKRQQRGGIRTLPFILANEVCDRFASAGFHANMITYL
TQQLNMPLVSASNTLSNFSGLSSLTPLLGAFIADSFAGRFWTIVFATLIYELGLITITTSAIV
PHFRPPPCPTQVNCQEAKSSQLWILYLALFLTSLGSGGIRSCVVPFSGDQFDMTKKGVES
RKWNLFNWYFFCMGFASLSALTIVVYIQDHMGWGWGLGIPTIAMFIAIIAFLLGSRLYK
TLKPSGSPFLRLAQVIVAAFRKRNDALPNDPLYQNLELDSSISLEGRLSHTDQYKWLDK
AAIVTDEEAKNLNKLPNLWNLATVHRVEELKCLVRMLPIWASGILLITASSSQHSFVIVQ
ARTMDRHLSHTFEISPASMAIFSVLTMMTGVILYERLFVPFIRRFTKNPAGITCLQRMGIG
FVINIIATIVSALVEIKRKKVASKYHLLDSPKAIIPISVFWLVPQYFLHGVAEVFMNVGHL
EFLYDQSPESMRSSATALYCIAIAIGHFIGTLLVTLVHKYTGKERNWLPDRNLNRGRLEY
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EFAKDE

Medicago truncatula Medtr_40 Medtr7g116510

MMEMVEEKGSANGKEDYTQDGTVDLKGRPILRSKTGRWKACSFIVVYEVFERM
AFYGIASNLVVYLTSKLHEGTVESSNNISNLGGAVWMMPLAGAYIADAYLGRYLTFVIA
SCIYFMGMCLLTLSVSLPSLRPPECAPGIADHNCPKASTLQKGIFFLALYIIAVGTGGTKP
NISTMGADQFDEFEPKERSYKLSFFNWWFFSIFLGTLFSNTFLIYIQDNVGWAVGYGLPTI
GLGISIFVFMVGTPLYRHKLPSGSPLTRMLQVYVATFRKWKSCVPEDPKELHELSMEDY
ACKGRNRIDRSTSLSFLDKAAIKTGQTSPWMLCTVTQVEETKQMTKMIPILITTIMPSTL
MIQSTTLFIKQGITLDKRMGPHFDIPPACLTAFVTIFMLISIVVYDRVFVPVIRRYTKNPRG
ITMLQRLGIGLVLHVIIMVTACLAERKRLSVARENGLFGQHDTLPLTIFILLPQFALTGVA
DNFVDIAKMEIFYDQAPEGMKSLGTAYFTTSLGLGSFLSTVLLSAVANITQRHGHKGWI
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KIRQSTPQPDAKSWENKAVVPSASP

Medicago truncatula Medtr_41 Medtr7g116560

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ASCIYLLGMCLLTLAVSVTSLRPPECAQGVADQNCPRASPLQRGIFFLALYIIAVGTGGT
KPNISTMGADQFDEFEPKERTYKLSFFNWWYFSIFLGTLFSNTFVIYIQDRVGWAVGYGL
PTAGLAVSVLVFLVGTPLYRHKLPSGSPITRMLQVFVAAMRKWMTRVPEDPKELHELSI
EKYACNVRNRIDRSSSLSFLDKAATKTGQTSPWMLCTVTQVEETKQMTKMIPILITTLLI
TTLIPSTLIVQSTTLFIKQGTTLDRRMGPHFDIPPACLTTFKTIFMLISIVVYDLAFVPIIRRY
TKNPRGITLLQRLGIGLVLNIAIMVTACLAERKRLRVARENNLFGRHDTIPLTIFILLPQFA
LGGIANTFVEIAKLEFFYDQAPEGMKSLGTSYFTTSLGLGSFLSTFLLSVVANITQRHGHK
GWVLDNLNISRLDNYYMFMAVLSLLNFLCFLVVAKVFVYNVDVRQDKSSLEMNPASS
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Medicago truncatula Medtr_42 Medtr7g116570

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ASCIYLLGMCLLTLAVSVTSLRPPECAQGVADQNCPRASPLQRGIFFLALYIIAVGTGGT
KPNISTMGADQFDEFEPKESTYKLSFFNWWYFSIFLGTLFSNTFVIYIQDRVGWAVGYGL
PTIGLAVSVLVFLVGTPLYRHKLPSGSPMTRMLQVFVAAMRKWMTRVPENPRELHELSI
EKYACNGRNRIDRSSSLSFLDKAATKTGQTSQWMLCTVTQVEETKQMTKMIPILITTLIP
STLIVQSTTLFIKQGTTLDRRMGPHFDIPPACLTAFTTIFMLISIIVYDLAFVPMIRRYTKNP
RGITLLQRLGIGLVLHIAIMRKQPLWPT

Medicago truncatula Medtr_43 Medtr7g116580

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TKPNISTMGADQFDEFEPKERTYKLSFFNWWFFSIFLGTLFSNTFVIYIQDRVGWTVGYG
LPTAGLAVSVLVFLVGTPLYRHKLPSGSPITRMLQVFVAAMRKGMTRVPEDPKELHELR
IEEYASNGRNRIDRSSSLSFLDKAATKTGQTSPWMLCTVTQVEETKQMTKMIPILITTLIP
STLLVQSTTLFVKQGTTLDRRMGPHFDIPPACLTAFTTIFMLISIVVYDLAFVPMIRRYTK
NPRGITLFQRLGIGLVLHIAIMVTACLAERKRLRVARENNLFGRHDTIPLTIFILLPQFALA
GIADNFVEIAKLEFFYDQAPEGMKSLGTSYFTTSLGLGSFLSTFLLSIVAKITQRHGHKG
WVLDNLNISRLDYYYMFMAVLSLLNFLCFLVVAKLFVYNVDVRQNKSSLEMNPATSQ
NSARISKNTPQQDANS

Medicago truncatula Medtr_44 Medtr7g116640

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DEFEPKEKSQKLSFYNWWVFYIIIGAILAETVLVYIQDNVGFALGYGIPTILLVFSTLVFLF
GTPIYRHKLPSGSPLTRMVQVFVAAMRKWKLNVPNDQKELHEVSIEEYTSNGSFLDKA
AVKTDQTSPWMLCTVTQIEETKQMTKMIPILIATCIPSIIFAQTNTLFVKQGTTLDRRLGA
HFKVPPASLIAFVHIFLAISTVIYDRVFVPIIRRYTKNPRGITMLQRIGIGLVFHVIVMVVSC
LIERKRLNVAREHNLLGKLDTTPLSIFILVPQFALMGIADTFVEIAKIEFFYDQAPESMKSL

GSSYATTSLSMGNFLSTFLLSNVARLTSKHGHKGWILDNLNISHLDYYYAFLALLSVVN
FFFFLIIAKFFVYNDDVTQTKMDLEMNPASSKGYKTEISQSISQLDVKS

Medicago truncatula Medtr_45 Medtr7g116670

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SCIYLLGMCLLTLAVSLPSLSPPPCTEGIVGENCLKATPLQKGVFFLALYTISLGNGGTKA
NISTLGADQFDEFDTKERFYKLSFFNWWFSSILIGMLFSSTILVYIQDNVGWGLGYGLPTI
GLAVSIITFFVGTPFYRHRFPSGSPITRMLQVFVAAMRKWKTHVPNDPKLLHELSIEEYA
CNARNKIEHTSFLRILDKAAVTTGQTSSWMLCTVTQVEETKQMIKLIPILIITIIPSTMVMQ
SFTLFIKQGTTLDRRMGPHFAIPAASLLAVIVIFMLISIVVYDRAFVPVIRSYTKNPRGITIL
QRLGVGLTLHVIVMLIASLVERKRLNVARENNLLGLHDTLPLTIFALFPQFALAGVADSF
VEIAKMEFFYDQAPEGMKSLGASLSTTSLGLGGFVSAFILSTVADITQRHGHKGWILNNL
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GEI

Medicago truncatula Medtr_46 Medtr7g116680

MTMLGENGKEDYTEDGTVDLKGRPVLRSNTGRWRACSFIVGYEMIERMAYYGI
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LGMCLLTLTVSLPMLRPPACAQGIADKDCQKASSLQIGIFFFALYIIAAGTGGTKPNISTIG
ADQFDEFEPKERSQKLSFYNWWVFYILIGTISAQTILVYIQDNVGFALGYGIPTILLVVSIL
VFVLGTPLYRHRLPSGSPLTRMVQVFVAAMRKWKLNVPIDSKELHEVSIEEYTSKGRYR
INHSSSLRFLDKAAVKTGQTSPWMLCTVTQIEETKQMTKMLPVLITTCIPSTIISQTTTLFI
RQGTTLDRGMGAHFEIPPACLIAFVNIFMLISVVIYDRVFVPVIRRYTKNPRGITMLQRLG
IGLVMHVIVMIVACLIERKRLSVARENNLLGPLDTIPLTIFILVPQFALMGIADTFVDIAKL
EFFYDQAPESMKSLGTSYATTTLSIGNFLSTFLLSIVADLTSKNGHKGWILNNLNVSRIDY
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Medicago truncatula Medtr_47 Medtr7g134690

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GDSPTIRIAQVIVVAFKNRKLSLPESHEELYEISDKDGTVEKIVHTKQMRFLDKAAIPQEY
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PASSIPVIPLIFISILVPIYELFFVPFARKITNHPSGITQLQRVGVGLVLSVISMTVAGIVEVK
RRDQSRKNPSNPISLFWLSFQYGIFGIADMFTLVGLLEFFYRESPSSMKSLSTSFTWLSMSI
GYFLSTVFVNLINVVTKRITPSKQGWLHGFDLNQSNLNLFYWFLAILSCLNFFNYLYWA
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Medicago truncatula Medtr_48 Medtr8g103070

VNTSTHSVSSLNLLVFGFHPNQQQSSSASSFFSLFFFLFVFETLSSPMACLEVCKEG

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KYRHFKPCGNPLSRFCQVFFAASRKLGVQMTSNGDDLYVIDEKESSNNSNRKILHTHGF
KFLDRAAYITSRDLEVQKGGQHNPWYLCPITQVEEVKCILRLLPIWLCTIIYSVVFTQMA
SLFVEQGAAMKTTISSFKIPPASMSSFDILSVAIFIFFYRRVLDPLVGKLKKSSSKGLTELQ
RMGIGLVIAIIAMVTAGIVECYRLKYAKQGDTSSLSIFWQIPQYALIGASEVFMYVGQLE
FFNAQTPDGLKSFGSALCMTSISLGNYVSSLIVSIVMKISTEDHMPGWIPGNLNRGHLDR
FFFLLAVLTSLDLIAYIACAKWFQNIQMACKYDNNDEPSSCKV

Medicago truncatula Medtr_49 Medtr8g106170

MSTLPQTQGQTIQDAWDCKGHPAERSKTGGWTSSAMILGVEACERLTTMGIAV
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TILTISTIIPSLHPPKCTKSNLKSCEPANNIQLTVLYIALYVTALGIGGLKSSVSGFGSDQFD
ETNEVEKNHMVKFFNWFFFFISIGSLTAVTILVYIQDHVGRDWGYGMCVCAIVVALCVF
LYGTKRYRFKKLAGSPLTQIAVVYVAAWRKRNMELPYDSSLLFNVDDIEDEMLRKKKQ
VLPHSKQFRFLDKAAIKDPKTDGNEINVVRKWYLSTLTDVEEVKLVLRMLPIWATTIMF
WTVYAQMTTFSVSQATTLNRHIGKSFQIPPASLTAFFIGSILLTIPIYDRVIVPITRKIFKNP
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VGSGEAFTYIGQLDFFLRECPKGMKTMSTGLFLSTLSLGFFFSSLLVTLVHKVTSQHKPW
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Medicago truncatula Medtr_50 Medtr8g113040

MNKIETSMEKSEKESVENNEVPNNYRGWKVMPFIIGNETFEKLGAIGTLANLLVY
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SGKKGINSFFNWYFFTFTFAQMVSLSVIVYIQVNVSWALGLGIPAGLMLFSCIVYFTGSK
YYVKVKATGSPVTNIVQVIYVAIKKRKHNLPEDEYSLVSLFSYISPHSINSKLLHTPQFRF
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MGVGMFIAILCMLVSGVVEWKRRTMAINNPIGFEPRNGAISSMSGMWLIPQLALAGFSD
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LNEGRLDYFYYMITGLEVVNLGYFVLCSRWYRYKGNEDDTDQGSGVELDKVSKQSET
KISGV

Medicago truncatula Medtr_51 Medtr8g113050

MEENVVNTNSSPSTLDLEHEAIPSNEASSREAGGWRSVKYIIGNESFEKLASMSLI
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QFDTNTAKGRGQLESFFNWWYFTFTIALVIVLTGVVYIQTNVSWTLGFAIPTVCLAFSIII
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LDRVGTR

Medicago truncatula Medtr_53 Medtr8g119910

MEKKMSWTVGDAVDYKGFPADRSKTGGWVPAALILGIEIVERLSTMGIAVNLV
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DEKEKSQMTFFFNRFFFFISLGTLAAVTILVYIQDEISRSWAYGICSISMVIAILIFLSGTTR
YRYKKSLGSPIVHIFQVIVASIKKRKMELPYNVGSLYEDTPEDSRIEQSEQFRFLEKAAIV
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LSTIGMAAASLIEVKRLSVAKGVKGNQTTLPISVFLLVPQFFLVGSGEAFIYTGQLDFFIT
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Mimulus guttatus Mimgu_01 mgv11b021031m.g

MAVDEISEAETPLIDDDIIRGSVDFSGLPARRSKSGCWKSATFIIGVEVAERFAYY
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IIFLMGSTTYRFRMSTDQRNPFVRIGRVFVSAATNWKETKYKFLDKDENVLRDVADAK
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Mimulus guttatus Mimgu_02 mgv11b021679m.g

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SIVVFVLGSRYYYRHKPVSVSPLVRMARVVVAAVRKWRVVVPVDPKELHELSLEEYSRC
GGFRVDHSSSIRILDKAAVKSGADSLWTLCTITQVEQTKQMIKMIPILASTFIPSTMIAQT
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Mimulus guttatus Mimgu_03 mgv1a002735m.g

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SANAVNNFLGISQASSVLGGFLADAYLGRYWTIAIFSTIYLVGLTGITLCGTLTILMPNQD
KCDQIALLLGNCEPAKPWQMLYLYTVLYITGFGAAGIRPCVSSFGADQFDERSKDYKDH
LDRFFNFFYLSVTVGAIVAFTAVVYIQIKHGWGSAFGSLAIAMGMSNFVFFLGTPLYRHR
LPGGSPLTRVAQVLVAAFRKRNASFESSEIVGLYELQGKRSAIQGSAKISHTEDFRCLDK
AALKLKEDSLDPSPWRLCTVTQVEEIKILIKLLPIPACTIMLNLILTEYLTLSVQQAYTLNT
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Mimulus guttatus Mimgu_04 mgv1a003103m.g

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FYRLQAPKGDSPLSRIAQVIVVAVKNSRLPHPESCSELYEINEKDSDSTGPKIVHTEQFRW
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Mimulus guttatus Mimgu_05 mgv1a003140m.g

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KRLAEEGIDLEEEELACH

Mimulus guttatus Mimgu_06 mgv1a003150m.g

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LTMAVSIKFLKPTCENGVCNKASTTQIAFFYTSLYTIAMGAGGTKPNISTFGADQFDDFN
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Mimulus guttatus Mimgu_30 mgv1a004515m.g

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Mimulus guttatus Mimgu_31 mgv1a004750m.g

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Mimulus guttatus Mimgu_32 mgv1a004892m.g

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Mimulus guttatus Mimgu_35 mgv1a017651m.g

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Mimulus guttatus Mimgu_36 mgv1a019257m.g

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Mimulus guttatus Mimgu_37 mgv1a020538m.g

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Mimulus guttatus Mimgu_38 mgv1a020560m.g

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Mimulus guttatus Mimgu_42 mgv1a020985m.g

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Mimulus guttatus Mimgu_43 mgv1a021345m.g

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Mimulus guttatus Mimgu_44 mgv1a021530m.g

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Mimulus guttatus Mimgu_45 mgv1a022341m.g

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Mimulus guttatus Mimgu_46 mgv1a022560m.g

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Mimulus guttatus Mimgu_47 mgv1a023842m.g

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Mimulus guttatus Mimgu_48 mgv1a024850m.g

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Mimulus guttatus Mimgu_49 mgv1a025040m.g

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Mimulus guttatus Mimgu_50 mgv1a025093m.g

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Mimulus guttatus Mimgu_51 mgv1a025520m.g

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Mimulus guttatus Mimgu_52 mgv1a026356m.g

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Nematostella vectensis Nemve_01 XP_001625276

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Oryza sativa Orysa_01 LOC_Os01g01360

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Oryza sativa Orysa_02 / OsPTR7 LOC_Os01g04950

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Oryza sativa Orysa_03 LOC_Os01g37590

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DEKC

Oryza sativa Orysa_04 LOC_Os01g54515

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Oryza sativa Orysa_05 LOC_Os01g65200

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Oryza sativa Orysa_06 LOC_Os01g65210

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Oryza sativa Orysa_07 LOC_Os01g67630

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Oryza sativa Orysa_08 LOC_Os01g68510

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Oryza sativa Orysa_09 LOC_Os02g46460

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Oryza sativa Orysa_10 LOC_Os02g47090

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Oryza sativa Orysa_11 LOC_Os02g48570

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VHV

Oryza sativa Orysa_12 LOC_Os03g01290

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Oryza sativa Orysa_13 LOC_Os03g04570

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Oryza sativa Orysa_14 LOC_Os03g13240

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Oryza sativa Orysa_15 LOC_Os03g13250

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Oryza sativa Orysa_16 / OsNRT1 LOC_Os03g13274

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Oryza sativa Orysa_17 LOC_Os03g48180

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Oryza sativa Orysa_18 / OsPTR8 LOC_Os03g51050

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Oryza sativa Orysa_19 LOC_Os03g60850

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Oryza sativa Orysa_20 LOC_Os04g36040

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Oryza sativa Orysa_21 LOC_Os04g39030

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LARRLMITRRPQGLTSLQRVGAGLVLATLAMAVSALVEKKRRDASGGAGGGGVAMIS
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Oryza sativa Orysa_22 LOC_Os04g41400

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Oryza sativa Orysa_23 LOC_Os04g41410

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STVRSDGDNFGA

Oryza sativa Orysa_24 LOC_Os04g41450

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Oryza sativa Orysa_25 LOC_Os04g50930

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Oryza sativa Orysa_26 / OsPTR5 LOC_Os04g50940

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Oryza sativa Orysa_27 / OsPTR6 LOC_Os04g50950

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Oryza sativa Orysa_28 LOC_Os04g56560

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Oryza sativa Orysa_29 LOC_Os05g27304

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YQNFGK

Oryza sativa Orysa_30 LOC_Os05g33960

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Oryza sativa Orysa_31 LOC_Os05g34010

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Oryza sativa Orysa_32 LOC_Os05g34030

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Oryza sativa Orysa_33 LOC_Os05g35650

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Oryza sativa Orysa_34 LOC_Os06g13210

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Oryza sativa Orysa_35 LOC_Os06g15370

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Oryza sativa Orysa_36 LOC_Os06g21900

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YIV

Oryza sativa Orysa_37 LOC_Os06g38294

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GVIKG

Oryza sativa Orysa_38 LOC_Os06g49210

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Oryza sativa Orysa_39 LOC_Os06g49220

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Oryza sativa Orysa_40 LOC_Os06g49240

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Oryza sativa Orysa_41 LOC_Os06g49250

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Oryza sativa Orysa_42 / OsPTR1 LOC_Os07g01070

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ADPREHRSKASFFNWFYMSINVGALVASSVLVWVQMNVGWGWGFGIPAVAMAVAVA
SFLMGSSLYRHQKPGGSPLTRMLQVVVAAARKSRVALPADAAALLYEGDKLACGTRR
LAHTEQFRWLDRAAVVTPTTDKDDDTGSRWRLCPVTQVEELKAVVRLLPVWASGIVM
SAVYGQMSTMFVLQGNTLDPRMGATFKIPSASLSIFDTLAVLAWVPVYDRLIVPAARRF
TGHPRGFTQLQRMGIGLLISVFSMVAAGVLEVVRLRVAAAHGMLDSTSYLPISIFWQVQ
YFIIGAAEVFAFIGQIDFFYDQAPDDMRSTCTALSLTSSALGNYLSTLLVVIVTAASTRGG
GLGWIPDNLNRGHLDYFFWLLAALSAVNFLVYLWIANWYRCKTITTTEAAAQT

Oryza sativa Orysa_43 / OsPTR4 LOC_Os07g41250

MDEAAAGQRASPLLAKNDGSSYGEESQSLLEEQEPQVKTKQSGWRAPSIILGLEC
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LISFIMYLLGTVFITVGAFLPSAPALCNTESCSSMNGTQHLVYFSGLYLTAIGCGGVRSAL
LPLGADQFNNDSSLDIQKRRNFFSLFYICVIFGVITSGTIVVWIQENVSWAIGYGVATACI
ALALIGFLVGTPIFRRHEPHGSPVRSVFQVIVASFRNLALELPADSSLLYEVRRKNTQKSE
PKLAHTDDFRFLDKAAIMSDLSLDQDSCTSPWRICTVTQVEELKILIRLLPIWATGIFFCV
GISQMHTTFIQQGTVMNTKIGSLSIPAASLYSFEVICVTFWVFLVNKVIIPVTRACFANGA
EMTQLQRIGIGRFLMIFAMAIAAFLEMKRLESVQGGDQPLSIAWQLPQYFVIAGAECFTII
TQLEFFHGQAPDSMKSMLTAFALLTTALGNYFSSAIITLIARVTGTWHSPGWIPDDLNKG
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Oryza sativa Orysa_44 LOC_Os08g05910

MVGMLPETNAQAAAEEVLGDAWDYRGRPAARSRTGRWGAAAMILVAELNERL
TTLGIAVNLVTYLTATMHAGNAEAANVVTNFMGTSFMLCLLGGFVADSFLGRYLTIAIF
TAVQASGVTILTISTAAPGLRPAACAAGSAACERATGAQMGVLYLALYLTALGTGGLKS
SVSGFGSDQFDESDSGEKSQMMRFFNWFFFISLGSLLAVTVLVYVQDNLGRPWGYGA
CAAAIAAGLVVFLAGTRRYRFKKLVGSPLTQIAAVVVAAWRKRRLELPSDPAMLYDID
VGKLAAAEVELAASSKKSKLKQRLPHTKQFRFLDHAAINDAPDGEQSKWTLATLTDVE
EVKTVARMLPIWATTIMFWTVYAQMTTFSVSQATTMDRHIGASFQIPAGSLTVFFVGSIL
LTVPIYDRLVVPVARRATGNPHGLTPLQRIGVGLVLSIVAMVCAALTEVRRLRVARDAR
VGGGEAVPMTVFWLIPQFLFVGAGEAFTYIGQLDFFLRECPKGMKTMSTGLFLSTLSLG
FFVSSALVAAVHKLTGDRHPWLADDLNKGQLHKFYWLLAGVCLANLLVYLVAARWY
KYKAGRAAAAGDGGVEMADAEPCLH

Oryza sativa Orysa_45 LOC_Os10g02080

MNRHEEFTEWHVGTECLGQLAFFGVQYSLVTFLTTQLRQGNAEAARNFSMWQG
TCYIAPLAGAIVADSCLGRYRTILAFFSIYIIGMGTMALSGASPAVISRSTQPAVFSLGLYL
MAIGAGCIKSCVGPFGADQFDGGDAMERPKKSSYFNWFYFAMYVGALVSGSAVVWLQ
DNFGWLLGFGVPALCTVLAMASFLLGSAMYRYHQPRGSQVVRACQVVVAAVRKRNV
VLPHDGFVLYDGPAEEGRRMAHTDQFSFLDKAAVAVAVPSSAAAQPWRLCTVTQVEE
LKAIVRMLPVWATGIVYCMVLVQQPLFPVQGRAMRRRLGVAFAVPAASLNSVYAAAM
LVLVPLYDAAVVPAARRLTGSERGLTELQRIGAGMALSVAAMAAAATVEGRRLAAAG

EVSIAWQVPQYVLLGASAVLAHIGQLEFFYNQAPDSMRSLCSALGHMTCSLGSYLSSVV
VTVVSHATARGGSPGWIADDIDDGHLDRFFWLVAGLSSINLVVFICCAKRYKYKDSIN

Oryza sativa Orysa_46 LOC_Os10g02100

MEGSITDAKLPLLPLLNGTPSLQEEGPYTGNGSVDVKGNPASKTHTGKWKACYS
ILGGEFCGALAYYAVGTNLVSYLTKVQGQSNVTAASNIAAWQGNCYLTTILGAFLADS
YWGRHRTIVVSLTTFTFGMVLLTLSAVVPPNMHRSMATFPQEALSSLGLYMTALGLGGI
WPCVPTFGADQFDDTDVSEKAQKELFYNWYYFAVNGGFFVASTVIVWVQDNCGWGL
GFGIPTLFSVIGVVGFLASMRFYRYQKPGGSALTRICQVVVAAFRKVHVDVPSDSSLLYE
MPGKESAIVGSRKLMHTDGLRFFDRAATITASDEASASRPWKLCTVTQVEELKIFARML
PIFLTGVIFNTAEACFPLFVEQGGAMDNHVAAAFALPPASLTTFTCVCILVLAPTYDRVL
MPAVSRLTGVKRGLSELHRIGVGMVFAVLALAAAAAVETARLRSVEADAPAVSILWQA
PQYVLVGVAKVFGVVGYIEFAYEQSPDAMRSLCQACSLIMVTPGSYLLSAMLTIISSVTG
GGGGHGGWIPENLNEGHLDRFFWLMAALQLINLIAFVCCAATYKRKLPTT

Oryza sativa Orysa_47 LOC_Os10g02210

MEGADEERPLIHHLPPQEQCSQYTCDGTVDIDRRPALKHSTGNWRACFFILGAEF
TQCLCFSAVVKNLVRYLTSVLQESNVNAARSVSTWIGTCFFTPLIGAFLADTFWGRYRTI
VICLSVYSIGMLILTTSASLPFLLHDSYNNGDDIRRVVAYLGLYLIALGAGGIKPCMSALG
ADQFDGADPVERVTKGSFFNYYYFSNNMGTLLSTTVLVWVQDNIGWGIGFATPMLLM
GFGLSMFVAGRRVYRYRKLGRSPLTRVSQVVVAAARNHRLKLPDDSSLLHELPSLTEG
GYRIQHTTRFRFLDKAAIPSDSDDNSPVQPDPWRLCTVSQVEELKMLLRVFPVWASLLV
FFVVTAQMSSTLIEQSAAMDGRVGPFTVPPASLATFNVVAVLIWVPVYDAVLVPLARRA
TGNDRGLSHLQRIGVGLALSAVAMAYSAQVERRRRRPAAEEEAMSIMWQAPCYLVLG
MAEVFTSIGMLEFFYERSPGSMKSLGTSLAHLAVATANYLNSGVLGVVVAATTRGGGA
GWIPDNLDEGHLDYFFWMMALVRSDWASAAGQTGGDLMPQESIAGDGSGVNLEIR

Oryza sativa Orysa_48 LOC_Os10g02220

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WTTVISLFIIIIGMLIVTVSSSPLFLNSSYYNWNICRATVYTGLYLTAVGSGCMKPCIPAFG
ADQFDSADPVERLAKGSFFNWYYFSMNVGSLLSTTLLVWVVANIGWSVGFAIPMLLSG
FGLALFFAGRKVYRYKKQGGSPLTRVSQVVVAAVRNHRLKLPDDSSLLHEVSKVTEDD
YRTQLTTQFRFFDKAAILSDEISPAQWSPWRLCTVSQVEELKILLRMFPVWVSMVVFFV
VTAQITSTLIEQGMAMDGRVGPFTLPAASIATFDVISVLVWVPVYDTVLVPLARRVTGK
DRGISHLQRIGVGLALAAVAMAYSAVVEARRLGTAPAPVSIMWQAPSYLVLGVAEAFS
VIGMMEFFYEQSPESMKSLCTALGQLAIAVANYLNSGVLVVVAAATTRGGGAGWIPDN
LDEGHLDYFFWMMAVVSVLNLLHFLHCSIRYRANNNTLSS

Oryza sativa Orysa_49 LOC_Os10g02240

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DTYWGKYRTVLTFLPIYILGLLTLMASTSLPSSMTSSDAGHQLHSVAVYLGLYLVAFGN
GGVKPCTSAFGADQFDGGDAAELRRKGSFFNWYTFMINSGSLLASTVLVWLQDNVGW
GISFVIVVVVMAFFLAVFFAGSRVYRYRPVRGSPLTGVCQVVVAAVRKWHLELPDDSSL
LYEAQVADHRIKHTDQFRFLDKAAIVVTPSSLSGEKGNVAAAAAPVSRWRQCTVTQVE
EVKMLVRMCPIWACLVLFFSVSSQMSSTLVEQGTAMDNRVGPFTIPPASLATFHSIGVLL
WIPVYDVALVPLARRATGKPKGITQLQRIGVGLAVAALIMAYSALVEERRLAAARAGA
ARTSILWQVPAQLMHGMAVVFTSIGKSEFFYDQAPRSMRSMCTALGQLAIAAGNYLSA
FLLAVVASATTRGGDPGWIPDDLNKGHLDYFFWLMAALLLLDLLLFVFCAMRYKGSTA
AS

Oryza sativa Orysa_50 LOC_Os10g02260

MAAIEEERPLLPLQSQDVGSEYTRDGSVDINKEPALKHSTGNWRACFLILGVEFC
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TIVVFLPVYITGMLIVTVSASLPMFLTSSEHGNVHRSVVYLGLYLAALGSGAMKPCTSSF
GADQFDSTDLEELPKKASFFSWSFYMTTVSTLLSSTVLVWLQDNVGWGVGCAIPTVFMI
ISFPVFIAGSRVYRFRNLGFSPLKSLCQVIVAAVRKCHLQLPENKSLLYEPSNSSSTTEASH
KIQPTNQFRFLDKAAIVLPPSDETCIKPMSSWSLCTVTQVEELKMLLRMFPTWASFVIFF
AVNGQMSSTFIEQGMAMDNHVGSFAIPPASLTIIAVLSVLVLVPVYEIISVPLVKHFTGQD
KGFSHAQRIGIGLSLSMIMMVYAALLEMKRLAIVQSSGLADHNVAAPMSILWQTPAYFL
QGVSEIFSCIGMSQFFYDQAPDSMKSVCAALGQLAIASGAYFNTFVLGAVAVITTSSGAP
GWIPDNLNEGHLDYFFWMMATLSLLNLAMFVYSSTRHRENTAS

Oryza sativa Orysa_51 LOC_Os10g02260

MQDVGSEYTRDGSVDINKEPALKHSTGNWRACFLILGVEFCENMTYF

Oryza sativa Orysa_52 LOC_Os10g02340

MAAAAAAAAAEDEEKRPLLLRPNGGGGKEEEDKGGGGGWRACVLILGTELSDC
LAFAGIARNLVSYLTGVVGESNVAAARDVSAWTGTCFLTPLVGAFIADSFLGRRTTILLF
LSIYSMGMITLTVSASFATPHLDASSDGVLRATVFLGLYLVALGVGGIKPCASPLGADQF
DDDDAAPAARASFFNWYYFCINVGSLLAATVLVWVQERAGWWLGFAIPAAVMTAAL
AAFLFCSTLCGLRAFHTPPGSPLTRLCQVVVAAVRNRGVELPGDSSLLHQLPDGDYRIIE
HTNQFAFLDKAAVVASPPAVAMASPWMLCTVTQVEEVKMLLRLSTVWPTVVFFFAAT
AQMSSTFVEQGKAMDTRVGPLDVPPATLSTFEVVSILLCVPAYDAALMPLARRVTGDR
RGLSQLQRLGVGLALSALAMAYSALLEASRRRRAATSIVWQAPSYMALGAAEVFTSVG
LLEFFYDQAPDTIKSLCTAVSLVAVAAGSYLNSAIVAVVAWATAPEKGGGGGWIPDDL
NRGRLDCFFWLMFGLSCVNLLAFVYSSTRYSYRVAN

Oryza sativa Orysa_53 LOC_Os10g22560

MEASDEDRPLIHHLPPQEQCSKYTCDGTVNIDSKPALKQSTGNWRACFFILGVEF
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VMSILVIILGMIVLTVSASPLFLNASFYNGGISRLTVYLGLYLFALGTGGIKPNIPAFGADQ
FDGADPVERVTKGSFFNWYYFSINVGSLLSSTVVVWVQDNIGWSVGFAGPMLLLGFGL

AMFIAGRRAYRYKKLGGSPLTRVFQVLVAAVRNHRLNLPDDSSLLHELPGVTEGDYRT
QHTYQFRFLDKAAILSDKNCAPAAPSSPWRLCTVSQVEELKMLLRTFPVWASLVGFFM
VTAQMTSTLIEQGVAMDGRVGRFTVPPASLATFDVVAVLALIPVYDAALVPLARRVTG
RDRGVSHMQRIGVGLALSAVAMAYSALVEARRLAMAAAAAGTRMSIAWQVPSFFVLG
AGEVFAVIGMLEFCYEQSPASMKSLGTALVQLAVAVANYLNSGMLRVVAAATARGGG
AGWIPDKLDEGHLDYFFWMMAALSVLNLLQFLHCSIRFRGNNTLSSS

Oryza sativa Orysa_54 LOC_Os10g33170

MENGAGAGDDEYTRDGSVDLRGNPVLRSKRGGWKACSFIVVYELFERMAYYGI
ASNLVIYLTEKLHQGTVEAANNVTNWSGTVFITPLIGAVVADAWLGRYWTFVAGSAVY
LMGMLLLTLAVSVPALKPPPCDGGGGAACPRASALQLGVYFGGLYTIALGHGGTKPNIS
TIGADQFDDFHPPEKLHKLSFFNWWMFTIFLGILFSTTVLVYLQDNVSWTVGYGIPTLGL
MVSVAVFLSGTPLYRHKVPQGSPLATMGRVVAAAVWKWRVPLPADSKELHELELEHY
TTRRGFRMDATVSMAFLNKAAVKPGEGGGGSVARLPGWTLCTVTQVEETKQIVKLVPL
LATMVVPCTLVAQAGTLFVKQGVTLDRRIGKFHVPPASLGAFVTATMLICIVLYDRFLV
PAVRRRTKNPRGITLLQRISLGMLLQIVTMVVTSVVESQRLGYARRHGLVATGGQLPVTI
FILLPQFVLLGVADAFLVVGQIEFFYDQAPESMKSLGTAMSLTAYGAGNLLSSAILAAVE
RVTGGGKGRTPWVTNNLNASRLDYYYAFLATLAAANLLAFVVLSCKYSYRVESTETID
VDVAMDNVAQGGGVVTVKSEAAPMA

Oryza sativa Orysa_55 / OsPTR3 LOC_Os10g33210

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FMIASLIYLIGMSLLTLAVSVPSLKPPKCGAGTADPGCSEKASSLQLGVFFLALYILAVGT
GGTKPNISTIGADQFDDHHPRERRHKLSFFNWWMFSIFFGTLFANTVLVYLQDNVGWT
VGYALPTLGLAVSIAIFTAGTPFYRHKPTSGSSFARMARVIVAAIRKLAVALPDDARELH
ELDDEYYAKKKTTPLPYTPYLKILSKAAVKTSTTSRWSLSTVTQVEETKQILKMLPVLA
VTFVPAAMMAQVNTLFVKQGTTLDRRVGGGGFEIPPASLQAFVTISMLVSVVLYDRVF
MPLMARATGNPRGITLLQRMGVGLVIHIAIMGIASVTERHRLAVAREHGIADSKGTTIPL
TIFVLLPQFVLMGVADAFLEVAKIEFFYDQAPEGMKSLGTSYAMTSLGVGNFLSSLLLST
VAHVTRRHGGGGGWIQNNLNASRLDHYYAFFAVLNCVNLVFFFLVCRLYVYNAEVSR
VVDVGGRGGGEGGEVLRPKEVAMVDTNL

Oryza sativa Orysa_56 LOC_Os10g40600

MAMVLPETAAEGKALTDAWDYKGRPAGRAATGGWGCAAMILGAELFERMTTL
GIAVNLVPYMTGTMHLGNAAAANTVTNFIGTSFMLCLLGGFVADTYLGRYLTIAIFEAV
QATGVMILTISTAAPGLRPPACGDPKGASAECVAADGTQLGVLYLGLYLTALGTGGLKS
SVSGFGSDQFDESDVDGERKKMMRFFNWFYFFVSLGALLAVTVLVYVQDNVGRRWGY
GICAAGILAGLAVFLSGTRRYRFKKLVGSPLTQVAAVTAAAWSKRSLPLPSDPDMLYDV
DDAAAAGHDVKGKQRMPHSKECRFLDHAAIIDRSAAESPATASKWRLCTRTDVEEVKQ
VVRMLPIWATTIMFWTIHAQMTTFAVAQAELMDRRLAGGFLIPAGSLTVFLIASILLTVP
FYDRLVVPVARRATANPHGLTPLQRVFVGLSLSIAGMAVAAAVERHRATASASAAAAA

PTVFLLMPQFLLVGAGEAFTYMGQLDFFLRECPKGMKTMSTGLFLSTCAIGFFFSTLLVT
IVHKVTGHGARGGGWLADNLDDGRLDYFYWLLAVISAINLVLFTVAARGYVYKEKRL
ADAGIELADEETIAVGH

Oryza sativa Orysa_57 LOC_Os10g42870

MGMESGDAQLPLLHHQASASNQHYTKPPFNWKAPALILAFEFLESIAYAGISLNL
VVYLGTVLHGTTASNAANVDTWNGTTFLTPVLGAFLADTYWGKYKTIAISTVFYLIGLL
VITASAVIPSLQPAPCNGSSCPPATGFQYFVFFTALYLISVGTGGVKSALLPFGADQYNDS
NLEESKKKQSFFSLFFIAINLGVFISGTVVVWIQQNVAWSLGFGISSICLVVATVAFLAGT
PVYKVQLPSGSPLKSVVMVFVASFKKRKLEVPADNALLYEGDDADLSNGQSVKLAHTD
GFRWLDKAAVVFEEVEEINKDEGGGGGWLQCSVTQVEEVKILLRMLPIWVTSVLYAAS
LGQTATTFVQQGNAMNTKIGSFSVPAASLNSAEVIFMMIWVVFQDTVVVPIARRYTGNP
AGLTQLQRMGVGRLLAVPALAVAAVLETWRLRSVRDGGNLSIAWQLPQFVILACSDVF
CGIAQLEFFYSEAPVSMRSLCSAFSFLALSLGYYVNSLVVSIVAVVTTTSNKGWLPADLN
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Oryza sativa Orysa_58 LOC_Os10g42900

MSMNNMMGSPPSRSRGRDEKKKRWKWKLGPATILGFELLESIAFSGVALNLVV
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TVSAAVPSLRPAPCTGVPCSPATGTQFSVFFLALYLTSIGTGGVKSALLPFGAEQYERDD
HDTDQEGAPAPEKTKQSFFSWFFGAINLGIFVAGTLVSWVEQNVSWALGFGIATLCLLIA
SAAFLAATPCYRVRLPTGDTPIKAILRVLVAAFRNRTRTLPPDADGDGLYEVDDDKNKN
GGDDEKLAHTEGLRWLDKAAVRVDGGGVWEVCTVSEVERVKVLARIVPIWVTCVLYA
ASLGQMTTTFIQQGMAMDTRVFGGRFRVPVASLVSVEVVFMLLWVLLHDVVVMPVAR
RWWRSGGLTQLQRMGVGRVLVVVAMATAALVERRRLRGEKRSMSILWQVPQFVVLA
GSDVFSGIAQLEFFYGEAPGSMRSICSAFSFLALSLGFYVNSLVVTIVAAVTKRSDGSGG
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Oryza sativa Orysa_59 / OsSP1 LOC_Os11g12740

MDVESRQGPKGGDTMAASEVSVDWRGRPCGSRKHGGMKAAVFVLGIQAFEM
MAIAAVGNNLITYVFNEMHYPLSKSANIVTNFIGTVFLLSLLGGFLSDSYLGSFWTMLIF
GFVELSGFILLAVQAHLPQLRPPACDMMAAAAAAEGGCEEASGVKAGIFFAALYLVALG
SGCLKPNIIAHGADQFRRGGGGGGDGDGDDGGDGKRLSSYFNAAYFSFCVGELVALTV
LVWVQTRSGMDVGFGVSAAAMAVGLVSLVAGVFFYRNKPPQGSIFMPIAKVFVAAVT
KRKQVCPSSSSTTAASHAVIPATGAAPVHRINKFRFLDKACVKVQDGHGGGGDGGKES
VWPPCTPAEVEQVKVLLCVVPIFACTIVFNTILAQLQTFSVQQGSAMDTRIGGGGGGAA
FHIPPASLQAIPYLVLIALVPAYEACFVPAMRRATGVDTGITPLQRIGVGLFAVTFSMVA
AALVEAHRRRHAGDGLLSIFWIAPQFLVFGVSEMFTAVGLIEFFYKQSLSGMQAFLTSM
TYCSYSFGFYLSSLLVSLVNKVTSGDGAGAGGGGWLSDNDLNKDRLDLFYWLLAGLSL
LNFFNYLFWSRWYSKSVETTVQVAGVGGEGGGGEQQEEKGVDEVNMGH

Oryza sativa Orysa_60 LOC_Os11g17970

MGSSSGLVDWRGRPVDTWKHGGVRASIYIHMLVWLSNVSNIGNMTNIVSYLSV
KMNMGVAAASTTSASFVAMMQVFTIPAAFLADSYLKRVYTVLFFAPIEILGYILLAIQAH
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VRACLPALGGDQFDEGDAAEQRQAASFFNWYAFAVSLGALVGLVAVVWVQDNKGWD
AGFAVCGAVVLLGLLVWAAGMPTYRNKVPAGSPITRILQVLVVAFKKRNLQLPENPDE
LYQPTNDDSAKGLEILQRTRGLKCLDKAAIVRGGGSNGGAWSVCSVSQVEETKIVLRM
VPIFLTAALGYMPVSVVLTFTVQQGNIMDTRMGAIRVSPATLFVIPTVFQLAILVVYDRA
VVPALRRATGRVGGVTHLQRIGVGFVSSLASCAVAAAVEVKRRRLVASSSSSAMMSVF
WLTPQFFLLGVVDVTSFVGLLEFFSSEASDGMKSIGSSIFYCMLGMAAWLNTMLIELVN
RVTRRRGGGGWLDGANLNESRLDLFYWLVSGIELVAFMAYLLFAWRYVYRNDQRIAA
AAADAVDEQEDKKAASNGSLVQINLI

Oryza sativa Orysa_61 LOC_Os11g18044

MGSSSGLVDWRGRPVDTKKHGGVRASIFIHAMVLLTNAPNIANMMNMVSYLRG
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LGDPDEQRQETSFYNWYTFAVSTGGFVGLVFIVWVQNSKGWGVGFAVSAAFVALGLL
VWAAAFPLYRNQLPMGSPITRVLQVFVAAFKKRNVRLPENPSELKQINQDDDANAHEV
LPKTDGFRCLEKAAVETGNDAGPWSLCSVTQVEETKIVLRMAPIFVAAVLSYIPVPLLLS
LTVQQGNTMDTRLGAVHISPATLFLIPTVFQMVILIIYDRAIVPPLRRLTGYVGGVTHLQR
IGIGFVATIVATAIAAVVETRRKMTAEESGLEDATTGIPLSVFWLTPQFFLIGIVDVTSFVG
LLEFFCSEASMGMKSIGSSIFYCILGVSAWLGSLLIQVTNRVTQRTNGGGWLDGANLNK
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Oryza sativa Orysa_62 LOC_Os11g18110

MGMVAQEEEGAAATHQWGKSAHHWLGDSHHCSTVEQATGEGYIVLALQAYTP
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AAAFPLYRNRLPTGSPITRILQVFVAAFRKRNVRLPEDPSELKQINQDDDNNALEVLPRT
DGFGYPDERNYNPLNFLQTLLTYHMIYLKKNLPLSMPMCGIIMNPPMWCLEKAAVRTG
NDAGAWSLCSVNQVEETKILLRMAPIFAAAVLGYIPMPLILTFTVQQGSTMNTKLGSVHI
SPATLFLIPIIFQLVILILYDRVIVPPLRRLTGYVGGVTHLQRIGVGFIATIMATAVAAVVEI
RRKSAADESSLADGTAGIPLSVFWLTPQFFLIGIFDVTSFVGLLEFFCSEVSMGMKSIGSSI
FYCILGVSAWLGSLLIQVTNRVTRRGGKGNGGSGGWLDGANLNNGKLERFYVVLCIIEV
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Oryza sativa Orysa_63 LOC_Os11g23890

MAKTMERGRRERRRIVRLRVSKVYQIVQLNSQCLLQIRFQKGASKRREQILFCRC
GDPLSLVLPWVLLMMEGHSNELGRANTLKKGGLRPIPVIIGNVFGLTNEVSERIVSASVT
ANLIIYLTTKYHLGAASSAIIIFVYQAAANFLPVCGAIVSDALLGRYLMVTLTLFSCTTGT
FMLFLTSLIPKLTPPDCGLSNQGCTSPSPLQLFVLCASLGFMSLGASGVRPCCLAFAEDQI

AHWDEAQKDRALRGLFSWYYVSVGFAQIVAVTILVYFQDQVGWKVGFGISAAVMLSIT
LVNLAASPFYVKMKPQRSIWISLLQVVVVSLKNHHLVLPKTYQSAQFHNASGLRELVPS
EKMRFLNKACILRYHATNVSDGAGRTNSWNICTVEQVENLKSALSVIPMWSAMIMTFLI
QSSSFGVLQAATMDRRVGTKKFQLPAGSISIFEIITFTIWSGCYDRYIVPFLRRITGRQQVL
TLKQRMGIGVSLSIASMLVASAVETYRRKVAVKGGLQHDAKGTLEMSVLWLAPQYVII
GLAGAFSSIGQIEFYYAVLPKSMGSFVLALLFFGAGVASIIATLVIKAINLITGRNGMAPW
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Oryza sativa Orysa_64 LOC_Os12g12934

MALQVQGLVDWRGRPVDPRRHGGLKAVMFIYVLIVMTNMGNIPTMLNIVSYLH
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PSLHPPPCDAAAGQCAAVSGRNLSLLRLGLYVIPLGEGALRVCGAALGGDQFDGGEVG
GDDPAAAAAAEARGKASFFNWFAFCISLGGLVGLVLVVWVQNNEGWDLGFALAALM
ALVAMAVVLAGLPFYRHRVPTGSPLTRILQVFVAAFRKRNVTMPESLVEMQECSDGSTI
ELLDKTPDFKFLDKAAVDDGDRRRWSACTVTQVEEAKIILRMLPVFLTSVLGYVPIPLLL
TFTVQQGGAMDTRLAGTSVPPASLFVVPIVFQMLILVAYDRAAVPWLRRATGYAAGVT
HLQRVGLGFASSAAALALAAAVESRRRRCLGVAAPAMSVFWLTPQFFLLGVMDVTSFV
GLLEFFYSEASAGMKSIGGAVFFCILGVASWLGGALIQAVNRATAGGAGHGGWLDGAD
LDASHLDRFYWLLAVFELVAFFLYLYSAWRYTYRHHPRVQPSMEDAKVSATATTTTKK
AEV

Oryza sativa Orysa_65 / OsPTR2 LOC_Os12g44100

MPPAPSQEQTKLAPEKQQHISGHGEQAVRYHGWKVMPYVIGNETCERLGTIGTT
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MLVLTLTAAIPSLHPPPCASSSSTSCQGPTHRQLAALLASFAFLVVGAGGIRPCNLAFGA
DQFDPATAAGRRGIASFFNWYYFTFTIAMMVSATLIIYLQSNINWAIGLAVPTALMALSC
ALFFMGTRLYVRVRPEGSPFTSFAQVLVAAARKRRLPAPASPADDLFDPPHRSKLVAKI
KHTDQFRWLDKAAVVTAEDAVVDGMSAAAANPWRLCTVQQVEEVKVLARMIPVWSS
SIVYYVMLTQLGTYTVFQVMQSDRRVGRSGFEVPAGSMVVFNMVALTAWLPVYDRAV
VPALRRVTGREEGISQLQRIGIGLALSVATMAVAVAVEQRRRGAGGGSSSSWAWMVPQ
QAMAGLSEAFAAIGLNELCYKESPESMRSVAGALSPLALAVASYASGAMVTAVERATG
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ADAPPAMAV

Oryza sativa Orysa_66 LOC_Os12g44110

MDAAAAMEKQQQPGEKKITGGEEEEEEEVISSVRYRGWKSMPYVIGNETFEKLG
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SCLGMLVLTLTAAIPSLHPPPCTASSSSSSCQGPTHGQLAALLAAFAFLVVGAGGIRPCNL
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VAKIAYTDQFRCLDKAAVVTPESRSSPWRLCTVQQVEEVKCLARIIPVWSAGIVYFIVVT
QLGTFVVLQALQMDRRLTRWWAFEVPAGSMVVFNMMAMTVWIPVYDRVVVPALRR

VTGKEGGISQLQRIGVGLVLSVATMVVAAAVEQRRRRLGAVGVKMSFLWLVPQQVAA
GMSEAFAAIGQTELYYRQFPENMRSVAGALFFLAFALANYASGFMVAAVHRTTGWLA
QDLNHARLDLFYLTVAAIAAANVCYFLLCARWYRFKNTTIADHVELPDYHHHQPGTAN
TIASKV

Physcomitrella patens Phypa_01 Pp1s113_26V6

MASSDAELAILKDLSIVAYDPKTDHSREHVKDDIVDDITVADGAVDVRGRPSIKS
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LIGAFIADAYLGRYLTLGTFLCGYFLALTFVTMSVTLPALKPPECNGLTADLTKFCRPAT
KLQRGFFYFALYLMAMGAGGIKSCVTAFAGDQFDITDPVEAKRKMSFPNWWFVSISFG
TMLSVSLLVYVQDTIGWTWGYGIPTGIAGLATLIFFIGTPLYRTHHIRGGSPFTRVAQVLV
SAARNWRVSVPTNPELLCELDDKEALTQAPGKLLRHTPGLVFLDKAATVPVMTHERVY
RFEELMKPDPWRLCTVTQVEEVKLLVRMLPIWVTNLMFSAVFAQVGTLFLNQGTTLNR
QMGPNFQIPAASMPLFVTLTICVFLPLYDKFFVPAVRRITGDKRGLTMLQRIGVGQVISTI
SITVAAFVEMKRLRLAHSLGKDIVGPLPMTIFWLLPQYMLTGICEVFISVGQMEFFLDQA
PASMRSLGNALYLSTVAVGSFLSSLLVSIVTNITYDSNGGWIGNNLNESHMDYFYWLLT
GLSLLNLFFYVLFAKWYTYKDSNKTDVSRRSSESPSSDSSGALQSGHCLTVPNGVAPLG
YKELK

Physcomitrella patens Phypa_02 Pp1s114_7V6

MTRDDMNAVGGAPDSEYPQDGTVDLRGNPVLKANTGGWKACPYILGNECCER
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ADQFDENDVKEKKRKSSFFNWFYFTINIGALIASSALVYIQENVGWGWGFGIPAVAMGI
AIVSFLIGSPLYRHQKPGGSPITRIAQVLVAATRKLSMKVQPNGKHLYEADDKESGIEGS
RKLEHTEEFRFLDKAAIPRGDEELQGTRPSGWRLTSVTQVEEVKIVMRLLPIWASGIVFA
TVYSQMSTMFVQQGALMNVSMGKANIPSASLSIFDTISVIVCVVIYDRFLVPVVRKRTG
HVRGFTQLQRMGIGLFISVLAMVVAAIVEIERLKLARRDGVAGNPQDEALPVESLTIFVQ
IPQYFLIGAAEVFTFVGQLEFFYDQAPDAMRSLMSALSLTTVALGNYLSSVLVTIVTEVT
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PSKSGYE

Physcomitrella patens Phypa_03 Pp1s116_20V6

MAPSDAEIAMLKELALAAYAPETDHSRELQVKNDMIDDITVADGAVDVRGRPSI
KSRTGNWKACWPIFGCEVCERVAFYAISSNLVIYLTTVLHEDISVSARNVNNWSGTTFLT
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KLQRGFFYFALYLMAMGAGGIKSCVTAFAGDQFDITDPVEAKRKMSFPNWWFVSISFG
TMLSVSLLVYAQDTIGWSWGYGIPTGIAGLATLIFFIGTPLYRTHHIRGGSPFTRVAQVLV
SAARNWRVSVPTNPELLYELDDKEALTQAHGKLRRHTSGLLFEEVIKPDPWRLCTVTQV
EEVKLLVRMLPIWVTNLMFSAVFAQVGTLFLNQGTTLNRKMGPSFQIPAASMPLFVTLT
ICIFLPLYDKFFVSAVRRITGDKRGLTMLQRIGVGQVISTLSITVAAFVEMKRLRLAHSLG
KDYVGPLPMTIFWLLPQYMLTGICEVFLSVGQMEFFLDQAPESMRSLGNALYLSTVAVG

SFLSSLLVSIVTNITYDSNGGWIGNNLNESHMDYFYWLLAGLSLLNLLFYTFFSKRYTYK
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Physcomitrella patens Phypa_04 Pp1s133_58V6

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VGALYLTPFLGGFAADAYLGRFWAITVFATIQVVGMVFLTLSATVSSLRPPPCIPNSSNP
CQPSHGIQLGVLYLGLFFFAVGNGGIKPNVSTLGADQFDEGDPNERKQMSHFFNWFYFII
SIGSLLSVTLFVYIQDNVGFGWGFGIPAAVMMVAVVVFLAGSRIYRFKPPGGSALTTIAQ
VAVAATRKRRVCLSHDRTLYEGSFQGRGPVERLNHTDQLVFLDRAAIPVGIKDSNFSFA
SPWQLCTVTKVEEVKAILKVLPIWASTLLVWTALSQMETFTVEVGAAMDRHVTAKFLF
PSASLAVFELFNIIFILPMYDRFFVPFARRFSGHPQGITTLQRIGTGMIFSTLAMLVAALVE
TKRVQVARDNGLLDRPELTIPMSIFWLVPQNFLRGSTEIFTQIGQLEFFYHEAPERMRSLG
SAIYLSTIGCGFFLSSALVTAVNKFTRDGDGPGWLTNNLNRSRLNYFYFLLAALSCANFL
LFLVCSSWYKYKKVTSHSYIRIDEPSEA

Physcomitrella patens Phypa_05 Pp1s14_129V6

MSSEMLLEDDPPVPEPPPHVKYMSGSSRGKDASDKEEMQVDEGRVSDGSVDIRG
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TTFMTPLLGAFVGDAFLGRYWTITVSSVCYIVSLVCVTMSVSLPALKPPVCNVAMLSSV
TGCQKASTSQICFFYFSLYLMALGAGGIKSCVTAFAGDQFDNNDPKEARRRMSFPNWW
FVSISFGTMLSVSILVYVQDNVGWAWGYGVPTAITGLATLAFLMGTPLYRHQIPSGSPLT
RVAQVLCAAVRKWNIPVPTNPEFLYEVDDASSFRRRLPHTSSLHFLDKAAVKPSDEGSM
HKVDGRQSPWEVCTVTQVEEVKLLVRMLPIWWTNLMFSAVFAQVGTLFLNQGSTMDR
HMGPNFEIPAASMPLFITATICIFLPLYDKYFVPFVRGFTGDIRGLTLLQRIGVGQILSSLSI
AVAAAVEMRRLKVVADSGSMDFGQVPISIFWLLPQYVLTGICEVFISVGQMEFFLDQAP
DSMRSLGNALYLSTVAVGSFVSSVLVSIVTRITYDSNGGWIGNNLNRSHMDYFYWLLAI
LSFANTLAFVWCARLYTYKSMHVRPRMVERSHS

Physcomitrella patens Phypa_06 Pp1s143_133V6

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TSFITSIFGGFISDAYLGRFWASLIFAVMEMVGLGLMVVSVSVNTLAPNCPITDHTCPSLE
GTKGFIVFLFALYLVALGTGCLRPCLATLGADQFDIEDPEEKRQIRSYFNWLFFFMSVGT
MIAMMVVVYVSQSVSWFWAYTIMGIAMLLSTACLVAGAGHYRHKKPQGSPLTRIAQVI
VAATRKKKTTLPSNSAMLFEVQDHENGNAIPTEPTLKRFNSNKGEVLGEPTLKRYYSLP
HTEGLTFLDRAAVVTEHDTGTQSTTKVNPWRLCTITQVEELKAIMRTLPIVWCVSFLYIV
VAQIQTWAVAQGYTMERNIGTFQFPPPSLSAISVAFVLIEIAVYDQWFVPFMRKYTKHT
HGITHLQRIGIGLLQSILAMAYGAIVETGRLRSARHHGLIESPMAVVPMSIFWLLPMWIL
ASSAELWAYVGLFEFYWQEMPVEMRSLGGGFSLLAIALGFYQSGGLIVVTNAVSKNYN
NGGWLADSNLNKNRLNYFYLVLMVLSSMNAFGFVMSTKWYNYVKFINTKLTDTTDQE

VPPSPMPDIFKRSESRLPLKSPRPSTGDQLQGTTPDSTPRKPKISADNKHDKGLPSSVKAG
AEVDATLPDSLPRSESRTPLRSTNNSDDL

Physcomitrella patens Phypa_07 Pp1s171_7V6

MGFYGCSANLVRYLTSVMHQSNATASTNVSNWNGVGYITPLIGAFLADAYWGR
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GAFQCVVTPLGADQFDDEDPEEKAQKTSFFNWYYQSMNMGGLLAGTFLIYIQDNVSW
GLGFGASLIAVVIGTMCFLGGTPFYRHNLPGGNPITRITQVIVASVRKWYIKIPISSELYEV
PEEMESIIQGSRKIRHTNEFRFLDKAAVEMDGDKSDDSSANPWRLCTITQVEEVKVLVR
MIPITITSAMFSTIYNQMSTVFVLQGATMDLRMGYFNIPPASLTVVELLSVSVWVPIYDFF
LIRLASKFTNNPRGFTELQRIGIGLLISVFSMVAAALLEIQRLEVARLHELLDDPTVPVPLS
VFWQIPQYFFVGAAEVFTYVGIYEFFYGESPDAMRGLGTAFALLTVALGSFLSSVLLTIV
THFTSKDGAPGWIADNLNRGHLDYFFWLLAGMSTVNLVFYVVCARWYTTKQTWGPSK
PATLSSGTQ

Physcomitrella patens Phypa_08 Pp1s173_71V6

MADEEGRDGTDVTSSSWRKDEEYTKDGTVDFRGRQAVKARTGGWRTSWFIYS
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WGRYWAAVVCCLIYIIGMIFLTFSASLRSLRPQQCSTEDVLCTHSSLGQAAFLFFALYVI
DVGAGGVQATVTSFGADQFDEEDSKEKTQKTSFFNWFYQSTILGGLLAATFFVYIQDNV
SWGLGFGASLIAVIIGTISFIAGTPFYRHHPPGGNPLTRIGQVIVASARKWHHKIPVGSELY
EVREVTNSVIQGGRKIRHTKEFRFLDKAAVEMQGDRINESHVDPWRLCTITQVEEVKVV
LRMIPIMITSAMFSTVYNQLYTLFIIQGSSMDLRMGNFKIPPASLSVFELLSVTVWVQVY
DFVLIRFVSKFTKNPRGFTELQRIGIGLFISIFGMIAAALLEIERLKVARHHGLLDNPEVPV
PLSVFWQVPQFSLVGASEVFGYIGIFEFFYGESPDAMRGLGSAFALLTIALGSFLSSVLLTI
VTRITTRNGAPGWVADNINRGHIDYFFWLLAGMSAMNLVLFVLCSRWYKTIRTWRPTV
QGN

Physcomitrella patens Phypa_09 Pp1s246_106V6

MTPRDARKMESESNKVVPICSTNYRTTSKRHPPLERTMSITRDGSMDYRGTPAD
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TAGQVGFFYFALYLMSLGGGCMKPCIAAFGADQFDEEDIRENEMKKSFFNWWVFGISL
GALVSATVLVYVQSYISWGWGFGTPTVLMGIYLVLYIVGLKFYRHNRPTGSPFTQIGQVI
VAAVRNFRLRVPADPALLNEVVDKERLQAGTRLIPHSNTMRFLDKAAVLPNISEGSTIGI
DDHSPWKLATVTEVEEVKLVLRLLPIWVAALIFQTPSAQISTFYTRQGNTLNVDLGSNFK
IPAASLQSIIPLTIVCLIPIYDRIFVPIARHFTGNVRGISMLQRIGIGIIISLLSMVCAATTEIYR
VKVARENGLLDEPFQTLPLTVFILLPQYILLGAAEVFTSIGALEFFYDQAPDSMRSLGTAI
FLSTIGIGNFLSSMLLSSVVKVTSLCGQSWIVDNLNRCRLDYFYWLLAGLMAANLCFFF
ALARWYQYKQVTSL

Physcomitrella patens Phypa_10 Pp1s298_30V6

MDADSNQVVPICNTNYPTTIKTHPPLERTVSLARDGSVDFRGNTADKRASGRLK
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AFWGRFWTILICGVIYFVGLVMLTLSVTVSAFKPPGCFISPSDGIQQCPSATAGGQVGFFYF
ALYLMSLGGGCMKPCIAAFGADQFDEEDKRENEMKKSFFNWWVFGISLGALVSATVL
VYVQSYISWGWGFGTPTVLMGIYLVLYILGSKSYRHKTPVGSSFTQIGQVIVAAVRNFRI
QVPADPALLYEVDDKESLQAGARHITHSNSMRFLDKAAVLPNPSEGSSSDIQKHSPWKL
ATVTEVEEVKLVLRLLPIWVAALIFQTPSAQISTFYTRQGSTLNVNFGPNFKIPAASLQSII
PITIVCLIPIYDRVFVPITRRFTGNVRGITMLQRIGIGIILSFLSMVCAAVTEVYRVKVAREH
GLLDHPFQTLPLSVFILLPQYVLLGAAEVFTSTGALEFFYDQAPDSMRSLGTAVFLSTIGI
GNFLSSILLSGIVKVTSLSGQSWIVDNLNRCRLDYFYWLLAGLMVANLCFFSGLARCYK
YKQVASL

Physcomitrella patens Phypa_11 Pp1s298_45V6

MVGKTMESREEADGWLVHDGTVDYKGRKADKRHTGGWKAAPLIFVTEMCERL
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VLQFLGMVVLTLSATLPAFRLPPCSGEPGALHPCQPAHGWDMVILYVGLYLVAFGTGGI
KSSVSPLGADQFDENDPREKKLKSSYFNWFFMAIEVGAILSVTLLIYIQIKLGRGWGFGIT
AGAMLFAIAVLVGGVPLYRYQVSYKRSPIAHVVRVFANAFRNRKLTTPPAHLLYETLD
NAEEGIEKIPHTNQFRFLDKAAIIDYEQFEAQLCKTGNPATVTQVEEVKCVLRMLPIAAL
TIIFYTVYAQMLTFSLEQGETMVRNELGFNIPPASLAVFREISVVFILSIYGPQLVPLLRRF
TGHHRGLTTLRRIGVGLLFSCLSMLAAAIVEWQRRRIAHQHGLQDKPKAIVPMSVFWLA
PQFMLLGAGEVFTYVGQLEFCYQESPLGMRSMSTAVFLCTISFGFFTSSFLVSTVNRATQ
SGPHHQGWLVTNLNSARLDYFYYVLLIITLLNFVGFVFCAKWYTYKASAMEESATKPV
TGKLPLSADSDVRNDK

Physcomitrella patens Phypa_12 Pp1s302_14V6

MRWASSSRQRSGLLRVLRISRSSQTPPGTSRYLTALVRISQELKESTQGRGAKDP
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LHEGVAESITNVWNWGGVAWTTPLIGGFIADAYLGHFKTITYSLLIYQVGMVLLTITVA
LPTLKPPPCPTQTNCKNASSASINLFYFALYLVAIAIGGMKTCTSTLGADQFDEEDVKER
PMKRSFLNYWWISATGGTFLALTVLVYVDDQVGFGWGYGISTVGLGICIFLFLAGRRRY
RYKKPTGSPLTQVAQVLVASFRKFRIQVPRDADLLHETYQPEKRNLLHTNNLRFLDKAA
TLAPEVQKQNQIKDKETVGNWHLCTVTQVEEVKLLAKVIPIWLTTLMFIVTSQQLSTVF
LRQGLSMDLHMGPNFKIPPASLELSCTITALISIPLYDRYLLPFVRKFTGNDRGFTLLQRIG
IGLLLALVGMAVCAIVETKRLCVIEEHGMQLSKSPLPMALFWLTPQYSIMGLAMVFGWI
GMLQFFYDQAPDDLQSIGTALFLSNTGVGHFLCTVIVNIVVRITGDGRDGRKGWIVTNT
NQSRLDKYYWLLTTMAAVNFFTLPHCGKVVYVQASNKSCERRPEQSFSRTSEPCSRISF
GIYKSPGKYWPRV

Physcomitrella patens Phypa_13 Pp1s389_6V6

MGTDAGRPSSTPIVLSSSSSKENLTQPLIPPSEAKTGAYDSENVYEGCITDVSRDG

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TNIDCQSASKLQVRVFYCALYVVAIGVGGVKPCASTLGADQFEEEDEKERFMKYSYFN
YWWFVVTSGSFFALTVLVYIEDHVGFGWGYGIPTVGLALALAVFLLGTRSYRYKHPKG
SPLTQVACVLVAAMRNRNVQVPTDSALLHEVGHPLKRNLHHTHHLRFLDKAAVQVRE
KDNETAPLVTYNWRLCTVTQVEEVKLLALVMPVWFTTLVFMVTVQQMSTFFLRQGIS
MDQSVGPNFKIPPASLDLATVSTALMLIPIYDSYVIPYARRFTGNERGFSLLQRLGIGLVIT
VLGMAVAALVEMRRLEIIRENGLEHSISPVPMSVLWLIPQYSIMGIAQVFAYMGQLEFFY
DQVPDDMQTIGTALFTSNTGVAHFVCTSILQLVISVTGRDGRQPWIVDNINDSRLDNYY
WMLALLSAVNFVAFFQVSRGYTYKSTMQREVKYHVEVPAEPPLID

Physcomitrella patens Phypa_14 Pp1s400_5V6

MGERLAGFGLSMNLITFLTLEMHMPTVKAANIITNFGGTCGLTPLVGAFIADAYL
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LAVGTGGIRPNTAPFGADQFDPSHPKEKNQLWHFFNWYYFCVGISILGALTVIVWVQDN
VGWTWGFGIPAGAMAIALLSFFIGAPFFRYMPPVGSPFTRIAQVIVASYRKRKLSLPSDTS
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KSLLRMAPIWMTTILVSTVIVQQGTFSVQQARTMNRWMGYNFQMPAASFGVFGILMLL
TWVPIYDLYVMGWLKKVTGNERGVTPLQRIGAGLFIAILSMVAAAAVEVKRRNVAHR
HGLLDRPDLTVPISAFWLVPQHCLFGLAESFVFIGELEFFYDQSPESMRSTGTALFWSTFA
LGNYVSTALVTLIDHNTNWLENNLNRAHLDHFYWFLAVLSTVNLLFFLLSAHWFRYRN
EGLDPDLDIHLETSAALKPN

Physcomitrella patens Phypa_15 Pp1s434_30V6

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FGCVELVGMSLMVISASLPSLRPLPCGTSPCKASSSADLAVLYLGMYLIALGSGGLKPCL
SSLGADQFDETHEKERRLSAVYFNWYFFSFVVGGLLGVTVLVYIQDNIGYDVGYGICLA
LVAVSLVVFVAGFHRYRRKPPSQSPLTRILQVIVAAFRKLRSPHPPPEYLYEIDDKEATQL
GFQKIDHTSSCRFLDRAAIVNASEKDHERNKSKWELCTVTQVEETKAMAKLMPIWTGTI
IMNVVLAQLQTFTIEQGSTMDRKIGSFNFPAASIPFFPLIIMANLVPLYDRIFVPVARRFTG
LDRGITFLQRIGIGLVLSVVSMIIAAVVEVKRTDKAKAYGLLEDSRATIPMSIFWLVPQYF
TFGIADMFTFIGVLEFFYDQAPDSMRSTSTGFSFCTISLGYFISSAVVSIVNMATKTDSHPG
WLSDDVPFNRKKLNLFYWLMAVLSFVNFAYFLVVAHFYRYKKYPSPKFMNPDAQLQK
SATPPVDSACGVGTKDQSRQP

Physcomitrella patens Phypa_16 Pp1s71_306V6

MAKHNSQVDTENQNHNLKHQLQPADQWIPVSSPSVTKPYSPAAAGSKKTTEED
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SRSQMAFLYVALYTIALGSGGIRPCVSSFGADQFDVENSKEREQLPRFFNGFYFMITFGIF

LSLTVVVYISEYISWAWGFGTLSIAMAAANIIFFLGTPFYRHRIPSGSPLTRFVQVMIAAL
RKRRVKTPKNKDDLYEVYDKESAIPGSRKLKHTYILSFLDKAAVETANDKAAGQPVTT
WRLCTVTQVEEVKILVKVIPIWATTIILNTVFLQILNFGAQQALSMDRRLFSFTVPAASVP
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SWETNTARSYNATVPLSAWWLTIPFCMTGLAEIFASIGQLEFFYDQAPDGMRSIGTAFFS
ATSALGAYLGSFLITITTKYAEHHAQQPWINALISLGHMDYYFWLLAVLSGINFVVYLFC
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Physcomitrella patens Phypa_17 Pp1s72_96V6

MASMCPSAEWIPHSSGQVQRLPSHEAERFVEPSKLSTATTYIATADGSLDFRGRP
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SYLTSLLGGFMSSAFLGNYWTIIVAMLIELVGVALLIISSAIAPLMPECVKNKLSRGPCLP
ANATQYGVCMFSVYLIAVGAGCIRPCLSAFGGDQFDQEDAAEREKTPRFFNWLVVSMT
CGGVLATTLVVHLGENVSWTWSFISIGLAMMMATLFFLAGTGRYRHQKAAGSPLTRIF
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DASGANLAAKASPWRLCTVTQVEEVKGLLRCMPVAMGPMLLYMVLAQVQTWTTQQG
YSMDRRIGTHYLIPPATLTAIAIGVVILEIVAYDYLLVGVLRRYTGCPQGLSHCQRIGVGL
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NLNHLNYFYLLMAAMSLVNFVIHLITTHFYQHKQYINIATIHTKLSQHRVSQDPSQTHAN
PSQSSSLPAEVRLQASLQL

Physcomitrella patens Phypa_18 Pp1s75_22V6

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GRYRTAIIFSAINLSGMVILTLSVTLPYLRPPPCPAAMAAIHECPEPSVQQIGVFYFAIYSIA
LGAGGFQPCLSALGADQFDELDPKESKQQKVFFSVYYLCLCAAALVSGSVIVYIEANVG
WDWGFGISLGALVVGNFVLVLGSRLYRQHPPAGNPLARIAQVVVASIRKWQVVAPKD
DTLLYEVEDSDTSAIQGTRKIKRSHEFMFLDKAATASEAEKQAAPGSFSPWRLVTVTQV
EEVKFILRILPIWFCSIIFSAIYTQMLTLFIVQGATMDTRIGRFNVPPASISLFDFISVLSWAP
IYEWVLVPMARSYSGNERGFTGLQRMGIGLAVMTVAMVAAATIEIARLKTARIHGLLD
AVDVPVPMSIFWQVPQYSLVGASEVFTYIGQLEFFYEQSPDGIRGLGSALALTTFGLGNF
LSSILVTGVTKITSTGGSPGWIPAKNLNRGHLDYFYWFLAGLSTLNLALYIKCAQWYRIT
SAQLTIPSGTCMSPTGCAEHKSFHDQETANL

Populus trichocarpa Poptr_01 POPTR_0001s02810

MACLEVCKEGKFKEGREECTFDGTVDWHGRPAIKDKSGQWVAGIIILLNQGLAT
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IFQVIFVIGLVILSLSSYLFLIRPKGCGNELTPCGSHSSMEVSLFYLSIYLVALGNGGYQPNI
ATFGADQFDEEDPREGHSKVAFFSYFYLALNLGSLFSNTILGYFEDEGVWALGFWASAG
SAFAALVLFLGGTSRYRHFKPSGNPLSRFCQVIIAAMKKWKLEMPRDGEEELYNVHAK
DCSMNGNRKILHTDGFKFLDRAAFISSRDIDDQKRGCRNPWRLCPITQVEEVKCILRLLPI

WLCTIIYSVVFTQMASLFVEQGAAMKTTVSNFKIPPASMSSFDILSVAFFIFLYRRVLDPL
VSRVKKTGSKGLTELQRMGVGLVIAIVAMISAGLVECYRLRYARKDCTHCEGSSSMSIF
WQVPQYALIGASEVFMYVGQLEFFNAQTPDGLKSFGSALCMTSISLGNYVSSLLVTMV
MKISTEDHMPGWIPGNLNKGHLDRFYFLLATLTTIDLVVYIACARWYKSIQLEGKCELN
DQEENFRV

Populus trichocarpa Poptr_02 POPTR_0001s05090

MGQVVFYLAIYLVAFGYGGHQPSIATFGADQFDESKPKERNSKAAFFCYFYFAL
NFGSLFSNTLLVYFEDHGRWTLGFLLSLGSAVVALVSFLFGAPGYKYVKPCGNPLPRVA
QVFVAAARKWDVIPVKADELYELEGPESAIKGSRKIFHSEEFEFLDKAATMTEDDLSHQ
KNPWRLCTITQVEEAKCVLKMLPIWLCTIIYSVVFTQMASLFVEQGDVMNSYIGKFHLP
AASMSAFDICSVLVCTGIYRQILVPLAGRLSGNPKGLTELQRMGIGLVIGMLAMLAAGA
TEIERLKNVIEGHKVSSLSIFWQIPQYVLVGASEVFMYIGQLEFFNGQAPDGIKSFGSSLC
MASISLGNYASSMLVNMVMKITTKGDKPGWIPDDLNTGHMDRFYFLIAVLTAFDFVIYL
FCAKWYKPINIDDNSLHFHTAFGCPALFFKIARIPYLEPVWLQGAPLVQPAFRHQVHCV

Populus trichocarpa Poptr_03 POPTR_0001s06440

MSKFSQPSVDSTVALIMTQNGRAETKVVSTTRKPSKGGWNAAIFIIFVEVALRFA
YYGLAGNLITYLTNDLHQSTSTAIKNINTWVGVSAIFPIFGAIVADSLLGRFKTILLSSTIY
FIGMVLLTLSVSVIPTHYREAVFFIALYILAVGEGGHKPSVQTFAADQFDEEEPEEKAAKS
SFFNWWYLGIVVGASSAILVVIYIQDNLGWTAGIGILTGALGVALFIFLIGIKRYRKQAPV
GSPFTMVAQVFVAATRKRRVVQTRQGWGICYEAGGTDIEGQTRKRTLAATNQFRFLDK
AMIIDDLDASSKNRNPWRLCSLNQVEEVKLVLRLLPIWLSCLMFTVVIVQTHTLFIKQGS
TMTRSIGPNFQVPPASFQSLVGLTILFTIPLYERVFIPAARKITGHSSGITMLQRIGIGLFLSI
VEMVVAALVEAKRVSIAREHGLMDIPKATIPMSVWWILPQYMISGISDVFTVVGLQELF
YDQMPESMRSMGAAAYISVTGLGSFFNTAIITVVQAITARSSGILLGNNLNRAHVDYFY
WILAVLSALNFCVYLWVAHGFVYKKVEGEKPQEGRELAFAENLDAKT

Populus trichocarpa Poptr_04 POPTR_0001s12890

MMIGRAGRQQSIMLGLTIEVACETFTHLSSGTAARELARDMGSGEIKSPEGLPET
PATYDGVSNPIHSKKLGIYFLESDNRRMAFGRGYTGGTTPVDIHGKPIPDLSKTGGWIAA
LFIFGNEMAERMAYFGLSVNMVAFMFYIMHRPFTSSSNAVNNFLGISQVSSVLGGFLAD
AYLGRYWTIAIFTTIYLAGLTGITLCATMNIFMPDQGQCDQLSLLLGNCEPAKSWQMLY
LNTVLYVTGFGAAGIRPCVSSFGADQFDERGENYKSHLDRFFNFFYLSVTIGAIVAFTLV
VYIQMKHGWGSAFGSLAIAMGMSNMLFFIGTPLYRHRLPGGSPLTRVAQVLVAAFQKR
KASFSSSELIGLYEVPGKRSAIKGSGKIAHTDDFRCLDKAALQLKEDGVDPSPWRLCTVT
QVEEVKILIKLVPIPACTIMLNLILTEYLTLSVQQAYTLNTHLGHLKLPVTSMPVFPCLSIF
LILSLYYSVFVPIFRRITGHPRGASQLQRVGIGLAFSILSVAWAAIFERYRRKYAIEHGYEF
SFLTPMPNLSAYWLLIQYCLIGIAEVFCIVGLLEFLYEEAPDAMKSIGSAYAALAGGIGCF
AASILNSIVKSVTGNPDKRQQSWLSQNINTGRFEYFYWLLTVLSAINFCAFLYSARRYKY
RAEQKFGIQEVVTNKQNTPARG

Populus trichocarpa Poptr_05 POPTR_0001s18640

MEKNMEEPLSSQGEMTHQHTTPKHSKGGLITMPFIIANEAFEKVASYGLIPNMIL
YLMRDYSVGVAKGTNILFLWTAGTNFMPILGALISDSYLGRFLTIGLGSISSLLGMILLWL
TAMVPKVRPPPCDITTQSCKTPTTGQMTLLLSSFALMSIGAGGVRPCSIAFGADQLDNKS
NPKNERVLESFFGWYYASAAISVLISLTAIVYIQDHLGWKVGFGVPAILMFLSALLFFFAS
PFYVKQKPSKSLFTGFIQVPVVAYKNRKLAFPPRDSDGWYHHKRDSKFIAPTTKLRFLN
KACIIRNPEQDIASDGSASNPWSLCTIEQVEELKALLKVIPLWSTGIMISINISQSTFQLLQA
SSMDRHISSSFQIPAGSFGMFTIISLATWVILYDRAILPLASKIKGKPVQLGAKLRMGIGLF
LSCMAMVVSAIVESIRRRKAIREGYLNNAHAVLDMSAMWLVPQYCLNGLAEAFNAIGQ
TEFYYSEFPKSMSSIAAALFGLGMAVANLLASAILSAVDKLTSRGGKESWVSNNINKGH
YDNYYWLLAIMSSVNLLYFLVCSWAYGPCVERVIKVSDEGNGFKEEEFSNIGAIVKDEV

Populus trichocarpa Poptr_06 POPTR_0001s25570

MAEEDVYTKDGTVDYRGNPANKKETGTWRACPYIIGNEFCERLAYYGMSSNLIL
YFKHRLNQQSATATRNNLNWGGTCYLTPLIGAFFADAYLGRYWTIACFSIIYVMGMTLL
TISATVPGLRPKCYAEDDCNPTDAQSALAFVSLYLIALGTGGIKPCVSSYGADQFDDADE
VEKKHKSSFFNWFYLSINVGALIAGSVLVWVQDNVSWGWGFGIPAIAMAIAVASFFSGT
RLFRYQKPGGSPLTRICQVLLASFRKKKVEVPADKALLYETADAESNIKGSRKLDHTEEF
SFLDKAAVETEKDDIKGPVDPWRLCTVTQVEELKSIIRLLPIWATGIIFTAVYSQMGNLFV
LQGEQMDKYVGNSNFQIPSASLSIFDTLSVIFWVPVYDRIIVPVARKYTGHKNGLTQLQR
MGIGLFISIFSMVSAAILELKRLEMVRRHNSYELKTVPLSIFWQAPQYFLIGCAEVFTFIGQ
LEFFYEQAPDAMRSMCSALSLTTVALGSYLSSLLVTIVTSISTKNGKPGWIPENLNYGHI
DYFFWLLGVLSVLNLCVFLLISNWYTYKKPVGTLR

Populus trichocarpa Poptr_07 POPTR_0001s27970

MDGLNTSSRRKGGFRACTFIFTLGALENMGFIANMASLVLYFYYIMHFDIATSAN
TLTNFMGSVFMLSLVGAFIADTFLNRFYTCLLFGIMEVMGLALLTTQAYFKDLQPEFCL
RSTCVEGGQAVMLYGSLCLYALGSGGVKGAIPALGGDQFDHHQQKKGALARYYNWN
LLISTTGSIVGVTAVVWVSMNKGWYKGFFVSTVATLIGFTVLALGKPFYRIQPPGNSTFV
RIAQVIAVTFRNRDLSLPKNPDKLFEIHDASRDPSEERLSHSNQFRLLDKAAILREGTEPQ
PWKVCTVTQVEEVKIIIRMIPIIASTILMNTSMAQLQTFSVQQGVTMDAHLGTKTIPTPSIP
VIPLVFMSVLIPIYEFVAVPFARKITGHPSGITQLQRVGVGLVLSILSMAVAGFIELYRKHE
VHKNPPNKISVFWLSFQYGIFGIADMFTVVGLLEFFYKEAPSGMRSVSTSFTWLTLALGY
FTSTVFVDIINSVTKRITPSKQGWLHGNDLNSNNLNLFYWFLAILNVINFVFYLFSASWY
KYKSDDRESETIAKAEKGPNGEITLVK

Populus trichocarpa Poptr_08 POPTR_0001s34640

MGDEEKQAPATLEISMENGNLKEEKTTSNDEPEIKYGGIKAMPFVIGNETFEKLG
TVGSSTNLAVYLTTVFNMKSVKATTLLNVFNGTSNLAPLIGAYLSDTYFGRYWTLGFAS
VFSFLGMVVLMLTAAISTMHPPKCAPGAVCAGPTSWQLAFLLSGFAFLVIGAGGIRPCN
LAFGADQFNPNTESGKRGITSFFNWYYFTFTFAVMISVTGIVYVQSNVSWAIGLGIPAFL
MLLSCVMFFVGTRIYVIVKPQGSPITSIVQVLVAATKKRGLKVPDNSAMSLFNYIPAKSI

NSKLPSTEQFRCLDKAAIITDENQINLDGTAANPWKLCSVQQVEEVKCLLRIIPVWSTSIL
YQIPLLQQQTYAVFQALQMDRRLGSTSFKVPAATYIIFTMLTLTIWIPLYDRIIVPFLQRLT
GKDGGITLLQRMGIGMILAILCTVVSGLVEENRRHIALTRPPLGQTNKGGSISSMSGMWL
IPQLALSGLSEGFNYIAQIEFYYKQFPENMRSIAGSAFFAGGALANYLSGVLVSIVHQITS
GSKTGDWLDDDLNKGKLDYFYYVIAGLGILNFGYFLLCAKWYRYKDADDSTVGMATK
GI

Populus trichocarpa Poptr_09 POPTR_0002s03070

MEESMPTSLVSNGCVDIRGRIADKRTTGGWKAAPFIIVNEVAERLAFFGIAVNMV
AYLVFEMHQSLPNAASHVTDWIGAAYVLTLFGAFCADAYLGRFRTIIVFSCIYTVGMVL
LTLSASIDSLRPPKCMVRLCPQATDGQTGFLYGALALIALGTGGIKPCVSSFGADQFDEA
DEEELPKKYAFFNWFFFAINMGAILGITVLVYIKEKKGWALGFGLPTGAMVISTIILAAGI
PFYRFQRPMGSPFTRFVQVMVASVRNHLNGVQVRHQTELYEVNTKESDIKGSQKLFHT
LQYSFLDKAAVVTDSEADTGNRWRLCTVTQVEEFKSFIRILPVWASTIAFSISFAQLSTFF
TSQANIMDRKLSSNFKIPAASVPVFSTLNALILVPIYEKVIVPILRKRTGHTRGITSLQRIGV
GLFISIFALIAAALVEKKRRDSPNPSGMSVFWLFPQFFLIGSAEVFTYVGQLEFFYDEATD
GTRSISSAVFLSEIGIGSWFSTAIVKIIESATGGEDKGWLRNNLNKSRLDYFYWVLTVINA
VNFVVYLWISVVYKSRGGAVGTVRDEGVVDMGDDGD

Populus trichocarpa Poptr_10 POPTR_0002s13090

MAFISMAVSLVTYFYGYMNFSLTKSATTLTNFMGTSFLVALFGGFICDTYMTRF
KACVLFGCVEFMGYGLLTVQAHFHHLRPSPCKGVSPDQCEGADGSQAAILFAGLYLIAF
GTSGVKASLPSLGADQFDENDPKEASQLSSFFNWFLFSITIGAILGVTIIVWISTNQGWDL
GFGVCAIAVLLAIIFASMGKSLYRNNVPKGSPLTSFAQVFVAAIRNRGLPIPEKAEELHEI
HNKDAGVKREILPWTDQFRFLDRAAIAKTTNDASTSISHRPWRLCTVTQVEETKILIRML
PIILSTVFMNTCLAQLQTFSVQQSITMDTRVFGFQVPGPSLPVIPLLFMFVLIPIYERVFVPL
ARKITGIPTGIRQLQRVGVGLVLSAISMAVAGIVETSRKSVAVEHNMVDSTEPLPMSFLW
LGFQYAIFGAADMFTLVGLLEFFYAESSAGMKSLSTAISWCSLAFGYFSSTVVVEVVNK
VTGGWLANNNLNRDKLNYFYWLLAGISIVNFGVYLACASWYRYKKGGEVNQIENGGG
GDAKGKAQMV

Populus trichocarpa Poptr_11 POPTR_0002s25060

METKEGNSGIEEYFDWKGKKADPKKHGGMRAASLACVVEVLENLVFLSNATNF
VAYFTKTMHYTISESANMVTNFIGTSFLLTIFGGFIGDSFFTRFRTFVVFCIIELLGMILLTV
QAHDTRLQPAVQEKPSSSQAAVLFSGLYAIATGVGGIKATLPAHGADQSDHSKQRSISSF
FNWFFFSLCIGGLLSSTIMVWIEENRGWNWSFKISVVVLGVALCIFIAGFPIYRFKRPGGS
PITRILKVFASASRNRKVSSGLELINDEVGERSHKKFRFLDKALFDDTISAVQVKETRTFL
GLLPIFASTIMMNCCLAQLQTFSVEQGSIMNRKLNNFQIPTQSLTVFPLIVVLASIPLFEHL
ANSYKNKMSENHYILDPLKRIGLGLALASASMAVAAIIEFKRREAAENGHTLSVFWLGG
QYLLLGVSDMLTLEGMLEFFYSEAPDSMRSFCTALSWCSTSMGYFLSSVLVSIINSITGK
LDHEWLGGHNLNHNRLDLFYTILCILNFLNLLNYIYWAKKY

Populus trichocarpa Poptr_12 POPTR_0002s26040

MICKVEEKGAADGSKDYTEDGTVDIKGNPALRSKSGRWKACSFILGYEVFERMA
YYGIAANLVLYLTRKLHEGTVTSSNNVTNWAGTVWILPILGAYIADAHLGRFRTFVIAS
GIYLLGMSLLTLAVSVPALRPPSCGHGIKDEGCDKRASALQKGIFYGALYIIAVGTGGTK
PNISTMGADQFDDFEPKEKQQKLSFFNWWMFSIFFGTLFSNTFLVYIQDNVNWALGYGI
PTMGLALSIIMFLAGNSFYRHKLPAGSPFTKMAQVLVASVRKWKVSLPNDPKELHELGI
EGSARSARNRIDHTYLLRLLDKAAVKSGPTSPWMLCPVTQVEETKQMIKMLPVLMVTFI
PSAMLAQLSTFFVKQGTTLDRSMGPHFEIPPASLGAFVTIFMLASLVLYDRCFVPIARHY
TKNPRGITMLQRMGIGIILHIIVMIVAFVVERKRLSVAREHNIVGKLEVVPLSIFVLLPQFA
LVGISDTFLEVAKLEFFYDQAPEGMKSLGTSYFCSSIGVGNYLSSFILSTVSGITKKHGHK
GWILDNLNLSRIDYYYAFLAILGFLNFLLFLLVANYFVYNVDMDSKRDLQRAMETSSSK
SPVQIL

Populus trichocarpa Poptr_13 POPTR_0002s26060

MAEVLEEKGPAGGKDDYTADGTVDLKGRPVLRSKTGRWRACSFIVGYEVFERM
AFYGISANLVIYLTKKLHEGTVASSNSVTNWAGTAWILPILGAYIADAHLGRFWTFIIAS
GIYVAGMSLLTLAVSVPALRPPSCGQGIKEVECDKKASALQKGVFYGALYIIAVGTGGT
KPNISTMGADQFDDFEPKERTQKLSFFNWWMFSIFFGTLFSNTFLVYIQDNVGWTLGYA
LPTLGLAVSIIVFLVGTPFYRHKLPAESPFTRMAQVLVAAVKKWKVPVPDDPKQLHELS
LDEYIGSGKFRIDYTSSLGFLDKAAVESGSRSPWMLCPVTQVEETKQMIKMLPVWAATF
IPSTILAQVHTLFIKQGTVLDRSMGPHFEIPPACLTAFVTISMLISLAIYDRYFVPMARHYT
KRPRGITLLQRMGIGFVLHVIVMITACLAERKRLSVAREHNIIGKNEVVPLSIFILLPQFVL
MGVADNFVEVAKIEFFYDQSPEGMKSLGTSYFTSSLGIGNFLSSFILSTVSKITKKHGHKG
WILDNLNLSHLDYYYAVLAILSFLNFLLYLVAANFFVYNVDVDSKSDLQGKKKEASLVE
AHQDNENLKVG

Populus trichocarpa Poptr_14 POPTR_0003s00860

MEARRYDNKGESKCVIGEEITVDWRGKPSNPNKHGGMRAAAFVLGLQAFEIMA
IAAVGNNLITYVINEMHFPLSKAANTVTNFVGTIFILALLGGYLSDSYLGCFWTMLIFGFV
ELSGFILLSVQAHLPQLKPPQCNMLTDGENCVEAKGVKSLIFFVALYLVALGSGCVKPN
MIAHGGDQFNQSNPKQSKKLSTYFNAAYFAFSMGELFALTLLVWIQTHSGMDVGFGVS
AAVMAMGLISLVSGNLYYRNKPPQGSIFTPIAQVFVAAILKRKQICPSNPQMLHGSQNSV
LDNGIVAPSADSGSLAHTQRFRFLDKACIKIEDGTNIKESPWRLCSVTQVEQVKILISAIPI
FACTIVFNTILAQLQTFSVQQGGAMDTQLAKSFHIPPASLQSIPYIILIIVVPLYDTFFVPLA
RKITGHESGISPLQRIGAGLFFATFSMVSAAIMEKKRRDAAVDSNKILSIFWITPQFLIFGL
SEMLTAVGLIEFFYKQSLKGMQAFLTAITYCSYSFGFYLSSLLVSLVNKITSSSSSNQGWL
SDNDLNKDRLDLFYWMLAVLSFLNFLSYLFWARWHSYSPISLLTTTQQETLGDDHLNN
YGFINSSKHGVDESMP

Populus trichocarpa Poptr_15 POPTR_0003s08710

MACLQVCKEDKFKEGEGECTFDGTVDWHGRPAIKAKSGQWAAGIIILLNQGLAT
LAFFGVGVNLVLFLTRVLQQSNADAANNVSKWTGTVYIFSLVGAFLSDSYWGRYKTCA

VFQVIFVIGLVILSLASHLFLIRPKGCGDELTPCGSHSSMEVSLFYLSIYLIALGNGGYQPN
IATFGADQFDEDDPREGYSKVAFFSYFYLALNLGSLFSNTILGYFEDEGMWALGFWMSA
GSAFAALVLFLGGTARYRHFKPSGNPLSRFGQVIIAAMKKCRVEMPPDGEEELYDVDRK
DCSMNGNRKILHTDGFKFLDRAAFISSRDIDDQKRGCRNPWRLCPITQVEEVKCILRLLPI
WLCTIIYSVVFTQMASLFVEQGAAMKTTISNFKIPPASMSTFDILSVAFFIFLYRRVLDPL
VSSFKQTSSKGLTELQRMGVGLVIAIMAMVSAGLVECYRLKYARKDCKHCEGSSSLSIF
WQAPQYALIGASEVFMYVGQLEFFNAQTPDGLKSFGSALCMTSISLGNYVSSLLVTMV
VKISTEDHMPGWIPGNLNTGHLDRFYFLLAGLTTIDLVVYMACARWYKSIKLEKKCEEN
DHEENFRV

Populus trichocarpa Poptr_16 POPTR_0003s11080

MSLPETQGKTLPDAWDCKGRPAERSKTGGWTSAAMILGGEAMERLTTLGIAVN
LVTYLTGTMHLGNATSANTVTNFLGTSFMLCLLGGFIADTFLGRYLTIAIFATVQATGVT
ILTISTVVPSLRPPKCVDNTDCIPANGEQLTVLYLALYLTALGTGGLKSSVSGFGSDQFDD
TDPKERKQMLNFFNWFFFLISLGALCAVTVLVYIQDNLGREWGYGICACAIVLGLIVFLS
GTRRYRFRKLVGSPLTQIATVFVSAWRKRHMELPSDVSLLYNVDDVEEGSKEKKQKLP
HTKQFRFLDKAAIKGLEVGKVNKWNLANLTDVEEVKMVIRMLPIWATTVIFWTVYAQ
MTTFSVSQATTMDRRIGKSFQIPAASLTVFFVGSILLTVPVYDRIIVPVARRVLKHPQGLT
PLRRIGVGLVLSIVAMIAAALTEKKRLRAARLHGLANDPTAEIPLSVFWLVPQFFFVGSG
EAFTYIGQLDFFLRECPKGMKTMSTGLFLSTLSLGFFVSSSLVTIVHKVTINKPWLADNL
NQGRLHDFYWLLAILSALNFVIYLICARWYVYKDKRLADEGIELDEVDEPTFH

Populus trichocarpa Poptr_17 POPTR_0003s21800

MEGMTKVVANTLLRRPLFPVTGESVISRENVAVNRIRTEEEHDIASNKRSITWKS
SGGWKAASILLANQCLATLAFFGVGVNLVLFLTRVLGQSNADAANSVSKWTGTVYLCS
LIGAFLSDSYWGRYLTCAVFQLIFVSGLALVSVSSCYFLIKPDGCGDGELACEPTSSVGV
AIFYLAIYLVAFGYGGHQPSLATFGADQFDESKPKEKNYKAAYFCYFYFALNFGSLFSN
TILVYFEDHGKWTLGFLVSLGSAVLALVSFLFGTPGYQYVKPCGNPLPRVAQVFVAAV
KKWDVIPAKADELYEVEGPESAIKGSRKILHSDDFEFLDKAATVTEDDLSHQKNPWRLC
TISQVEEAKCVLKMLPIWLCTIIYSVVFTQMASLFVEQGDVMNSYAGKFHLPAASMSAF
DICSVLVCTGIYRQILVPLAGRLSGNTKGLTELQRMGIGLIIGMLAMFAAGATEIERLKH
VTEGKKVSSLSIFWQIPQYVLVGASEVFMYVGQLEFFNGQAPDGIKSFGSSLCMASISLG
NYVSSMLVSMVMKITAKGDKPGWIPDDLNTGHMDRFYFLIAVLTAFDFVIYLFCANWY
TPINIDDSHGGIGMEKQEDDALARV

Populus trichocarpa Poptr_18 POPTR_0004s06290

MQEKLEFVEGKVDWKGRQALKNKHGGLWASLLILVMFALESMATISLAVNFVT
YFNGVMHFQIADAANMVTNYMGVSYILSIVAAVLADTLFGRHRTAVISGCLELMGLSL
LAFQAHYAKLKPPPCNILDPTAHCEKVGGGNIVLLFVSLFVLAAGSSGTKASVPSHGAD
QFDEKDPKELIQMSSYFNFVLLAVCLGAAVSLTFFVWIQDNKGWDWGFGVGAISMLLA
VIVFIAGLPMHRIHVVQGSSTVVEILQVYVAAFRNRKLQLPEDPLDLYEINKDKEAAIEA
ESLPHRDTLRFLDKAAIQTSTEKFSEAPNPWKLCRVTQVENAKILLSILPVFSCTIIMTLCL

AQLQTFSIQQGLTMDTSITKSFNIPPASLPIIPVIFLIILVPLYDRLVVPFARKFTGLPTGITH
LQRIGVGLILSSISMASAALMEVKRKDVARDHNMLDAIPVLQPLPISTLWISIQFFIFGIAD
MFTYVGLLEFFYSEAPKGLKSISTCFLWCSMALGYFLSTILVNIVNGVTKGSTKSGGWL
AGNNINRNNLNLFYWLLSILSFLNFCVYLFVARRYTYRPQNSSLPSNENREAPANQEDR
REN

Populus trichocarpa Poptr_19 POPTR_0004s06710

MASGQKPKGLNRSCFLLIVIAGMERFAFKGVASNLVTYLTDVVMMSNSAAAKT
VNNWCGFTSMLPLLVASLADSWDRYSTILSSSFLYVVGLVALTSTALAWARHPTNNISS
SYLFWSLCLISLGQGGYNPSLQAFGADQIPNDDELPCTKDEQKSNKKSLFFQWWYFGVC
GGSLAGVTVMSYIQDTFGWALGFAIPTIAMTASILLFWCGSRIYTYKQDDNISERSSLDIF
RAIKGAVSKLMNSRITLSSNKPDVAELELQEKPLCQNSGNAKALMEKPVGDINYLVENG
KVVLRLLPIWSMLLMFAVIFQLPATFFTKQGMTMKRNVGSSFKIPPATLQSSITVSIILLM
PFYDALLIPLARLITRDEKGISVTERMGIGMVLSIIAMAIAALVETKRLEIGQKMEVVDQK
METEVPLSIFWLLPQYILLGISDIFTVVGMQEFFYSEVPVRMRTMGIALYTSVFGVGSFLS
ALLISLVEYFTSSTGGKSWFSDDMREARLDKYYWLLALLSVLSLIFYVVFCKCYVSRSS
DLDNEKS

Populus trichocarpa Poptr_20 POPTR_0004s23790

MDMEARRHDTKGESVCVVSEEVTVDWRGKPSNPNKHGGMRAAAFVLGLQAFE
IMAIAAVGNNLITYVINEMHFSLSKSANIVTNFVGTIFILALLGGYLSDSYLGCFWTMLIF
GFVELSGFILLSVQAHLPQLKPPQCNMLTGGENCIEAKGFKTLIFFVALYMVALGSGCVK
PNMIAHGGDQFNRSNPKQSKKLSTYFNAAYFAFSMGELFALTLLVWVQTNSGMDVGF
GVSAAVMAMGLISLVSGTLYYRNKAPQGSIFTPIAQVFVAAMFKRKQTYPANPQMLHG
SQNSVPSNGLVDPSSDPCRLVHTQRFRFLDKACIKVEDGSNRKESPWRLCSVTQVEQVK
ILISAIPIFACTIVFNTILAQLQTFSVQQGSAMDTQLTKSFHIPPASLQSIPYIILIFVVPLYET
FFVPFARKITGHESGISPLQRIGAGLFFVTFSMVSAAIMEKKRRDAAVDSNKILSIFWITPQ
FLIFGLSEMLTAVGLIEFFYKQSLKGMQAFLTAITYCSYSFGFYLSSLLVSLVNKVTSSSS
TNKGWLSDNDLNKDRLDLFYWMLAVLGFLNFLNYLFWARWYSYSPTSVSITTQQGTH
GDDYGFTNSSKHVGDESIP

Populus trichocarpa Poptr_21 POPTR_0005s00320

MPKLSGCMQGDVEGSKEDHVPLGLAGKKGRGGFRATMFVYGLVALDSMGFVA
NMVSLVLYFMGVMHFDIPTSANTLTNLMGSTFLLTVLGGFISDAYLNRLHTVLLFGFLEI
MALVLITIQAHAKNMHPPACGKASCVEGGIEYMLYFSLGLLALGSGGVRGALPALGAD
QFNEKDPEEARALASYFNWMTLSTVVGAVVGVTGIVNLSMFHGWWKGFLVSTVGTFI
GFVILAAGKPFYHLRQPGDSPLIRIAQVFALAIRNRRLPLPKVEELYEISDKETIAYEEKLE
HTEQFRFLDKAAILPEGTQPAPWKVCSVTQVEEVKILTRMLPILGSTIIMNTCLAQLQTFS
VQQGNDMYRKIGKHDFPAPSVPVIPLVFMVILIPAYEFFFVPFARKFTGHPAGITQLQRV
GVGLVLSAVSMAVAGLVEVKRRDQALKGHLISLFWLSFQYGIFGIADMFTLVGLLDFFY
KEAPSSMKSLSTSFTWLSLSFGYFLSTVFVNLINAVTKRITPSRQGWLHGQLLDYNNLNL

FYWFLAILSCLNFVLYLYSASWYKYKPDDTESNNKPKAKDSDEGLLLAKESSGAKTDEE
ESEQNAANRNEEESAQETDDAEAKAPSSEQSNGTK

Populus trichocarpa Poptr_22 POPTR_0005s25490

MQRIGPVGDEHFDQSFMQPSLEKFPQEELHQTAMEESMGTTLVSNGCVDIRGRI
ADKRTTGGWKAAPFIIVNEVAERLAFYAIAVNMVAYLVFQMHQSLPDAATHVTDWIGA
AFVLTLFGAFCADAYLGRFKTIIIFSCIYAVGMVLLTLSASIDSLRPPQCKVRPCPKATGG
QTWFLYGALALIALGTGGIKPCVSTFGADQFDEADKKEVPKKYAFFNWFFLAINMGALF
GITVFVYIQDNKGWAWGFGLPTGAMVISIVILVAGIRFYRFQEPMGSPFTRFVQVMWAS
VRNHLHGVLVGHQTELYEVNTNESDIKGAQKLSHTIQYSFLDKAAVVTDPEADTRNRW
RLCTVTQVEEFKSFIRILPVWASTIALSISFAQLSTFFISQANIMDRKLGSNFIIPAGSVPIFS
VINALILVPIYEKVIVPILRKRTGHSRGITSLQRIGVGLFISIFAVASAALVEKKRRHSPNPS
DMSVFWLFPQFFLIGSAEVFSYVGQLEFFYDEATDGTRSISSAMFLSEIGIGSWLSTAIVKI
IERATGGEEKGWLRNNLNLSKLDYFYWVLTSINAVNLAVYVWIAVLYKGRGGAVGSV
RSESVFEMGDGVLLEKEDDKGERF

Populus trichocarpa Poptr_23 POPTR_0006s03240

MESQDNKKSHEEKQEEVKIKEDDKRKKLGGIKATPFILATEIFDRFSTIGFHANMI
TYLTQQLNLPLVRASNIVSNFDGTASLTPLIGALIADSFAGRFWAIIVGSIIFELGLISFTTT
ALLKSLHPPPCPTLVDCKEASNFQLSTLYLSLLLLAIGLGGTRPCVMTYAADQLDMSKSS
VESRSWNFFNWYYFSLGLARLTAVSVVVYIQDNVSWGWGLGIPTIAMGIAFIVFLAGSP
LYTKVKPGGSLLVRVTQVIVSAIRKRKAVAPEDSSLLYQNKELDAAISVHGRLLHTPQF
KWLDKAAVMKDGEATDSNPPNPWKIATVHRVEELKSFLRLLPVWAAGILLVTANSHSG
SFNTQQAWTMKRHLSNSFQIPPASMSVFGILTGMTGLVLYERLFVPFVRRFTGTPAGITY
LQRMGIGLIFNILTSIVSALVEKKRRTVAEHHNLLDNPKATVPISVFWLVPQLSLHGISEIF
MTVGQLEFLYDQSPESMRSIALGLFWIANSMGNYLGTFMVSLVHKYTGHKNNWLPDR
NLNRGKLDYYYWLVTGIQVVNFVYFVICAWFYNYKPLEEDMEADFKASEDGAAGNGE
VELGTTEKV

Populus trichocarpa Poptr_24 POPTR_0006s03250

MKHEMEMELESNSSKVGNGKGKEEEEEEEKKEDSKRRKLGGIKTMPFILSNEICD
KFAAAGFYANMITYLTQQLNLPLVKASNTLTNFGGMGSFTPLIGALIADSYAGRYWTIIG
GSIIYELGMISLTVSAVLPSLRPPPCPSQVNCKEASNSQLWILYMSLILTSIGSGGIKPCVV
TFAADQFDMTKSAVGSRSWNFFNWYYFCMGMATLTALTVVVYIQDNVGWGWGLGIP
AIGMALSIVAFIFGSSLYNKLKPEGSPLVRLAQVVVAAAKKRKEVMPLDPGMLYQNKEL
DAAISVNGRLLHSDQFKWFDKAAIVTNEDAKDSKSPNLWRIATVHRIEELKCIVRMLPI
WSAGILLVTASSHLHSFVIQQARSMDRHLSHSFEIPPASFSVFSILTMLIGLVLYERLFVPF
ARRFTGNPSGITCLQRMGVGFFINIIATIVSALVEVKRKQVAALHNLLDAPQAIIPISVFW
LLPQYILHGIADVFMSVGHMEFLYDQSPETMRSTAAALNSLEVSMGNYIGTLVVSLVHK
YTGQKNNWLPDRNLNRGKLDYYYWLVTGIQVINLVYYVICAWFYTYKPLEEVKEEDD
DVPAEDEIQHKRLNYAEGNGEVELRRNVIV

Populus trichocarpa Poptr_25 POPTR_0006s09270

MENVVVTAKTSSPSDDDISPPPPISFLPPPPPKKAPGGWRSVKYILGNESFEKLAS
MGLIANLTVYLQTRYNMDGIQLVNVYNIWSGSTNVTPLLGAFLSDAYLGRFRTLLFGSM
SSFLGMVVLALTAGMPKLRPLDCPGVSNCQKPQDWQLGVLYSGLGLLAVGAGGVRPC
NIAFGADQFDTRTEKGRAQLESFFNWWYFSFTVALVIALTAVVYVQTNVSWVIGYAIPA
ACLFSSIIIFLIGKHTYIITKSQGTVFVDIAKVIVAARKKRAVSLESSSGHPLYDPPLTESDQ
RVAKLAHTDMFKFFDKAALITDPSELDDKGLPKNSWRLCSVQQVEQLKLIVGLVPVWF
TGIGCFITMDQMNTFGLMQAIQSNNEVHNFKIPPGWMGLISMICLSIWIFIYEQIYLPQAR
KRSKKNIRFTTRHRINTGIVMAILCMVVAAIVEKSRRDAALKQGTLVSPQSILLLLPQFAL
SGLNEAFAAVAIMEYYTNHLPETMRTLSGAIFFLSFSASSYLNTAIINLVHLVTSNNGKES
PWLGGRDLNKVKLDYFYYLIASLAALNLLYFNLFSCRYLEKQLFIIIILV

Populus trichocarpa Poptr_26 POPTR_0006s09310

MELKKGVETRGVNEEKWVHDSSVDHKGRVPLRASTGAWKASLFIIAIEFSERLS
YFGIATSLIIYLSKVMHQDLKTAARSVNYWGGVTTLMPLFGGFLADAYLGRFTTVFVSSI
VYLLGLILLTMSAFVPSLKACEAAVCPKPRKVHEVVFFLAIYLISVGTGGHKPSLESFGA
DQFDENHDDERKKKMSYFNWWNFGLCCGLLLGVTVVVYVQDHVGWGAGDIIFTAVM
ALSLVIFIIGRPFYRYQVPTGSPLTPMLQVLVAAIRNRNLPYPSNPAELYEVPKSRTDKGR
LLCHTESLKFLDKATIVKDRKIGAENQNPWRLATVTKVEEMKLILNLIPIWLAMLPFGIS
VAQTATFFIKQGTTLDRNIGNGLQIPPASVYALAAIGMIVSVTIYEKILVPVLRRATGNER
GIKILQRIGFGMLFSISTMVVSALVERKRLGVVAKDPVKGSLSMSVFWLAPQFIIIGVGD
AFTLVGLQEYFYDQVPDSMRSLGIAFYLSVIGAANFLSSLLITAVDHVTEKTGKSWFGK
DLNSSRLDNFYWLLAGMTAANLILYVFLAQRYPYKNVQSSVAVADCYKDGLEGSMA

Populus trichocarpa Poptr_27 POPTR_0006s09820

MAQDDYSNDGTVDIKGNPANKKKTGNWKAGRFILGNECCERLAYYGMSTNLV
NYLEDRLNQGNVAASNNVTNWSGTCYITPLIGAFLADSYLGRYWTIASFVVIYIIGMTLL
TLSASVPGLESSCDKDSCHPTTGQTTAFFVALYFIALGTGGIKPCVSSFGADQFDETDETE
RKKKSSFFNWFYLSINIGALIASSVLVWIQMNVGWGWGFGIPAVAMAVAVVFFFLGSKL
YRIQKPGGSPITRIVQVIVASFRKYHVQVPADKSLLYETAEEESQIQGSRKLEHTDKFKFF
DKAAVETQTDNIKDLTNPWRLCTVTQVEELKSIVRLLPVWASGIVFATVYSQMSIMFVL
QGNTMDQHMGPHFKIPSASLSLFGYLSVIFWAPVYDRIIVPYARKFTGHERGFTQLQRM
GIGLVISIVSMIVAGVLEAVRLNFVRENNYYDLEYIPMTIFWQVPQYFLIGCAEVFTFIGQ
LEFFYDQAPDAMRSLCSALSLTTVALGNYLSTLLVTIVTKVTTRGGKLGWIPDNLNRGH
LDYFYWLLAILSFLNFTAYLWISKWYAYKKATERPH

Populus trichocarpa Poptr_28 POPTR_0006s25670

MENSIVEEKMVLIPKDKDPRKGGLRTMPFIIVNEAFERVASYGLMPNMIFYLMK
NYRMEAASGSTILFLWSAMSNGLSIFGAFLSDSFMGRYLVISLGSFCSLLGMILLWLTAM
IPQLTPPPCDRFTNVCSSATAGQLATLFSSFGLISIGAGCIRPCSIAFGADQLDNKENPNNE
SVLQSFFNWYYAATGLSTIIAFTAIVYVQDNLGWKVGFAIPAVLMFFSALMFLVGSSQY
VKVKASTSLFTGFVQVLVAAFRNRKLSLSHSSIEQYYYHSDDSEFQIPTVNLRCLNRACII

TDPDRDVNPDGSASNPWSLCTVDQVESLKALLRVIPIWSTGIMMQINLNQNSFATLQAN
TMDRQIFNFELPAGSLNVFLVLTLTIWLTFYDRILLPLLAKFTGKQRGGPSPTVRIGIGLLI
PIAARAMSAVVETIRRRTAIEEGLEDQPDGVVNMSVVWLLPPIILLGLAEAFNSIGQIEFY
YSQFPKSMSSIAVAIFTFGTAMADMIGSGLVDVVDRVTSRGGQESWLSSNLNKGRLDDY
YWLITVLSIINFVYFLVCCRTYGRTKDEKEERLLE

Populus trichocarpa Poptr_29 POPTR_0008s04470

MKHSKRGGWTTFPFIIGAVMGLTLAAGAGSANLIVFLVTVMNIKSINATQINNIII
GCYSLFPVAGAVIADSFFSSFYVVSVFAFVSLLGLIMLTLASTIHSLRPPTCVIGSLACEAP
SKLQYAVLYLALALASLGVGGTRFTISTMGADQFKKPNEQGTFFSWYFFTLYLASAISLT
AIIYVQDSVSWGLGFGIGVVANAIGLAVFLLGKRFYCHTKPKGSPFVGIARVLVAAIRKR
RKLETFQSQGYFHGDNTKAISSPTESLRFLNCAALRYEDDRKSDGSYSSSRWLCTVEEVE
DLKTLIRIMPLWSSGILLSTTIAMINSLTVLQALTMDRHLGPHFKIPAGSFLVFSILATALSI
SIIDRFLLPMWKNLTRRSLKPLQQIGIGHVINIFAMVGSALVETRRLRVVRTHHLNGEPPG
SVVPMSGLWLVVPLFVIGVGEAFHFPGQVALYYQEFPTSLRSTSTAMISLLIAIGYYLSTA
IIDSVRRSTGWLPDNINDGRLDYVFWLLTAIAFVNFGYYLLCTKFFKYQNTENHENEAS
A

Populus trichocarpa Poptr_30 POPTR_0008s06140

MEQPENRKVGREAKESDEEEKWVRDSSVDYKGRVPLRSSTGVWTASLFIITNEF
SERLSNFGITANLISYLTKVIHQDLKTAAKSVNYWAGVTTMMPLFGGFLADAYTGRFSM
VLLSSLVYLLGLSLLTMSQFIPSLKPCDVGGCEKARKIHEVAFFLAMYSISLGTGGHKPC
LQSFGADQFDDDHAEERKKKLSYFNWWNIAVCCGLFLGVTVIVYIEDNMSWGVAILILT
ITMAVTVATFYMGKPYYRYRLPEGSGSTSMLQVLVAAIRKRKLPSPSNPALLYEVPNYK
IQGRLLGHTDRLTFLDKAAVLEEEEISNEVKHNPWRLATVTKVEEMKLVLNIIPIWLTSL
PFGLCVVQTATFFVKQGATLNRKIGHNFEIPPASIFSLSAVGMIISVVIYDKILVPFLRRAT
GNERGISVLKRIGSGLIFSVVAMSVAALVERKRQKIAEEDIDVLDGEKNVELPMSVFWL
APQFLILGLGDGFTLVGLQEFFYDQVPDSMRSLGMAFFLSVLGAGNFLSSFLITAVDRITE
KDGKGWIGKDLNSSRLDKFYWLLAAINSVNIFVYVLFARRYTYKTVQRRLTATHLNKD
DGMELMP

Populus trichocarpa Poptr_31 POPTR_0008s17000

MENGLDECTQDGTVDLKGNPVLRSKRGGWRACSFVVVYEVFERMAYYGISSNL
VVYLTKKLHEGTVRSSNNVTNWVGTIWMTPILGAYVADAHLGRYWTFLTASVIYLLG
MSLLTLSVSLPALRPPPCKDANSDNCRKASTMQLAVFFGALYTLAVGTGGTKPNISTIGA
DQFDDFHPKEKAHKLSFFNWWMFSIFFGTLFANTVLVYIQDNVGWALGYGLPTLGLLIS
VAIFLAGTPYYRHRLPTGSPFTRMAKVIVAALRKSKVSVPSDPKELYELDLEEYAKGGK
FRIDSTPTLRFLTKAAVKTGRTDPWMLCSVTQVEETKQMLRMIPILIATFVPSTMIAQINT
LFVKQGTTLDRNIGSFKIPPASLVGFVTLSMLVCVVLYDRFFVSIARRWTKNPRGITLLQ
RMGIGLVFHIIIMIAASLIERHRLSVAREHGLVENGGQIPLTIFILLPQFVLMGVADAFLEV
AKLEFFYDQAPESMKSLGTSYSTTSLGIGNFLSSFLLSTVSDITKKHGHRGWILNNLNAS
HLDYYYAFFAILNFLNFIFFLIVNRLYVVYKAEVSDSMEVLAEELKGMTLTEPNQVSSHE

Populus trichocarpa Poptr_32 POPTR_0009s04710

MAEEDVYTKDGTVDYLGNPANRKETGTWRACPFIIGNEFCERLAYYGMSSNLV
LYFKHRLNQSSATATRNNLNWGGTCYLTPLIGAFVADAYLGRYWTIASFSTIYVAGMTL
LTMSATVHGLRPECYSKDHCHPTGGQTAVTFVALYLIALGTGGIKPCVSSYGADQFDDA
DETEKKHKSSFFNWFYLSINVGALIAGSVLVWIQDNVSWGWGFGIPAIAMAIAVVSFFS
GTKLFRYQKPGGSPLTRICQVLVASFRKQKVEVPADKSLLHETADAESNIKGSRKLDHT
EEFSFLDKAAVETEKDDIKGTGDPWNLCTVTQVEELKAIIRLLPIWATGIIFSAVYSQMG
NLFVLQGETMDKFVGNSTFEIPSASLSIFDTLSVIFWVPVYDRIIVPVARKFTGHKNGLTQ
LQRMGIGLFISIFAMVSAAILELKRLQMVRNNNYYELDSVPISIFWQVPQYFLIGCAEVFT
FIGQLEFFYEQAPDAMRSMCSALSLTTVALGNYLSSLLVTIVTTISTKNGKAGWIPDNLN
YGHIDYFFWLLGMLSVLNLGAFLLISNWYTYKKAIGTLR

Populus trichocarpa Poptr_33 POPTR_0010s04320

MELEHQPTRWEGYVDWRNRPALRGLHGGMLAASYVLGVEILENLAYLANASN
LVIYLSEYMHLSPSKSANNVTNFMGTSFLLALLGGFLADTFFTTYHIFLISAAIEFLGLVIL
TVQARSSSLKPPACNPSNPTIPCQQIDGAKAAMLFTGLYLVALGVGGIKGSLPAHGAEQF
DESTPQGRKQRSTFFNYFVFCLSCGALIAVTFVVWVEDNKGWVWGFGISTIAILLSIPIFL
AGSAAYRNKIPSGSPLATISKVLVAAGVNTCMSRSSGNAIASLTTSPSNPNPTSKDAIDNS
IAVMPAETPTKSLDWLNKAVVNKPIHSALECTVQQVEEVKIVIKIFPIFACTIMLNCCLAQ
LSTFSVQQADTMDTKLGSLKVPPASLPVFPVVFIMMLAPVYDHLIIPFARKLTKSEMGIT
HLQRIGIGLVLSIIAMAVAALVEIKRKRVAANSGLVDKLPITFFWIAFQYLFLGSADLFTL
AGLLEFFFTEAPAGMRSLAMSLSWASLAMGYYLSSVIVSIVNNVTGNSKNRPWLSGTNI
NHHHLERFYWLLCVLSVLNFLHYLFWATRYKYSTRVQN

Populus trichocarpa Poptr_34 POPTR_0010s04370

MAEDEKKGTSSYRLYCSIKCFQKPSSPEQKHGNLAETEQKKPGGWRAMPFILGN
ETFERLATFGLLANFMVYLMRVFHLEQVTAANVINIWSGVTNFAPLVGAFISDAYVGRF
KTIAFASCAAFLGMVTVTSTAWVPYLHPQKCEPEGKQQSYGNCESPTSMQLGVLLLGL
GFLSIGTGGIRPCSIPFGVDQFDPTTEEGIKGISSYYNWYYTTFTVVMLITLTAVVYVQDS
VSWVLGFGIPTVLMLCSIILFFIGTRIYVHVKPEGSVFSGIAQVFVSAYKKRRLKLPDNCD
GEQVDGIFYDPPIKDQLTILSKLPLTNQIRFLNKAAMIEKETDLKPDGSCAKQWRLCSVQ
QVEEVKCLIKIGPIWASSIVSLTSMVQQGTFTVSQALKMDRHLGEKFQIPASSIIVVSLITI
GIWLPFYDRVLVPAIRKVTKHEGGITILQRIGIGNVFSVLSMVVAGLVERERRAAAISHPE
AAPMSVFWLAPQLVVMGLCEAFVGTGQIEFYNKQFPDHMRSLGNSLFFCSFAGASYLS
TMLGSIVHKVTGTRHHPDWLTNDLNAGNLDYFYFLLAGMGVVNWFYFLLCAHRYRYK
VSTVLIPL

Populus trichocarpa Poptr_35 POPTR_0010s07870

MEHGLDDYTQDGTVDLKGKPVLRSKRGGLKACSFVVVYEVFERMAYYGISSNL
VVYLTKKLHQGTVKSSNNVTNWVGTIWLTPILGAYVADAHLGRYWTFVVASVIYLSG
MSLLTLSVSLPALRPPICKNANVENCKEASTLQLAVFFGALYTLAIGTGGTKPNISTIGAD
QFDDFHPKEKAYKLSFFNWWMFSIFFGTLFANTILVYIQDNVGWALGYGLPTLGLVISV

AIFLAGTPFYRHRQPTGSPFTRMAKVIVAALRKWKVSVPNDPKELHELDLEEYAKAGKF
RIDSTPTLRFLNKAAVKTGSTDPWMLCSVTQVEETKQMLRMIPILISTFVPSTMIAQINTL
FVKQGTTLDRQIGNFEVPPASLAGFVTLSMLVCVVLYDRFFVRIVRRWTKNPRGITLLQ
RMGIGLVFHIIIMITASLIERHRLSVARQHGLVEKGGQVPLTIFILLPQFVLMGAADAFLE
VAKLEFFYDQAPESMKSLGTSYSTTSLGVGNFISSFLLSTVSHITKKHGHRGWILNNLNA
SHLDYYYAFFAILNFLNFIFFLGVIRFYVVYKAEVSDSMEVLAEELKAMRLREPNQVSEH

Populus trichocarpa Poptr_36 POPTR_0010s11050

MGSVEEHSSLLEDGLIQQDESNGLYTGDGSVDINGNPVLKQKTGNWKACPFILG
TECCERLAYYGIATNLVTYLTKKLHEGNVSAARNVTTWSGTCYLTPLIGAVLADTCWG
RYWTIAAFSSIYFIGMCALTLSASIPALKPAECVGSLCPPATPAQYAVFFFGLYLIALGTG
GIKPCVSSFGADQFDDTDPKERVKKGSFFNWFYFSINIGALISSSFLVYIQDNAGWGLGF
GIPALFMGIAIASFFSGTPLYRFQRPGGSPITRMCQVLVASFHKWNLEVPLDSSLLYETQD
KHSAIEGSRKLVHSDELKCLDKAAVLSEAEMKSGDFPNPWRLCTVTQVEELKILIRMFPI
WATGIVFSAVYAQMSTMFVEQGMLMDTTIGSFTIPPASLSSFDVISVICWVPIYDRIVVPI
ARKFTGKERGFSDLQRMGIGLFISVLSMTAAALVEIKRLQLAKELGLAGEAVAVPISIFW
QIPQYMLVGASEVFTFIGQIEFFYEESPDAMRSLCSALSLLTTSLGNYLSSFILTMVTYFTT
TGGKPGWIPDNLNEGHLDYFFWLLAGLSVLNMLVYVFCARKYKQKAS

Populus trichocarpa Poptr_37 POPTR_0010s13620

MERMESKGCRRKRQNGGLVTMPFIFANEACEKLAVVGFSTNMISYLTTQLHMPL
TKAANTLTNFGGTSSLTPLLGAFMADAYAGRFWTITVASIIYQIGMISLTLSAILPHLRPPP
CKLGEQVCQEADTGQLAILYASLLLGALGSGGIRPCVVAFGADQFDESDPKQTTKTWR
YFNWYYFVMGVSILVAVTVLVYIQDNIGWGWGLGIPTIAMFFSIIAFIGGYPLYRNLDPA
GSPFTRLLQVSVAAFRKRKLAMVSDPELLYQNDELDAPISIGGKLLHTIHMKFLDKAAIV
VEEDNFKQGQAPNLWRLNTVHRVEELKSIIRMGPIWAAGILLITAYAQQNTFSLQQAKS
MDRHLTKSFQIPAGSMSVFTMTSMLTTIAFYDRILVPVASKFTGLERGISFLHRMGIGFVI
SIFATLVAGFVEIKRKHVASAHGLINSQQPIPIPVFWLVPQYCLHGIAEAFMSIGHLEFFY
DQAPESMRSSAMALFWTAISVGNYASTLLVTLVHKFSAGSDGSNWLPDDNLNKGKLEY
FYWLITLLQVANLIYYLFCAKMYTFKPIQVHNKEISDSKESGVELANKV

Populus trichocarpa Poptr_38 POPTR_0011s12070

MSSGEEQTLLLEDELLLQNKNNGLHTGDGSVDINGTAVLKQKTGNWRACSFILG
NECCERLAYYGIATNLVSYLTGKLHEGNVSAAKNVNIWAGTCYFTPLIGATLADAYWG
RYWTISVFSTIYFIGMCTLTLSATIPVLKPAECIGSLCPPATPAQYGVFFFGLYLIAFGTGGI
KPCVSSFGADQFDDTDPKERVKKGSFFNCFYFSINIGCLVSSSLMVYIQDKAGWGLGFGI
PALFMGIAIAIFFSGTPLYRFQRPVGSPITRMCQVVVASFHKRNLEVPQDISLLYETQEKH
STIEGTWKLAHSNELKCLDKAAIISEAEIKGGDFSDPWRLCTMTQVEELKILIRMFPIWAT
GIVFSAAHAQMSTIFVEQGMLMDKTIGSFNIPPASMITIDVISVIFWVPIYDRIIVPIARKFT
GRERGFSELQRMGIGLFISMLSMTAAALLEIKRLQLVKELGLVGDAVAVPLSILWQIPQY
MLMGTAEIFTSIGQLEFFYEQSPDAMRSLCSALALLAASLGNYLSSFILSMVTYLTTTGG
KTGWIPDNLNKGHLDYLFWLLAGLSFFNLLIYTICAKRFIKRRRPPKVFTRGEA

Populus trichocarpa Poptr_39 POPTR_0012s07250

MLNTCEGYVDWRNRPAVRGRHGGILAASFVLVVEVLENLAFLANASNLVLYLS
MYMHFSPSSSANVVTNFMGTAFLLALLGGFLADAFFTTYYIYLISASIESLGMLVLTIQA
RVTSLKPPPCFSASTSISCEQVDGRKALMLFAGLYLVALGVGGIKGSLPPHGAEQFDENT
LQGRKQRSAFFNYYVFCLSCGALIAVTLVVWVEDNKGWQWGFGVSTATILLSIPIFLIGS
PVYRTKVPIGSPITTIFKVLAAAVYSTYKFRDSSNSAIGMDTSRTSYTTETSEGEDRNTKR
KELSQTPTESLEFVNRAVKNKTVNPMLECTAEQVEEVKIVLRILPIFMSTIMLNCCLAQLS
TFSVQQASTMNTNLGSLKVPPASLPVFPVIFIMILAPIYNHIIIPFARKVTKSEMGITHLQRI
GTGLVLSVVAMVVAALVEMKRKRVAANSGLVNSTKPLPITFLWIALQYLFLGSADLFTL
AGMMEFFFTEAPKSMRSLATSLSWASLAMGYYLSSVLVSLINTITGRYRDTPWLFGSNL
NKYRLERFYWLMCILSGLNLSHYLFWASRYKYKSMRKSLSQPNN

Populus trichocarpa Poptr_40 POPTR_0012s07320

MMEQPADEHRENYRGVKAMPFVIGNETFEKLGSTGTLSNLLVYLTTVFHMKSIT
ATTLINIFNGTTNIATLLGAFLCDTYFGRYKTLAFASIASFLGMVVITLTAAISKLHPPQCA
SGTQDTAACPALTPWQMTFLLSGLGLLVIGGGGIRPCNLAFGADQFNPQTESGRKGITSF
FNWYYFTFTFAMMISLTIVVYVQSDINWAWGLAIPAFLMFFSCVLFFAGSRIYVKVKPD
GSPLTSVVQVIVAAIKKRKLELPEQPWLSLFNHIPARSINSNLPYTDQFRFLDKAAILTTE
DQIMPNGSTATPWRLCSLQQVEEVKCLLRVIPIWASALLYYIGLIQQQTYVVFQALQSNR
GLGNTNFKIPAASYAIFSMLGLTIWIPIYDRLIVPWLAKHTKKEGGITILQKMGVGMALGI
VTMLISGIVEERRRALAISSPIGVDSRSNVNVSSLSALWLAPQLILIGISEAFTIIAQIELYYK
QFPENMRSIGGSLSFVGVAVSSYLSAFLISMVHQITKKSACGDWLPEDLNKGRLDLFYY
LVAALGVINMGYFIVCAKWYKYKGNDGTSNTLEIGENLMFKRN

Populus trichocarpa Poptr_41 POPTR_0012s07340

MEKRDERGSIGEENGKESVQNDLKETMGNSGEDETNSKPKVIYRGWKVMPFIIG
NETFEKLGTIGTLSNLLIYLTTVFNMKSITAATIITVFNGTANLGTLIGAFLCDTYFGRYKT
IGFATVASFLGLLAIQLTAAISKLHPPHCAKESITCIGPTGGQIAFLLAGFILMIIGAGGIRPC
NLAFGADQFDPETESGKRGVNSFFNWYFFTFTFAQMISLTLIVYVQSNVSWPIGLGIPAIL
MLISCLVYYMGTKLYVKVKATGSPMTSVARVIVVAVKKRKLKPVDQPWLSLFNYIPPK
SINSKLSYTDQFRFLDKAAIMTHQDQVNPDGSPANPWKLCSLQQVEEVKCLFRVIPVWT
AAIIYYVAVVQQHTYVVFQAVQSNRRLGNSNFAIPAASYIVFLMLSMSIFIPIYDRILVPF
LRRITGKEAGITILQRIGVGIFLTIVTMLVSGLVEEKRRTIALTKPTLGNAPRKGAISSMSA
LWLIPQLSLSGIAEAFGSIGQVEFYYKQFPENMRSIGGSLFYCGMAASSYFSSLLITVVHQ
TTNGAATGNWLSEDLNKGRLDYYYYMIAALGVLNMGYFLLCARWYKYKGGKDDALL
ELCGGEKTI

Populus trichocarpa Poptr_42 POPTR_0012s08940

MEIAVDEKQATQKVASKKGGLRTMPFIIANETFEKVAGVGLQANMILYLRNEYN
LSNASGAYILSLWGAISYFMPILGAFISDSYLGRFSVIAYGTVISLLGMIVLWLTALIPHAR
PPHCAQTDDDLKDCVSPKLGQFLLLFSSFALLAIGAGGIRPCSLAFGANQIDNPTNPKNQ
RTLQTFFNWYYASVGISIMISVLVIVAIQDAAGWVVGFGVAVGFMLLSTIFFFLGSSLYV

KVKANKSLVAGFAQVTVAAWKKKNLALPPMEYAAWYHHKGSKLVAPTEKLRFLNKA
CVIGNPEKDLDCDGLAIDPWRLCTVKQVEELKSLIKVLPICSTGIMIAVTLNQHAFPVLQ
ATTMDRHFIGNQKLPAGSYGVFTILALTIWVAVYDRLLVPLLAKFTNRPQGLSNKQRMG
IGIVISCIATATAGAVENKRRATALRQGLADHPRDVVDMSANWLIPQYCLVGLGEAFSA
VGQIDFFYSQFPKTMTSIAVALFSLGMAVGNLVASLIIGIVDDVTRRGGKVSWVSDNLN
KGHYDYYYWLLSLLSLVNFFYYLLCSWAFGSEDREEYDDGEAMEEMSGELIRILTNFLR
S

Populus trichocarpa Poptr_43 POPTR_0013s11100

MSISNLSSSETQEVRTPLLNDTVDDCVDYKGNPVCRYNSGGWRSASFIIGVEVAE
RFAFYGISSNLIMYLTGPLGQSTITAAKNVNVWSGTASLLPLFGAFVADSFLGKCRTIIIA
SLIYILGLGLLTLSAMLPTSDCQSDSMSCSSNTLQVILFFIALYLVALGQGGHKPCVPAFG
ADQFDRQDTKEYKAKSSFFNWWYFFVSSGILVSLLVLTYIQDNLSWSLGFGIPFIMMICA
LIIFLLGSKKYRYSVKREGNNALLRIARVFVAAFRNWRFTPSSLASEEEGRGTVPHQSYE
QFKFLNNALLTTDGSKEDQKVCTFRDVEEAKAVLRLIPIWTTCLGYAIVFPQSSTFFVKQ
AATMDRSISPGFEIPAASLESFSSISMILCIAIYDRLFVPVARALTRKPSGISMLQRIGTGMF
LSAVSIAFAALVEMKRLEIAQESGLVNEPNVTVPMSVWWLVPSYVLFGVADVFTMVGL
QELFYDQVPSDLKSVGLSLYLSIFGVGKFLSSFLISVIEKATAGIGCYSWFDNNLNRAHLD
YFYWILAALSVVELIMYMYYTRFYIL

Populus trichocarpa Poptr_44 POPTR_0013s11110

MSISNISSSETQEVRTPLLNDTVDDCVDYKGNPVCRYNSGGWRSASFIIGVEVAE
RFAYYGISSNLITYLTGPLGQSTVTAAKNVNVWSGTASLLPLFGAFVADSFLGRCRTIIIA
SLIYILGLGLLTLSAMLPTSDCQSDSMSCSSNTLQVILFFIALYLVALGQGGHKPCVPAFG
ADQFDRQDTKEYKSKSSFFNWWYFFMSSGILVSLLVLTYIQDNLSWSLGFGIPCIMMICA
LIIFLLGSKKYRYSVKREGNNALLRITRVFVAAFRNWRFTPSSIASEEEGRGTVPHQSYEQ
FKFLNNALLTTDGSKEDQKVCTFSEVEEAKAVLRLIPIWTTCLGYAIVFPQSSTFFVKQA
ATMDRSISPGFEIPAASLESFSSISMILCIAIYDRLFVPVARALTRKPSGISMLQRIGTGMFL
SAVSIAFAALVEMKRLEIAQESGLVNEPNVTVPMSVWWLVPSYVLFGVADVFTMVGLQ
EIFYDQVPSDLKSVGLSLYLSIFGVGKFLSSFLISVIEKATGGIGCYSWFNNNLNRAHLDY
FYWILAALSVVELIMYMYYTRFYIYSRDERI

Populus trichocarpa Poptr_45 POPTR_0013s11120

MSSSNQTPLLSYDIVDGSVDYKSRPAYRSNSGGWRSASFIIGVEVAERFAYYGISS
NLITYLTGPLGQSTATAAENVNVWAGTASLLPLLGAFVADSFLGRYRTIIFASLIYILGLG
LLTLSALLPSHAAATGFRSTNLPSSPVPFQLILFFFALYLVAIGQSGHKPCVQAFGADQFD
GQDPQESKAKSSFFNWWYCFMCAGTVVTLLVLNYIQDNLNWGLGFGIPCAVMVIALIIF
LLGTKTYRYSIKGDEKSAFLRIGWVFVSSIRNWRTTPSAIAFEEETRGTLPHQSSEQYKFL
NKALLAPNGLKEDGKVCSLGDVEEAKALLRLVPIWATCLVFAIVFAQTSTFFTKQGVTM
DRSISPSLDLPAASLQSFISLSIVLFIPIYDRVLVPIARALTRKPSGITMLQRIGSGMFISVVA
MIVAALVEMKRLKTAQEHGLVDLPNVTIPMSVWWLIPQYVLFGVAEAFTMVGLQEFFY

DQVPSDLRSVGLSLYLSIFGVGSFLSSFLISIIEKATGGNGRYSWFANNLNRAHLDYFYW
LLAGLSAVQLVAYVCFAKSYIYNRGGTV

Populus trichocarpa Poptr_46 POPTR_0013s11130

MAIETPLLLDTPVEDSVDYKGRPVYRFNSGGWKSTLFIIVVEVAERSAYYGIAGN
LITYLTGPLGQSTVTAAENMNVWSGTAWLLPLLGAFVADSFIGRYRTIVVSTLIYILGLG
LLALSAVLPPLGSSGCQSSDSAGSCSPDPVLILFFFALYLVALGQGGFRPCVQAFGADQF
DAQDPEERKAKSSFFNWWHFFMNAGLIAVLPALNYIQDNINWVLGFGIPCLILAGALAIF
LLGTRTYRYSIRREEEKHAFLRVGRVFVATFRNWRITTAVAFEEETHRAQPQQSSGQFKF
LNKALLDPIDSKGDSKVCSLREVEEAKAVLRLVPIWTTCLIYAIVFAQPATLFTRQAITM
NRSVSADLEFPAASVQLFIPATVVVLVAIYDRAFVPVARALTGEPSGITMLQRIGTGVFLS
FLAMVVAALVEMKRLKKAQQYGLVDTPEVTIPMSAWWLIPQNVLLGAADVFTMIGMQ
EFFYDQVPSELRSVGLALFLSVIGVGDFLSSFLISIIDKATGGDGHYSWFANNLNRAHLD
YFYWLLAALSAVQFVAFLYFGKSYIYSRGGAT

Populus trichocarpa Poptr_47 POPTR_0013s11160

MATETPLLLPYAVDSSVDYKGFSNSGGWKCAFLIIGVEVAERSAYFGISGNLITY
LTGPLGQSTVTAAENLNLWSGTAWLLPLLGAFVADSFLGRYRTIIVAASIYILLVKCMEF
NLNSQGLSLLTLSAVLPSVRAHDCQSADTIQLCSPDPSLILFFFALYLVAFGQGGFRPCVQ
AFGADQFDGQDPEERKSRSSFFNWWNFGMNAGLIVILPFLNYIQDNLNWGFGFGIPCVI
MAVSLVIFLLGTKTYRYSIRREEEHPFLRIGRVLVKAIKNWRISPAVSFKEDASCIVSRQK
SEQFEFLNKALLEINGSEDSWMACTPREVEEAKAVLRLVPIWTSCLIFATVGSQVGTFFT
KQARTMNRSISERLEFPAASIQLSIPLAIVVLVPIYDRVFVPVARKLSGEHSGITMLQRIGT
GLFLSVLAMVVSALVEMKRLKTAEEHGLVDMPNVTIPMSGWWLIPQLVLLGAADVFTII
GLQEFFYDQVPSELKSVGLALFLSVVGVGHFLSGFLISIIDKTTGKDGDDSWFANNLNRA
HLDYFYWILAVLSVVQLVAFLYFSKSYIYKRGSIV

Populus trichocarpa Poptr_48 POPTR_0013s11170

MLLPLLGAFIADSFLGRYRTIVVASCIYILVIIQTLGLSLLTLSAVLPSSRDSGCQTA
DAISLCSPDPRQVILFFFSLYIVAIGQGGHKPCVQAFGADQFDGQHPEESKAKSSFFNWW
YFSMNSGMVVALLILNYIQDNLNWGLGFGIPCIIMVGALIVFLLGTKTYRYGIKTAERSA
FLRIGQVFVEAVRNWRTNSSAIDCREEEALGIVPHQCSEQFKFLNKALLTPNGSKEDGKV
CSIGEVEEAKAVLRLVPIWTTCLIYGIVFAQSSTFFTKQGATMDRSISPGLDVPAASLQSLI
SLSIVFLIPFYDRVLVPTARAITRKPSGITMLQRIGTGIFLSALSMVLSAVVEMKRLKTARE
YGLVDLPNTTIPMSVCWLVPQYIVYGAADVFAMVGLQEFFYDQVPSELRSVGLSLYLSI
FGVGSFLSSFLISGIEKATGGDGHGSWFADNLNRAHLDYFYWLLAGLSVVQLVAFLYFS
KSYIYNREGTR

Populus trichocarpa Poptr_49 POPTR_0014s03550

MVCGIYIKTLKSLANRNVPTNSGEALNNTGCQGISRDVKIESKPERRLGGNRAAF
FVYTMEGLENMAFVCMVASLMTYFSGYMNFSLTKSATTFTNFVGTSFLLALFGGFICDT
YWTRFKTCVLFGCVEFLGYALLTVQAHFHQLRPIPCKGVSSDQCEAADGSQSAILFTGL

YLIAFGTSGIKAALPSLGADQFDENDPKEAIQLSSFFNWFLFSLTIGAIIGVTVIVWLSANQ
GWDLGFGVCAIAVFFAIIFVSMRKSLYRNNVPKGSPLARIAQVFVAAIRNRDLPIPERDEE
LHEIHDKEAGVKQEILPRTGQFRFLDRAAIANTTDCASTSINHGPWRLCTVTQVEETKILL
RMLPVILSTVFMNTCFAQLQTFSVQQSTTMDTNVFGFKVPGPSLPVIPLLFIFVMIPIYERF
FVPLARKITGIPTGIRHLQRVGVGLVLSVISMGVSGVVETWRKSVAIEHNMVDSTEPLPM
SFLWLGFQFAIFGAADMFTLVGLLEFFYAESSAGMKSLGTAISWCSVAFGYFLSSLVVQ
VVNKVTGGWLASDNLNRDKLNYFYWLLAGISTVNFGVYLTCASWYRYKDRGAMKQI
ENGGEDDAKGKVQMVEI

Populus trichocarpa Poptr_50 POPTR_0014s15580

MGISMNLVTYLVGELHISSAKSATIVTNFMGTLNLLGLLGGFLADAKLGRYLAV
AIFASITALGLSLLTMATTIPTMRPPQCDDYRKQHYQCIEASGNQLALLYAALYTTALGG
GGIKSNVSGFGSDQFDQTDPKEEKAMHFFFNRFYFCISIGSLFAVIVLVYIQDNVGRGWG
YGISAGTMVIAVAVLLCGTPWYRFKKPRGSPLTTIWRVSLLAWKKRRHPYPSHPSLLND
YDSATVPHTEKFKYLDKAAIMDPTSSAQKNDPWIVSTVTEVEEVKMVLKLIPIWSTCILF
WTVYSQMTTFTIEQATFMNRKVGSLVIPSGSYSTFLFITILLFTSLNERLFIPLARKLTHNA
QGLTSLQRIGIGLFLSILAMVAAAIIEKERRETVIQQNTMISAFWLVPQYFLVGAGEAFVY
VGQLEFFIREAPERMKSMSTGLFLSSISMGFFVSSLLVSLVDKATKKIWLRSNLNKGRLN
NFYWMLAVLGLLNLFIFLVFAREHQYKVQQYIKPKNSEEKELKTANDLTVLEMVKEEE
MI

Populus trichocarpa Poptr_51 POPTR_0014s17750

MACLNICKEEGSVQGKLVKKEQEVCTRDGSVDRHGDPAIRGRTGTWFAGILILV
NQGLATLAFFGVGVNLVLFLTRVLGQDNAEAANNVSKWTGTVYIFSLLGAFLSDSYWG
RYKTCAIFQAIFVTGLVLLSLSSYLFLLKPRGCGDEHSPCGSHSTYQNVFFYFSIYLVALG
NGGYQPNIATFGADQFDEEDPKEGHSKIAFFSYFYLALNLGSLFSNTILGYFEDRGMWA
LGFWASAGSALLALVLFLIGTPRYRHFTPKGNPLSRCCQVMVAATRKWKVQRMPNQG
DDQFESDVPKDGSKNGDRKILHTQGFRFLDRAAIITSKDYTENRIHDPWRVCTVNQVEE
FKCILRLLPIWLCTILYSVVFTQMASLFVEQGADMKTTISKFHIPPASMSSFDILSVAAFIFI
YRRVLDPLVARIRKDPKGLTELQRMGIGLVIAIIAMVSAGIVELFRLKYARKDCPRCESA
SSLSILWQIPQYVLIGASEVFMYVGQLEFFNGQAPDGLKSFGSALCMTSISLGNYVSSLL
VTVVMKISTRDEMPGWIPGNLNKGHLDRFFFLLAVLTTADLVLYIICARWYKYIKFERQ
QEADSILSNEEADLRV

Populus trichocarpa Poptr_52 POPTR_0016s03180

MEFQDNNKSHEAEKPEEMKIMEYDKRKKKLGGMKAIPFILVTEVCDRFSTIGFH
ANMITYLTQQLNLPLVKASNIVSNFNGTASLTPLIGALIADSFAGRFWTIIVGSIIYELGLIS
ITTTALLKSLHPPPCPSLVDCKEASSFQLSTLYLSLLLLAIGLGGTRPCVMTYAADQLDM
SKSGVESRSWNFFNWYYFSLGLARLAAVTIVVYIQDNVSWGWGLGIPTIAMAVAFMVF
LSGSPLYKKVKPGGSPLVRVIQVIVAAIRKRKAVAPEDPSLLYQNQELDAAISVHGRLLH
TTQFKWLDKAAVEKYGEATASSTPNLWKLATVHRVEELKSFLRLLPVWAAGILLVTAN
SHSGSFNTQQARTMDRRLSNSFQIPPASMSFFGIMTVIIGLVLYERLFVPFVRRFTRNSAGI

TYLQRMGIGLLFNILFSVVAALVEKKRRTVAENHNLVDNPKATVPISVFWLVPQLSLHG
MSEVFMAVGQLEFLYDQSPESMRSIALGLFWIASSVGDYLGTLMVSLIHEYTGHKNNW
LPDRNLNIGKLDYYYWLVTGIQAINFVYFVICAWCYTYKPLEEVMEEDSV

Populus trichocarpa Poptr_53 POPTR_0016s10230

MELKKGVETRGVDEEKWVYDSSVDHKGRVPLRASTGVWKATLFIIVIEFSERLS
YFGVATSLIIYLTKVIHQDLKTAARNVNYWAGVTTLMPLFGGFLADAYFGRFTTVFLSS
VVYLLGLILLTMSTFVPSLKACDAAVCLEPRKVHEMVFFIAIYMISIGTGGHKPSLESFGA
DQFDENHSEERKKKMSYFNWWNFGLCCGLLLGVTVIVYVQDRVGWGAADIILATVMA
SSLAIFIIGRPFYRYHVPPGSPLTPMLQVLAAAIKKRNLPYPSDPAELHEVPKSRVNKGRL
LCHTESLKFLDKAAIVEDWENCAEKQDPWTLATVTKVEEMKLILNLIPIWLATLPFGISV
AQTATFFVKQGTMLDRNIGNGVEIPPASIFALSAFGMIVAVAIYEKILVPVLRRATGNER
GIKILQRIGFGMLFSISTMVVSALVERKRLGVVEKDPVKGSLSMSVFWLAPQFIIIGVGDA
FTLVGLQEYFYDQVPDSMRSLGIAFYLSVIGAANFISSLLITTIDHVTGRFGKSWFGKDLN
SSRLDYFYWLIAGMTAANLIVYVFLARRYSYKNVQRSVVVADCCEDGFEVSMA

Populus trichocarpa Poptr_54 POPTR_0016s10270

MENVLTKTSSSSADSDITRAPPNSLLPPKKEAGGWRSVKYILGNESFEKLASMGLI
ANLTVYLQTRFNMDGIQLVNVFNIWSGSTNVTPLLGAFLSDTYLGRFRTLICGSTASFLG
MVVMSLIAGIPNLRPLHCTGGSNCQKPEFWQLGVLYLGLGLLAIGAGGVRPCNIAFGAD
QFDTRTEKGRAQLESFFNWWYFSFTVSLVIALTVVVYVQTNVSWVIGYGIPAACLFFSIV
IFLIGKHTYIITKPQGSVFVDMAKVIVAACKKRAMSLESTPENSFYDPPWIESDQRVTKL
AHTNMFKFFDKAALIADPSELDDKGLPKNSWRLCSVQQVEQLKLVVGLVPVWITGIGC
FITMDQMNTFGLMQAIQSNNKIHNFKIPPGWMGLSSMICLSTWIFIYEQIYLPFAKKRSK
KNVRLTMRQRINTGIVMAILCMVVAGIVEKNRRETALKQGSLLSPQSILLLLPQFSLSGL
NEGFAAVAVMEYYTNHLPESMRTLAGAIFFLSFSASSYLNTVIVNVVHHVTAKLGKTP
WLGGRDLNKVKLDNFYYLIAGLALLNLLYFNLFSCRYLEKNADKRPGSRHEDKGLEMN
ENV

Populus trichocarpa Poptr_55 POPTR_0016s11930

MAETDYTNNGTVDIEGNPANKKKTGNWKSCRFILGNECCERLAYYGMSTNLVN
YLGDRLNQGNVAAANNVTNWSGTCYVTPLIGAFLADSYLGRYWTIASFVIIYIIGMTLLT
LSASVTGLKPSCDKDSCHPTTGQTAACFVALYMIALGTGGIKPCVSSFGADQFDETDETE
RKKKSSFFNWFYLSINIGALVASSVLVWIQMNVGWGWGFGVPAVAMAVAVVFFFLGS
KLYRIQKPGGSPITRIVQVIVASFRKSNVQVPADKSLLYETAEEESQIQGSRKLEHTNKFK
FFDKAAVKTQDDNIKGLTSPWRLCTVTQVEELKSIIRLLPVWASGIVFSTVYSQMSTMFV
LQGNTMDQHMGPHFQIPSASLSLFDTLSVIFWAPVYDRIIVPYARKFTGHERGFTQLQR
MGIGLVISIVSMITAGILEVVRLNFVQKNNYYDLKYIPMSIFWQVPQYFLIGCAEVFTFIG
QLEFFYDQAPDAMRSLCSALSLTTVALGNYLSTLLVTIVTKITTRGGKLGWIPDNMNRG
HLDYFYWLLAILSFLNFILYLWISKWFTYKKATGHPQRD

Populus trichocarpa Poptr_56 POPTR_0016s11940

MAEDGFTKDGAADFRGNPAIKKETGTWKACPYILGNECCERLAYYGINTNLVN
YLKFQLNQSNVVAVNNVTNWSGTCYVMPLLGAFLADAYLGRYWTIASFSIIYVFGMTL
LTLSASIHGLKPSCDRTNVCHTTGLQTSVFFLGLYLIALGTGGIKPCVSSFGADQFDDSDE
DEKKRKSSFFNWFYFSINIGALIAASVLVWIQTNVGWGWGFGIPAVAMAIAVVSFFSGT
RLYRNQRLGGSPLTRMCQVLVASFRKFRVEVPNDKSLLFETADHESAVMGSRKLDHTD
QLSFFDKAAVETPSDRLKGSANQWKLCTVTQVEELKSIIRLLPVWATGIIFSAVYSQMGT
LFVLQGNTMDLRMGKSFEIPSASLSLFDTISVIFWVPIYDRAIVPFARRFTGHKNGFTQLQ
RIAIGLVISIFAMLVAGTLELVRLREVRKHNYYELKHIPMSIFWQVPQYFIIGCAEVFTFIG
QLEFFYEQAPDAMRSLCSALSLTTAALGNYLSTFLVNIVTDMSTRHGKPGWIPDNLNHG
HLHYFFWLLAVLSVLNLGVYLLVARWYTYKKAVVSSD

Populus trichocarpa Poptr_57 POPTR_0017s03380

MASGQKPKGLNKSCFLLIVIAGMERFAFKGVASNLVTYLTDVVKMSNSAAAKT
VNNWCGFTSMLPLLVASLADSWDRYSTILTSSFIYVVGLVALTSTALSWARHPTNKISSS
YLFWSLCLISLGQGGYNPSLQAFGADQIANDDELPSTKDEQKSNKKSLFFQWWYFGVC
GGSLAGVTVMSYIQDTFGWVLGFAIPTIAMGASILLFWCGSRIYAYKQDDAISERPSRDI
VRSIKEALSKLMNSRITLPNNNPGVVELELQEKPLCQNSGNAKGLKEEPCSGINYLVENG
KVVLRLLPIWTMLLMFAVIFQQPATFFTKQGMTMKRNVGSSFKIPPATLQSAITVSIILLM
PFYDALLIPFTRLITRDKKGISVTQRMGIGMVLSIIAMVIAALVETKRLEISRKMEVLDPK
LETEVPLSIFWLLPQYILLGISDIFTVVGMQEFFYSEVPVRMRTMGIALYTSVFGVGSFLS
ALLISLVEYFTSSRGKGRSWFSDDMREARFDKYYWLLALLSVLSLVFYVIFCKCFVSRSS
DLDNEN

Populus trichocarpa Poptr_58 POPTR_0017s11320

MGDEEKKTPTSLETSMENGREEKTTSNDEPVVKYGGIKAMPFVIGNETFEKLGT
VGSLTNLVVYLTTVFNMKGVTATTFLNVFSGTTNLAPLLGAYLTDTYFGRYKTLGFASI
SSFVGMVALMLTAAISTLHPPECAPGGACAGPPTWQLAFLLSAFAFLIIGAGGIRPCNLA
FGADQFNPNTESGKRGINSFFNWYYFTFTFAVMISVTGIVYVQSNISWAIGFGIPAFLMFL
SCVMFFVGTRIYVIVKPEGSPISSVVHVIVAATKKRGLKLPENSTVSLFSYIPAKSINSKLP
RTEQFRFLDKAAIITDGDQINLDGSATNPSKLCSIQQVEEVKCLLRIIPIWSTSILYHIPLIQ
QQTYAVFQALQMDRRLGTSFEVPAATYVIFTMITLTIWIPLYDRIIVPFLQRLTGKEGGLT
LLQRMGIGMVLAMLCTIVSGLVEEKRRHIALTRPTIGITSKGGAISSLSAMWLIPQLSLSG
LSEGFNYIAQIEFYYKQFPENMRSIAGSSFFAGIAISNYLSGFLVTIVHRITSGSKSGDWLD
DDLNKGKLDCFYYVIVGLGILNFCYFLLCAKWYKYKDGDISTVEMATKGSQKHIV

Populus trichocarpa Poptr_59 POPTR_0018s00430

MDCPSEHGQMITEPLLSNRKGGIRTLPFILANEAFESLANYGLFPNLILYLTREYRI
DAAKGAHVLFLLSSAINFTPILGAFLADTYVGRYRMIGFGCMASLLGMVLLWLTTFPEA
RPPPCVQFSYDCKSATTLQLLLLYTAFCFLAIGAGGIRSSSLAFGADQLGTSNSLEHARIR
ESFFSWYYGIVAASVFLGMTFVVYIQDNIGWMVGFGVPVVLMILSSLSFFVASPSYVKS
KPKASWITGLAQVVVGSIRNRRIKLSSQATDKVDYHTTGSMLLVPSEKLRFLNKACIIRN

PQEDLTPDGKASDPWSLCTVDQVEDLKALIKVIPIWSAGMLKSVNVSQGSFLVLQASTM
NRHITSKFEVPAASFPSIVVLVITTWVVLYDRIIIPLVSKVSGKIVCLNLKQRMGIGILLSTI
SMAALAIAESFRRATAIKEGFPDNPNAELHISAMWLLPYFVLSGLAEAFNAIGQNEFFYT
ELPKSMSSVASTLQGLGLSAASLVSSFIVSAVRDFTKGEAQESWVSSNINKGHYDYYYW
ILTILSLVNFIYYLVCSKTYGPCRQEKWFNR

Populus trichocarpa Poptr_60 POPTR_0018s00440

MDCSSEHRQMITEPLLSNGKGGIRTIPFILANEAFERLASFGLSTNMIMYLTREYG
MDAAQGAQLLFLFSSATNFTPILGAVLADSYVGRYRMIGFGCMASLLGMVLLWLTTFP
EARQPLCVHFSHSCNSRSTLQLVHLYTAFGFMAIGAGGIRSSSLAFGADQLSITHNLQRA
RIRESFFRWYYVTVTASVFVAMTCVVYIQENMGWMVGFGVPVVLMILSALSFSLASPF
YVKSKPKASWITGLAQVVVASFRNRSVELSTQATVEVRYHTTGSMLPVPSKRLRFFNKA
CIVGNPQVDVTPDGNALDPWSLCTVDQVEDLKTLIKVIPIWSSGMLMFVNVSQGSFIVL
QVSTMDRHITSKFEIPAATFLSFAVLVIVLWVALYDRIIIPLVSKIKGQPVCLGLKKRMGI
GILLSTTSMAALAIAESVRRETAIKEGFSDRPDAGLHISTFLFLPFLALSGVAEAFTPIGQN
EFFYTELPKSMSSVASTLNGIGMSVASLVSSFIVRAVRDLTTVEGQESWVSSNINKGHYD
YYYWLLASLSLVNFLYYLVCSKSYGPSMEEQRNILADESY

Populus trichocarpa Poptr_61 POPTR_0018s00450

MITEPLLSSPKGGIRALFFIIANEALERLASFGLSTNMILYLTREYGMDAASGAQIL
FLYSAAGNFMPIIGAFLADTYVGRYPMIGFGCIASLLGMVLLWLTTIIPGARVPSCAQFSS
NCTNDATTPQLLFLYLCLGLMSIGAGGIRSCSLAFGADQLSKRDSLKHAGILESFFSWYY
VTSSASVFISMTCIVYIQDTMGWKVGFGVPVVLMILSTLSFFLASPIYVKPKVKASWLIGF
ARVLVASYRKRRIELSWLDTDELYHHRKGSALVVPSERIRFLNKACVIKNPEEDLMPDG
RASDPWTLCTVDQVEELKALIKVIPIWSTGVLVSVNVCQNSFLLLQASTMNRHITSKFEIP
AGSFYAFLLLSATMWIALYDRVIIPLASKVRGKPTRLGLKQKIGIGILVSAASMAVLAIIE
RVRRETAIREGISDIPDAVTHMSAMWLLPFYFLLGFSEAMNGVGLNEFFYTELPKSMSSV
ASNLFSIGLSAASLVASFIVSNVRGFISEANQESWVSSNINKGHYDYYYWLLYSLGFANFI
YYLACSKAYGPCKGGQRGITGDAREGLIDDDDDDDDDYDDDVV

Populus trichocarpa Poptr_62 POPTR_0018s00460

MITEPLLSSPKGGIRALFFIIANEALERLASFGLSTNMILYLTREYGMDAASGAQIL
FLYSAAGNFMPIIGAFLADTYVGRYPMIGFGCIASLLGMVLLWLTTIIPGATVPSCAKFSS
ICNNDATTPQLLFLYFCLGLMSIGAGGIRSCSLAFGADQLSKRDSLKHAGILESFFSWYY
VISSASVFISMTCVVYIQEAMGWKVGFGVPVVLMILSTLSFFLASPIYVKPKAKASWLIG
FARVLVASFRKRRIELSSLDTDELYHHRKGSALVVPSERIRLLNKACVIKNPEEDLMPDG
RASDPWTLCTVDQVEELKALIKVIPIWSTGVLVSVNVCQNSFLLLQASTMNRHITSKFEIP
AGSFYAFLLLSATMCIALYDRVIIPLASKVRGKPTRLGLKQKIGIGILVSAASMAVLAIIER
VRREIAIREGISDIPDAVTHMSAMWLLPFYFLLGFSEAMNGVGLNEFFYTELPKSMSSVA
SNLFSIGLSAASLVASFIVSNVRGFIREANQESWVSSNINKGHYDYYYWLLSSLGFANFIY
YLACSKAYGPCKGGQRGITGDKSTGGTREKTEDKGGNNKDE

Populus trichocarpa Poptr_63 POPTR_0018s00470

MYCEPSGNIISFQLGIISRLSIFLPSVCHEDNHVSGQRIYGSVAILSQTKVGMVLLW
LTTIIPGATVPSCAQFSSICNNDATTPQLLFLYFCLGLMSIGAGGIRSCSLAFGADQLSKRD
SLKHAGILESFFSWYYVISSASVFISMTCVVYIQEAMGWKVGFGVPVVLMILSTLSFFLA
SSIYVKPKAKASWLIGFARVLVASFRKRRIELSSLDTDELYHHRKGSALVVPSERIRFLNK
ACVIKNPEEDLMPDGRASDPWSLCTVDQVEELKALIKVIPIWSTGVLVSVNVCQNSFLLL
QASTMNRHITSKFEIPAGSFYAFLLLSATMWIALYDRVIIPLASKITGKPTRLGLKQKIGIG
ILVSAASMAVLAIIERVRREIAIREGISDIPDAVTHMSAMWLLPFYFLLGFSEAMNGVGL
NEFFYTELPKSMSSVASNLFSIGLSAASLVASFIVSNVRGFIGEANQESWVSSNINKGHYD
YYYWLLSSLGFANFIYYLACSKAYGPCKGGQRGITGDVREGLIDDDDDDDDDYDDDVV

Populus trichocarpa Poptr_64 POPTR_0018s00480

MITEPLLSSPKGGIRALFFIIANEALERLASFGLSTNMILYLTREYGMDAASGAQIL
FLYSAAGNFMPIIGAFLADTYVGRYPMIGFGCIASLLGMVLLWLTTIIPGATVPSCAQFSS
ICNNDATTPQLLFLYFCLGLMSIGAGGIRSCSLAFGADQLSKRDSLKHAGILESFFSWYY
VISSASVFISMTCVVYIQEAMGWKVGFGVPVVLMILSTLSFFLASPIYVKPKAKASWLIG
FARVLVASFRKRRIELSSLDTDELYHHRKGSALVVPSERIRFLNKACVIKNPEEDLMPDG
RASDPWSLCTVDQVEELKALIKVIPIWSTGVLVSVNVCQNSFLLLQASTMNRHITSKFEIP
AGSFYAFLLLSATMWIALYDRVIIPLASKITGKPTRLGLKQKIGIGILVSAASMAVLAIIER
VRREIAIREGISDIPDAVTHMSAMWLLPFYFLLGFSEAMNGVGLNEFFYTELPKSMSSVA
SNLFSIGLSAASLVASFIVSNVRGFIGEANQESWVSSNINKGHYDYYYWLLSSLGFANFIY
YLACSKAYGP

Populus trichocarpa Poptr_65 POPTR_0018s00490

MEDPLDHKGKIKEPLLSSSTTKGGLRALIFIIVNEAFERLANYGLSTNLILYLTREY
GIDAVNGAQILYLHSAATSFTPFIGAFLADTYVGRYFMIGFGCIACLLGVILLWLTTIIPGA
RPPPCVQFHDSCESASTLQLLLLYSSLGLMAIGAGGIRSSSLAFGAEQLGKRDTLKRAGIL
ESFFRWYYATVSVALFLAMTCILYIQDNMGWKVGFGIPVVLMILSTLSFFLASPIYVKSK
AKAGWLDGFARVLVASFRNRSIKLSSQVKDDVYHHRKGSRLLVPSEKLRFLNKACVIR
NPKEDLIPDGRASNPWSLCTVDEVEELKSLIKVIPIWSTGVLMSINVLQHSFIVLQASTMD
RHITSKFQVPAGSFTAFQLFSSVIWIALYDRVAIPLASKIRGKPTRLGLKQRIGIGILSSSAA
MAALAIIESVRRKTAIKEGFSDDPNSVLHISALWLLLYFFITGFAEAFCGIGQNEFFYTELP
KSMSSVASNLFEMGLSVSNLIASLLVTIVRNFFKGNDQESWLSSNINKGHYDYYYWLLA
GLSLANFIYYRACSKAYGPCKGQEGNATDGGEALTDED

Populus trichocarpa Poptr_66 POPTR_0018s00500

MENTIAEEKMILIPKDKDRKKGGLRTMPFIIVNEAFERVASYGLMPNMIFYLMNN
YRLEAANGSTILFLWSAMSNGLSNFGAFLSDSFMGRYLVISLGSFCSLLGMILLWLTAMI
PQLQPPPCDRFTETCSSATAGQMAILFFSFGLISIGAGCIRPCSNAFGADQLDNEENPNNE
SVLQRLSTIIAFTVIVYIQDNLGWKVGFAVPAILMFLSALMFLVGSSQYIKVKASSSLFTG
FVQVVVAAFRNRKLNLSHGSIEQYYHSDDSEFQVPTDNLRCLNRTCIIIDPDRDVNLDGS
ASNPWRLCTVDQVENILNFELPAGSLNVFLVLTLTIWLTFYDRILLPLLARFTGRPRGGLS

PKVRIGIGLLVPVAARAMSAVVETIRRKTAIEEGLEDEPDGVVNVSTFNSIGQIEFYYSQF
PKSMSTIAVALFTFGTAVADLIGSGLADVVDRVTSKGGKDGWLSSNLNKGRLDDYYWL
ITVLSIINFVYYLVCFWAYGPAEDKEE

Populus trichocarpa Poptr_67 POPTR_0019s08340

MDTKCCTQDGTVDLRGRPVQASRTGKWKACAFLVGYEAFERMAFYGVASNLV
NYLTTQLHEETVASVRNVNNWSGAVWITPILGAYIADTYLGRYWTFTVSSLIYAMGMIL
LTMAVSFKFMKPACTNGVCNKASPSQIAFFYSALYIIAIGAGGTKPNISTFGADQFDDYN
PQEKKLKVSFFNWWMFSSFVGALFATLCLVYIQENLGWGLGYGIPAVGLLLSLFIFYLG
TPIYRHKVRKTKSPARELFQVLIAAFNNRKLQLPNSPSELQEFDLQYYIQTGKRQVHHTP
VLRCLDKAAIKDGSNNADTSNPSSSSCTVTQVEGVKLVFGMMLIWLVTLIPSTIWAQINT
LFVKQGTTLDRNLGPNFQIPAASLGSFVTFSMLLSVPMYDRFFVPFMRKKTGNPRGITLL
QRLGIGFAIQVIAIAIAYAVEVRRMHVIRMHHVVGPKEIVPMSIFWLLPQYVLLGIADVF
NAIGLLEFFYDQSPEDMQSLGTTFFTSGIGVGNFLNSFLVTMVAKITGTGGGKSWIGNNL
NDSHLDYYYGFLLVISALNLGVFLWASSRYVYKKETLQALNEDCIRIDGKTMDTSPLGL
QV

Populus trichocarpa Poptr_68 POPTR_0019s09540

MKFKQDSLSGAVEETSVDWRGRICKSKHGGMAAAVFVLGLQAFEMMGIAAVG
NNLITYVFNDMHFPLSKSANIVTNFVGTVFLLSLLGGFLSDSYLGSFWTMLIFGFVELSGF
ILLSVQAHLPQLRPPSCDMVSDGVDCVEAKGYKALIFFLALYLVALGSGCLKPNIISHGA
DQFKKEDPKQSKKLSTYFNVAYFAFCIGELIALTVLVWVQTHSGMDVGFGVSAAAMAV
GLICLISGSFSYRNKPPKGSIFTPFAQVFVAAITKRKQICPSNAQMLHGCHNNVSSHVPAT
STDASNLLHTEKFRFLDKACIRVQDGSEASESTWRLCTVAQVEQVKILISVIPIFSCTIIFN
TILAQLQTFSVQQGSAMNTRITKSFKIPPASLQSIPYIMLIFVVPLYETAFVPFARRITGKDS
GITPLQRVGVGLFIATFSMVSAAVIERKRRTSALDYQETLSIFWIAPQFLIFGLSEMFTAV
GLIEFFYKQSLEGMQSFLTAMTYCSYSFGFYLSSLLVSLVNKITSSSSSGGWLSDNDLNK
DKLDLFYWLLAVLSLINFFNYLFWSKWYSYNPSLSHDHSLGQDIESQNFNSSKRVGPEN
TIS

Populus trichocarpa Poptr_69 POPTR_0019s10860

MEAAEGTVNGSVDYKGNPVHRSGSGGWRSASFIIAVEVAERFAYYGISSNLITYL
TGPLGQSTASAAVNVNTWSGTATLLPLLGAFVADSFLGRYRTIIAASLIYILGLGLLTLAA
KLTSVNLHDCRSTKDATLCAPPRFQVILFFFSVYLVAVGQGGHKPCVQAFGGDQFDGQ
DPKESKAKSSFFNWWYFAISVGITVTLIVLVYIQDNLSWALGFGIPCIVLVAALLVFLLGS
RTYRYCAKENGKNPFMRIGRVIVRAIRNRHNTPSAMPSEEDACLWDRCSEQFKFLNKAL
LAPDGSLEDQNVCSVNDVEDTKALLKLVPIWITSLAYAIAFAQTSTFFTKQGATLDRKIA
SGFKVPAASLQTFIGFAIMIFIPVYDRIVVPISRGLTRKPSGITMLQRIGTGMVFSAISMVT
AALVEMKRLETAKDHGLVDLPKVTVPMSIWWLVPQYILCGVADVLTIVGLQEFCYDQV
PKELRSLGIALYLSIFGIGSFLSTFLISTINKATSGDGQESWFANNLNRAHLDYFYWLLAG
LKLRTSLLYDIVDGSVDHKGRPVYRSNSGGWRSAGFIIGVEVAERFAYYGISSNLITYLT

GPLGQSTATAAENVNLWAGTATLLPILGAFVADSFLGRYTTIIVASLIYILGLGLLTLSAL
LSTHTAPDLPCSPPPFQLILFFFALYLV

Populus trichocarpa Poptr_70 POPTR_0019s10870

MTISHLSNISSGTERSSAATPLIEAGDDSVNGSVDYKGNPVHRSTSGGWRSASFII
AVEVAERFAYFGISSNLITYLTGPLGQSTASAAANVNTWSGTATLLPLLGAFVADSFLGR
YRTIIAASLIYILSCVRFAWSGIIRWRGLGLLTLAATLTSDSVHDFQNIKDAMLSAPSQFQ
VTLFFFSIYLVAFGQGGHKPCALAFGADQFDGQNPKESKAKSSFFNWWYFYSSVGVNL
TLVVMVYIQDNLSWALGFGIPCIVMTTTLLILLLGSRTYRYSVNGNEKNPFMRIGRVIHR
AIRNRHTTPPSAMPGEEDACQWHQSHEQFKFLNKALLAPDGSLVDQNVCSVSDVEDTK
ALLKLVPIWITSLAYATVFAQTTTFFTKQGATLDRTIVSGFKIPAASLQIFIGFAIILFIPVY
DRIVVPISRGLTRKPSGITMLQRIGTGMVFSAISMVTAALVERKRLETAKEHGLVDLPNV
TVPMSIWWLVPQYILCGIADVLTIVGLQEFCYDQVPKELRSLGISLYLSILGVGNFLSSFL
VSVIDEATSGDGQESWFASNLNRAHLDYFYWLLAGLSAVGFIAYLYFARSYIYSRGNTI

Prunus persica Prupe_01 ppa002462m.g

MKSAKLWQNMHQHSNKLKGIMGMTIGRYITSPISLTSFYVNPYIYKPQFQFASQP
FSQVHIVTSSLKHQRSQHILVARSMDKLELVEGKVDWKGRSAVKYKHGGMRTAVLILA
TFGFENMATFALAVNLVTYFNGVMHFELADAANQLTNYMGTGYILSIIVAILADTFFGR
FKALLTSGCFEFVGLALLTVQAHYPKLRPPLCNVFDPTAMCEKVGGGNAALLFIALYML
AAGAAGIKATLPSHGADQFDEKDPREARQMSSFFNLLLLAVCLGGAVSLTLIVWIQDNR
GWDWGFGSSTIAMFLGVVIFFAGLPLYRIQPIRGTSAIVEIIQVYVAAIRNRNLSLPEDPA
DLYEINKDKEAALEEEFLPHRSIFRFLDKAAIQPSTTGQVDEQQPPNPWKLCRVTQVENA
KIILGMVPIFGCTIIMTLCLAQLQTFSIQQGLTMDTSITKSFKIPPASLPIIPVLFLIIIIPVYDR
IFVPIASKFTGIPSGITHLQRIGVGLILSCVSMAVAGIMEVKRKDVARDHNMLLARPVLQP
LPISTFWLSFQYFIFGIADLFTYVGLLEFFYSEAPMGLKSISTCFLWSSMALGYFFSTILVKI
VNGATKDVTRSGGWLAGNNINLNHLNLFYWLLSFMSLINFIVYVFVAKRYKYRPGNPIL
LSKQNKKIEE

Prunus persica Prupe_02 ppa002962m.g

MEMEQRRQLQNHKGEAMITSEMGKEDITLDWRGRPSNPTKHGGMRAAAFVLG
LQSFEIMGIAAVGNNLITYVINEMHFSLSKSANIVTNFIGTVFLLALVGGYLSDSYLGSFW
TMLIFGFVELSGFILLSVQAHIPQLKPPPCNNIAAADNGEECIEAKGFKSLIFFVALYLVAI
GSGCVKPNMIAHGADQFNPEIPKQSKKLSTYFNAAYFAFSMGELIALTLLVWVQTHSG
MDVGFGVSAAAMAMGLISLVSGTLYYRNKPPQGSIFTPIAQVFVAATLKRKQVRPSNPQ
LLHGSQNNVPNDTTTFSTDAGSFLHTEKFRFLDKACIKMQDGTNTKESPWRLCTVTQVK
QVKILLSVIPIFASTIVFNTILAQLQTFSVQQGSMMDTKLTKSFHIPPASLQSIPYVMLIAV
VPLYDTFFVPFARKFTGHDSGISPLKRIGFGLFLATFSMIAAAIMEEKRRDAAVNSNKILSI
FWITPQFLIFGLSEMFTAVGLIEFFYKQSLKGMQAFLTAVTYCSYSFGFYLSSLLVSLVNN
ITSSSSSSGGGGWLGDNNLNKDRLDLFYWLLAGLSFLNFLNYLFWSNWYSHNPSSSASS
APGNETPMEDYNHYRLDDNNIP

Prunus persica Prupe_03 ppa002984m.g

MADGNKEKQQQPRSSFCLHVTECFQDGSPKLSRKSSSPDNLEDEKHGQRKPGG
WKAMPYILGNDTFERLASFGLLANFMVYLTRMLHLDQVSASNIINVWSGFTNFAPLLG
AFISDAYAGRFRTIAFASFSSLLGMATVTLTAWLPQLHPPACSAQQQTLDQCTGPTRAQL
GTLLLGLGFLSIGSGGIRPCSIPFGVDQFDPTTEEGQKGINSFFNWYYATFTVVLLISQTVV
VYIQDKISWSVGFAIPTLLMACSIVLLLVGSRVYVHAKPQGSMFSSIAQVLVAAHKKRHI
KLPEEAGMVDGKFYDPPIKGFFVPKLPLTNQLRFLSKAAVILDNDLKPDSSPINNWRLCS
VQQVEELKCVIKTIPVWASAIVSFTSMTQQGTFTVSQALKMDRHLGPHFEVPAGSLSVIS
LLTIGLWLPFYDRLLVPALRKFTKHEGGITVLQRCGIGIIFSVLSMLVAGLIERERRSFALL
HPNEHVSFAWLVPQLVLMGLCEAFNIIALIEFFNREFPDHLRSVGNALLSCAFAGSSYLSS
LVVNIVHHVTGRNKRPDWLTKDINAGRLDYFYFLLAGIGVLNFFYFVYCAQRYHYKTK
NVYIIEEKPYANQVELASTDV

Prunus persica Prupe_04 ppa003007m.g

MREIVEKNERDDSMEKTERDDSMEKTERGNSSRTEEPVNYRGWKAMPFVIGNE
TFEKLGAIGTLSNLLVYLISVFNMKKITAATMLIIFNGTTNFATLLGAFASDTYFGRYKTL
GFSSFASFLGLLLIDLTVVFKKLHPPHCKAEEGETCKGPTTGQMAFLLTGFALLVVGAA
GIRPCNLAFGADQFNPKTESGKRGINSFFNWYFFTFTFAQMVALTLIVYVQSKISWALGF
GIPPILMLISCALFFMGSKMYVKVKATGSPITSLAQVIVVAIKKRHLKLSEPEQPWFCMFI
YMPPNSINSKLPNTNQFRYLDKAAILTPQDEILPDGSAANPWRLCSMQQVEELKCLLRV
LPIWAAALVCHVAIVQLQTYVVFQAIQSDRRLGNTNFDIPPASYSVFLMLSMTIWIPIYD
QLVVPFLQRLTGKEGGITLLQRIGIGTFLTVICMIVSAFVEERRRTIALTKPIPGPKGAISSM
SGFWLIPQLSIAGLADAFTTVGQIEFYYKQFPENMRSIAGSLFFCGIAGSSYLSSLLIAVVH
RTTEGAATGNWLPEDLNKGRLDYFYYLIAALGAINLGYFLVCANWYKYKGTENNNAL
GVEVELVREKLLVDNEA

Prunus persica Prupe_05 ppa003058m.g

MAMACLNVCKDDQEYVEEKNQKIKEVCTLDGTTDWYGRPAVRGRTGTWVAA
TLILVNQGLATLAFFGVGVNLVLMLTRVLGQDNAEAANNVSKWTGTVYLFSLLGAFLS
DSYWGRYKTCAIFQLIFVIGLSLLSLSTYIFLLKPKGCGDKNTPCGDHSAFVIGLFYISIYLI
ALGNGGYQPNIATFGADQFDDQGDPKEGQSKIAFFSYFYLALNLGSLFSNTILGYFEDKG
MWTLGFWASTGSAAMALVLFLCGTPRYRHFKPQGNPLSRFCRVMVAATRKWKVEMM
PSGENLYEEDGKECSPNDRNIVHTHGFKFLDRAAVITSKEKNEMDKGAHNPWRLCTVT
QVEEVKCILRLLPIWLCTILYSVVFTQMASLFVEQGASMKTTVSGFHIPPASMSSFDILSV
AAFIFICRRFLDPLFGRLRKKRLTELQRMGIGLVIAIMAMVSAGVVEVFRLKYAVKECN
NCESPSSLSIFWQVPQFVLVGASEVFMYVGQLEFFNGQAPDGLKSFGSALCMTSISLGNY
VSSLLVTIVMKVSTRDEMPGWIPGNLNKGHLDRFYFLLAALTTADLLVYILCAKWYKYI
KFEAKVGNDNGVHNIGQPELGV

Prunus persica Prupe_06 ppa003155m.g

MEGEKKFHATTSMEKSNNEKAVTKDEPEVKHMGIKAMPFVIGNETFEKLGTIGT
SSNLLVYLTTVFNMKSITATTLVNVFNGTTNFATLLGAFLCDTYFGRYKTLGFASVASFL

GMLVLTLTAAVSKLHPPSCEHNALCTDATPWQLAFLFSGLGLLVVGAGGIRPCNLAFGA
DQFNPNTESGKRGLDSFFNWYYFTFTFAMMVSLTIIVYVQSNVSWAWGLAIPAFMMLL
SCALFFMGSRIYVKVKPEGSALTSAVRVTVAALKKRRLQLPEQPWVSLFNYVPTGSINS
KISHTDQFRILDKAAIITNEDKINLDGSTATPWKLCSLQEVEQVKCLLRVVPIWISTIIYYV
AMVQQQTYTVFQALQSDRRLGNTGFKIPAASYIVFNMVALTIWIPIYDRLIVPALRRMT
GKEGGITILQKMGFGMVLAIITMVVSAVVEEKRRSLALSHPIGIEERRGAISSMSGFWFIP
QLGLIGLSEAFTVIAQVEFYYKQVPENMRSIGGSFLFVGMAMSNYFSSGLVSIVHHTSKG
SSMGDWLPEDLNKGKLDYFYYMVAALEVLNFGYFIVLSRWFKYKGSDDSASEVGMEN
MQSQKHLV

Prunus persica Prupe_07 ppa003158m.g

MACLEVSKQGKFKEDEDACTLDGTVDMHGQPAIRAKSGRWVAGIIILVNQGLAT
LAFFGVGVNLVLYLTRVLQQDNATAANNVSKWTGTVYIFSLVGAFLSDSYWGRYKTC
AIFQLIFVTGLISLSLSSQLFLLKPEGCGSQEDPCGTHSKLHVWLFYLSIYLIALGNGGYQP
NIATFGADQFDEEDNKEGHSKVAFFSYFYLAMNLGSLFSNTILGYFEDEGVWAIGFWAS
TASAFAALVLFLGGTARYRHFKPNGNPLSRFCQVLVAAMKKCRAEMPQGGDDLYDEA
KKESSNSNRKILYTHGFKFLDRAAYISSRDLDHQKQGICSPWRLCPISQVEEVKCILRLLP
IWLCTILYSVVFTQMASLFVEQGAAMKTTVSNFKIPPASMSSFDILSVAVFIFFYRRILDP
VVARIRKSDAKGLTELQRMGIGLVIAVLAMLSAGIVECYRLKYADKECPHCEGSSSLSIF
WQIPQYACIGASEVFMYVGQLEFFNAQTPDGLKSFGSALCMTSISLGNYFSSFLVSVVM
KISTEDDMPGWIPGNLNKGHLDRFYFLLAVLTSIDLIVYIASAKWYKSIKFEGRFEANDD
EQGNFKV

Prunus persica Prupe_08 ppa003177m.g

MSNCTLPETQEKLTLPDAWDFKGRPAERSKTGGWTAAAMILGGEACERLTTLGI
AVNLVTYLTGTMHLGNATSANTVTNFLGTSFMLCLLGGFVADTFLGRYLTIAIFATFQA
MGVTILTISTTIPSLRPRKCTSDTGTPCIPASGKQLMVLYIALYLTALGTGGLKSSVSGFGS
DQFDESDKQERRQMTNFFNWFFFFISIGSLAAVTVLVYIQDNLGRQWGYGICVCAIVLG
LIVFLSGTRRYRFKKLVGSPLTQISGVCVAAWRKRNMELPSDMSFLYNVDDIDDGLKKK
KKQKLPHSKQFRFLDKAAIKEPKTTSGTAMIINKWSLSTLTDVEEVKLIIRMLPIWATTIM
FWTVYAQMTTFSVSQATSMDRHIGKSFQIPPASLTAFFVGSILLTVPVYDRLIVPMARKA
LENPQGLTPLQRMGVGLVFSIFAMVAAALTEVKRLNIARSHGLTDNPTAEIPLSVFWLVP
QFFFVGSGEAFTYIGQLDFFLRECPKGMKTMSTGLFLSTLSLGFFFSSLLVTIVHKTTGHN
KPWLADNLNQGKLYDFYWLLALLSALNLVIYLFCANWYVYKDKRLAEEGIELEEPEIC
AHA

Prunus persica Prupe_09 ppa003196m.g

MVLISRDGEKEGASDGAVVDFRGNPVDKSKTGGWLAAGLILGIELAERICVMGIS
MNLVTYLVGNLHISSAKSATIVTNFMGTLNLLGLLGGFLADAKLGRYLTVALSATITGL
GIILLTLATSIPSMRPPPCDDYRKQHHECIEANGKQLALLYAALYTTALGGGGIKSNVSGF
GSDQFDGRDPREEKSMIFFFNRFYFGISIGSLFAVIVLVYVQDNVGRGLGYGISAGGMIIA
LVVLLSGTPFYRFHKPQGSPLTVIWRVIFLAWKKRAYPYPAHPSLLNEYQEAKIPHTQRL

KCLDKAAILDEYASAEGNRSNPWIVSTVNQVEEVKLVFKLMPVWSTCILFWTVYSQMT
TFTIEQATFMNRKIGSFVIPSGSFSAFLFITILLFTSLNEKLFVPLARKLTNTAQGITSLQRIG
IGLVLSTAAMIAAAIVEKQRREFAVHQNTKISAFWLVLQYFLVGAGEAFVYVGQLEFFIR
EAPDRMKSMSTGLFLSTISMGFFVSTLLVTLVDKVTKKSWLRSNLNKGRVDYFYLLLA
VLGALNFLVFLAFAMRHQYKGQQHISPNNSVKKEHKNSNGIRVEEMAEMIRIEAKEGP

Prunus persica Prupe_10 ppa003209m.g

MAAEEGGQRVDQYTQDGTVDLKGNPVLRSKRGGWTACSFVVVYEVFERMAY
YGISSNLVLYLTKKLHQGTVTSANNVTNWVGTIWITPILGAYVADAHLGRYWTFLIASII
YLSGMSVLTLAVSLPSLKPPPCRDPHVENCKKASPLHLAVFYGALYTLAIGTGGTKPNIS
TIGADQFDDFDPKEKNQKLSFFNWWMFSIFFGTLFANTVLVYIQDNVGWTLGYGLPTLG
LLISVIIFLAGTPFYRHKVPTGSPFTRMAKVIVAAVRKWTVTLPSDPKELHELNLEDYTK
KGKFRIDSTPTLRFLNKAAVKTGSNSPWKLCAVTQVEETKQMIRMVPILVATFVPSIMIA
QVNTLFVKQGTTLDRAVGSFKIPPASLSGFVTLSMLVSVVLYDRFFVKIMQKLTKNPRGI
TLLQRMTIGMLFHIIIMVIASLTERYRLNLAKEHGVVENGGQVPITILILLPQFVLMGTAD
AFLEVAKIEFFYDQAPESMKSLGTSYSMTTLGMGNFLSSFLLSTVSHITKKHGHKGWILN
NLNASHLDYYYAFFAVLNALNFIFFLVMTKMYVYKAEISDSIKVLTEELRETTYKPSNKE
ES

Prunus persica Prupe_11 ppa003244m.g

MEAKASYTLDGTVDLRGRPVLASKTGKWKACAFLVGYEAFERMAFYGIASNLV
NYLTTQLHEDTVSSVRNVNNWSGSVWLTPVLGAYIADSYLGRFWTFTISSLIYVMGMM
LLTMAVSLKSFKPSCSNGICNKASSSQIAFFYISLYIIAIGSGGTKPNISTFGADQFDDFDPQ
EKKLKASFFNWWMFSSFLGALVATLGLVYIQENLGWGLGYGIPTVGLILSLFIFYFGTPM
YRHKVSKTKSPARDLCQIPIAAYKNRKAQLPSNPSELHEFEPQHYINSGKRQMYHTPIFR
FLDKAAIKDGNNMDASMRPPCTVTQVEGTKLVIGMVMIWLVTLIPSTIWAQINTLFVKQ
GTTLDRSLGQQFHIPAASLGSFVTLSMLLSVPMYDRYFVPLVRARTKNPRGITLLQRLGI
GFVVQVIAIAIAYAVEVRRMRVIRVHHLNGPKEIVPMSIFWLLPQYVLLGIADVFNAIGL
LEFFYDQSPEEMQSLGTTFFTSGIGVGNFLNSFLVTMVDKITGRNGGKSWIGNNLNDCH
LDYYYGFLLVISAINLGAFLWASCKYVYKRESVEVKEGCVDLVEGKAIATSPLGLQV

Prunus persica Prupe_12 ppa003260m.g

MEERKGAKPSKVEDEEKWVYDSSLDHKGNVPLRAQTGVWKASLFIVAIEFSERL
SYFGIATSLIIYLTKVMHDDLKVAAKSVNYWSGVTTLVPLFGGFIADAYLGRFNTVLASS
IIYLLGLILLCMSWFVPSLRPCDTKSCHGPRKIHEVVFFLAIYLVSIGTGGHKPALESFGAD
QFDDDHPEERKQKMSYFNWWNFGLCCGLLLGVTVVVYVQDHVSWGVADIVLTAVMA
VSLVIFIVGRTNYRYRKPTGSPLTPMLQVLVAAIAKRSLPHPSDPAQLYEIPKSEKVHGRL
LCHTKNLKFLDKAAIISAQTLAEKPSPWRLATVTKVEEMKLVLNMIPIWLATLPFGMCV
AQASTFFIKQGATMNRNIGNGFEIPPASIFSLAAIGMIISVTFYEKLLVPILRRTTGNERGIN
ILQRIGIGMVFSIATMVAAALVEKKRLGAVESDPVKGSHSMSVLWLAPQFVIIGLGDGFT
LVGLQEYFYDQVPDSMRSLGIAFYLSVIGAGNFLSSLLITVVDHITEKGGKSWFGKDLNS
SRLDRFYWVLACIVAANLCVYVFLARRYSYKNVQKVAVVADCYEGELEKGGPMA

Prunus persica Prupe_13 ppa003278m.g

MEQEQQLSTRWEGYVNWRNRAAIRGRHGGMLAASFVLVAEILENLAYLANASN
LVLYLSKYMHLSPSKAANDVTDFMGTAFLLALLGGFLSDAFFTTYHIYLISTVTEFLGLIL
LTVQARLPSLKPPTCSPDSLNNPCQEVEGGKAALLFIGLYLVALGVGGIKGSLPSHGAEQ
FDESTPQGRKQRSTFFNYYVFCLACGGLIAVTLVVWIEDNKGWEWGFGIATISILLSIPVF
LAGSTLYRNKIPRGSPLTTIFKVLIAATLHSCMTKSPSNAIASMAPTPSSPTPTSKAIQEGN
TTEKEASTADDQDQAPTQSLKFLNRAAQVNNPAHKALECTLQQVEEVKIVLKILPIFACT
IMLNCCLAQLSTFSVQQAATMDTKLGSLKVPPASLPIFPVVFIMILAPVYDFFIIPFARKST
KSEMGITHLQRIGIGLALSIIAMAIAALVEIKRKRVASTSGLLDSKEPLPLTFFWVALQYLF
LGSADLFTLAGLLEFFFTEAPTSMRSLATSLTWASLAMGYYLSSVIVSLVNDVSGKYSK
HKWLSGSNLNHYHLERFYWLMCVLSGLNFLHYLFWATRYKYRPGRPNK

Prunus persica Prupe_14 ppa003292m.g

MGSEDDERALLEANILQNEGSGLYAGDGSVDSKGKPALKNDTGQWKACSFILGT
FFCERLAFYGISTNLVNYFIEKLHERTVVASTNITNWKGTCYITPLIGAILADTYWGRYW
TIAGFTTVYLIGMCTLTLSASVSALKPAECVGSLCPSATTVQYAVFLTGLYLIALGTGGIK
PCIWPFGADQFDDTDPKERVKKGSYFNWFYFSQNIGAIIASSLLVWIQDNVGWGIGFGIP
TALMGVCIASLLIGTPLYRFQKPGGSPLTRICQVLVASFRKRNLKVLVDNSPLHETQDRS
SAIEGSRKLEHSNELRCLDKAAVISDADIEHGDLCNPWRLCTITQVEELKILIRMFPIWAT
GIVFSAVFAQMSTLFVVQGKLMKRTLGSVTIPAASLSFFDFVSVIIWVPIYDSIIIPIVKKFT
SKERGFSQLQRMGIGLFVSILCMAAAALVEIKRLQLVAELGLEDEKVAVPLSILWQIPQY
FLLGAAEVFTFIGQHEFYYEQAPDAMRSLCSALSLLTNSLGNYLSSLILTIVTYITTKGGK
AGWIPDNLNEGHLDYFYWLLAGLSFLNLVVYMVFSRNYEEKKAAAAA

Prunus persica Prupe_15 ppa003298m.g

MENGHEDDTKSVHQFVMATSGAAPPLRIQNYHEDGEQNLISQEELSSSRGGWGA
AIFIILVEVAERFAYYGMAGNLITYLTNELHEPIPMAAKNVNTWVGVSSLLPLLGAFIAD
AFLGRFSTIFVSSIIYLLAMVLLTITVSVIPLHYQKAMFFVALYMLSVGLAGHKPCVQTFA
ADQFREDSPEEKKAKSSFFNWWYLGITVGASAAILVVIYVQDNVGWAAGFGILTGAMA
VALAVFLFGYKKYRKQGPLGSPFTTVAQVFVAAVRKRHINGTSAGFGVYSRDDKDQHE
TRRLLAQTSQLRCLDKAIIIDHLDASSKNRNPWRLCSLNQVEEVKLVLRLIPVWMCCLLF
AVVQSFVQTFFTKQGSTMVRSIGPNFKLPQASLQIFLGLTIAVAIPIYDRVFVPTARKFTG
HSSGITILQRIGIGLFLSIISMMVAALVEAKRVGIVIDHNLLDNPKAIVPMRVWWLIPQYM
VCGLSDVFAFVGLQEFFYGQTPEAMRSMGAAAYLSVVGVGNFICSAIITSVQAISSKSGE
KWLTDNLNRAHLDYFYWLIAALSTLNLCVYVWIAKGFVYKKLEAEETGKEKELA

Prunus persica Prupe_16 ppa003339m.g

MGSLEEERSLLEDGLIQDETNGLYTGDGSVDITGKPVLKQSTGNWRACPFILGTE
CCERLAFYGISTNLVTYLTHKLHEGNVSAARNVTTWSGTCYLTPLIGAVLADAYWGRY
WTIAIFSTIYFIGMCTLTLSASVPALKPPQCVDSVCPSASPAQYGVFFFGLYLIALGTGGIK
PCVSSFGADQFDDTDSRERVKKGSFFNWFYFSINIGALVSSTLIVWVQDNAGWGLGFGIP
ALFMGIAIVSFFSGTPLYRFQKPGGSPLTRMCQVLVASFRKWNLDVPRDSSLLYETRDK

GSAIKGSRKLEHSDELNCLDKAAVISETETKTGNFSNPWRICTVTQVEELKILIRMFPIWA
TGIVFSAVYAQMATMFVEQGMMMDTSVGSFTIPPASLSSFDVISVIFWVPIYDRFIVPIAR
KFTGKERGFSELQRMGIGLFLSVLCMSAAAVVEMKRLQLATELGLVDKDVAVPLSIFW
QIPQYFLLGAAEIFTFIGQLEFFYDQSPDAMRSLCSALSLLTTSLGNYLSSLILTIVTYFTTQ
GGKAGWIPDNLNEGHLDYFFWLLAGLSLLNMLVYIVCAKRYKKKKAS

Prunus persica Prupe_17 ppa003360m.g

MAEAHHLDIWEGYVDWRNRPAIKGCHGGMLAASFVLVVEILENLAFLANASNL
VLYLSKFMHFSPSTSANIVTNFMGTAFLLALLGGFLADAYFTTYCIYLISAAIEFMGLLIL
TIQAQIPSLRPPTCLSVSTNSPCQEVHGGKTVMLFAGLYLVALGVGGIKGSLPPHGAQQF
DETTQQGRKQRSAFFNYYVFCLSCGALVAVTFVVWIEDNKGWQWGFGISTATILISIPLF
LLGSPKYRTKIPAGSPITTMFKVITAAICNACKARNPSNAVTNMAITPSYTNDPSEREEKI
SQTPSESLKFLNRAVTIRPVHPMLKCTVKQVEEVKIVLKILPILMSTIMLNCCLAQLSTFS
VQQAATMNTQLGSFKVPPASLPVFPVLFIMILVPVYNLAIIPFARKITKTEMGITHLQRIGI
GIILSVIAMAVAAVVEMKRKNVAAKYGQLDSAEPLPITFLWVALQYLFLGSADLFTLAG
MMEFFFTEAPMSMRSLATALSWASLAMGYYLSSVLVSIVNDVTGAYRHTPWLFGDNL
NHYHLERFYWLMCVLSGLNFLYYLLWASRYKYRSTGSDFKENQNPTTL

Prunus persica Prupe_18 ppa003364m.g

MAEDDVPTKAAAAEDVYTKDGTVDFHGNPAKRNATGTWKACPFILGNECCERL
AYYGMSSNLVLYFKTQLHQTSAVAAKNNSNWSGTCYLTPLLGAFLADAYLGRYKTIAS
FSIIYVIGMTLLTMSASVPGLKPTCSGKDNCHANGGQTAATFIALYLIALGTGGIKPCVSS
YGADQFDDDDEVEKKHKGSFFNWFYFSINVGALIASSVLVWIQENVGWGWGFGVPAV
AMAIAVVSFFSGSRLYRNQKPGGSPLTRIIQVLVASVRKYKVKVPEDKSLLYETADAESS
SIQGSRKLDHTNEFRFFDKAAVEVQSDHIKDSKDPWRLSTVTQVEELKSIIRLLPIWATGII
FAAVYNQMSNFFVLQGNLMDIRVGHSSFEIPAASLSIFDTLSVIFWVPIYDRVLVPVARK
YTGHKNGLTTLQRMGIGLFISIFSMICAAVLELIRLRSVREHNYYEYEHMPMSVFWQVP
QYFLIGAAEVFTFIGQSEFFYDQAPDAMRSLCSALALSTVALGNYFNSILVTIVTKTTTKN
KNPGWIPNNLNYGHLDYFFWLLAVLSVLNLGAYLLISKWYTYKKTVGTLR

Prunus persica Prupe_19 ppa003472m.g

MATSHHETAGVQTPLLDDVVEGAVDYKGLPVHRSRSGGWRSAWFIIGVEVAER
FAYYGISCNLITFLTGPLGQSTATAAENVNIWSGTASLLPLLGAFVADSFLGRYRTIVFAS
LLYILGLGLLTLSAVLPSLTGSYCQKFNQSTSCSSQFQVLFFFFSLYLVAVAQGGHKPCV
QAFGADQFDASDPEECKAKSSFFNWWYFSLCFGTTFTLILLTYIQDNLSWGLGFGIPCIA
MVLALFIFLLGTRTYRCSIKGDEESPFVRIGRVFVAALRNWRTTPSAITCEEESRGTLPHK
SSEQFKFLNKALLAPDDLKESRKVCTVAEVEEAKSVLRLFPIWVTCLAYAVVFAQYSTF
FTKQGATMDRTIAPGLDIPAASLQTFISITIVIFVPIYDRIFVPIARVFTRKPSGITMLQRIGI
GMFISIISMVVAALVEMKRLKTAKDYGLLDMPSATVPMSIWWLVPQYLLAGLADVFTM
VGLQEFFYDQVPNELKSIGLALYLSIFGVGSFLSSFLISAIDDATTWAGETSWFSTNLNRA
HLDYFYWLLGGISVVELAIYLYFAKSYIYNRAGTV

Prunus persica Prupe_20 ppa003507m.g

MAENGLQLRSQNPSTHPKPSRGGWNAAIFIIFVEVAERFAFYGLAGNLIMYLTNE
LHQPTAMAAKNVNLWMGVSSLFPLVGAVVADSYLGRFKTIIFSSSIYFMGMVLLCLSVS
VVPLHYREAIFFVSLYILAVGEGGHKPCVQTFAADQFDEDSEKERKAKSSFFNWWYLAI
VIAGTVASLVVIYIQDNVSWVIGYGVLAAVIAAGIILFLLGIKSYRKQGPLGSPFTAVAQV
FAAAIRKWRVKETHDWDVYYGDERSETHMEAQPKHKTLARTKQFRFLDKAMIIDNLD
ASSKTRNPWRLCSINQVEEVKLVIRLIPIWLSCLMFNVVQSQLHTYYTKQGSKMNRSMG
PHFQLPPASLKVFVGITILITVPIYDRIFVPMARKLSGHPAGITVLQRIGVGLFLSILNVVA
AALVEAKRVSVAKQHDLMDNPKAIIPIRVWWLLPQYLICGLSDTFAVVGLQELFYDQM
PEGLRSLGAAAYISILGVGSFLSSAIISLVQAISSKSGEEWLGDNLNRAHLDYFYWVLAG
MSALNLCVYVWTAKGFVYKKVEAQKPTGAKKAGTKAGEV

Prunus persica Prupe_21 ppa003862m.g

MAGSGGKTLGNSCILLIVIAGMERFAYKGVASNLVTYLTDVVKMSNSAAAKTV
NSWCGFTSMLPLLVAPFVDSYWDRYPTILASSFLYVAGLVALTSTALTRASSAANKTSS
NSSFLFWSLYLISLGQGGYNPSLQAFGADQLDSEEELPSSKDEQKSNKKSVFFQWWYFG
VCSGSLLGITLMSYIQDTFGWILGFAIPMISMITSVVVFSCGSRIYTYRESEAMDYKPIVN
MVQSIKATTLKLMKYCRITLPNKSDVTELELQEKPLCHQNFSTNEGLVENPKSGFYVLE
NAKVLLRLLPIWIMLLMFAVIFQQPPTFFTKQGMTMKRNIGSKFKIPPATLQSAITLSIILL
MPLYDKIMIPITRLVTCHEKGISVMQRMGIGMFISVLAMASAAVVETRRLHISGEMEAL
GAHSETVPFSIFWLLPQYILLGISDIFTVVGMQEFFYSEVPVRMRTMAFGLYTSVFGVGS
YLSSLLIATVEAVTSSNGRQSWFSDDMSEARLDKYYWFLASLSALSFLFYVLLSACYRS
RRDLDLDNENCK

Prunus persica Prupe_22 ppa004666m.g

MLQGKREAWSPCPSSLGMISLTVSAVLPQLRPPPCQHDQVCKEANGGQLAILYA
SLLLGALGSGGIRPCVVAFGADQFDETDQKQTTKIWNYFNWYYFVMGASILLAVTVLV
YIQDNIGWGWGLGIPTIAMFISIIIFMVGYPLYRNLDPAGSPFTRLIQVSVAAYKKRKLPL
VSDPRLLYQNDELDAPISLGGKLLHTKHMKFLDKAAIVTEEDNLKSPNLWRLNTVHRVE
ELKSVIRMGPIWGSGILLITAYAQQNTFSLQQAKTMDRHLTKSFEIPAGSMTVFNIVTML
STIAFYDRLFIPFARKLTGLDRGITFLHRMGIGFVISILATLVAGFVETKRKNAAFAHGLV
NQPHSMIPISVFWLIPQYSLHGMAEAFMSIGHLEFFYDQAPESMRSTATALFWTAISAGN
YVSTLLVSLVHKFSAGPNGSNWLPDNNLNKGKLEYFYWVLTLLQVINLIYYIFCAKMYT
FKPIQVIKKEAAESEEKGVELVNRV

Prunus persica Prupe_23 ppa006469m.g

MRTEEERKAKSSFFNWWYLGLVFGATSATLGVVYLQDNVGWGLGFGILAGVV
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MVEGQPQALVLSRTNQLRFLDKAMMIDEVDASNQTRNPWRLCSLNQVEEVKLVLRLIPI
CPTSHRLHQSSTTIRSIGPHFQVPPASLQGLVGIAILIAVPIYNRFLVPLTRKYTGHSSGITV
LQRIGIGLVISILNMVVSALVEAKRLDVAKHYNLIDKPKAIIPMKVWWLLPQYLICGVSD

AFTTVGLQELFYDQMPEQMRSMGAAAFISVIGVGSFISSGIISIVQSITSRNGEKWLGDNI
NRAHLDYFYWVLAVLSTLSLCVYVLITRAFVYRKIGGEEKLKAEMSLFAKNHDGGET

Prunus persica Prupe_24 ppa014631m.g

MEEEDIHTKDGTIDYQNRPAIKKNTGTWKACPYILGNECCERLAYYGINTNLVN
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LTLSASLQGLKPPCDTNNVCHPTGLQAGVFFMGLYLIALGTGGIKPCVSSFGADQFDDS
DEAEKKNKGSFFNWFYFSINIGALVASSVLVWIQTNVGWSWGFGIPAVAMALAVVSFF
LGTRLYRNQRPGGSPLTRICQVFVASFGKFRVKVPGDKSLLYETADEEPVVKGSRKLDH
TEELSFLDKAAVETPSDKIKDSVMAWRLCTVTQVEELKSLVKLLPIWATGIIFSAVYSQM
GTLFVLQGNTMDLHVTKSFEIPSASLSLFDTISVIFWVPVYDRLIVPFVRKFTKRNNGFTQ
LQRIAIGLVISIFAMLAAGTLELVRLNEFFYEQAPDAMRSLCSALSLTTAALGSYLSTML
VNIVTDVSTRDGKAGWIPDNLNYGHLHYFFWLLACLSVMNLGFYLLVARWHTYKRAV
VPNH

Prunus persica Prupe_25 ppa015854m.g

MISEDNNRDAEVSGAVDTNIPENEQQVTTEITESKETKSPVQKSRGGWTLATILL
ANQGLATLAFFGVGVNLVLFLIRVLDQQNAAAANNVSKWTGTVYLFSLVGAFLSDSY
WGRFLTCAIFQLILVLGLGLLSLSSWLYLIHPSGCGDGVTPCKPKSTVGVVMFYLSIYLIA
LGYGGHQPTIATFGADQFDETNPKQQSSKAAFFCYFYFALNVGSLFSNSILVYYEDKGF
WTMGFLVSLGSAIVGLVSYLLAAPRYRYIKPSGNPLPRVAQVFVAAFRKWKVVPASPE
NLYEVEGSESAIKGSRKILHSKEIEFLDKAATITEMDQSGHNNPWRVCTVTQVEEAKCVL
KMLPIWLCTIIYSVVFTQMASLFVEQGDVMESHIGNFHFPAASMSLFDIFSVLICTGIYRHI
VVPVSGRLSGNPKGLSELQRMGIGLIIGLLSMVAAGATEVARLKHVQPGQKVSSLSIFW
QIPQYVLVGASEIFMYVGQLEFFNGQAPDGIKSLGSSLCMASISLGNYVSSLLVTIVMMIT
ARGENPGWIPNNLNEGHLDRFYFLIAILTALDFVVYVFCAKRYKGINLQGPELEMESIES
PQEEVGINRV

Prunus persica Prupe_26 ppa016778m.g

MSIERDQNVFNQKESDDQFVDWKGRKANPGKHGGITAAAFACVVEVFTNMVFL
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NQRLISAFFNWFFFSLCLGGLISCTVMVWVEENEGWNWSFTITAIVLSLALSIFISGSPFY
RHKLPGGSALTRIIKVLASAARNCKASPEERVENQYAVSAINPNTVDGKSHNKFKFLDK
ALIDNTISEAHVEETRTFLGLLPIFASTIMMNCCLAQLQTYSVVQGVLMNRKLHNFKIPT
QSLSVLPLSIMLASIPLYEKFRRILSSKKSEKIHIFQPLWRIGLGLALASGSMAVAALVEAK
RREAALDNATLSVFWLAWQFLLLGVSDMLTLGGMLEFFYSEAPDSMRSMCTALSWCS
TSMGYFLSSVLVSIVNSASGRFGREWLGGNDINHSRLDLFYTLLSILNTLNFLNYMYWA
KQY

Prunus persica Prupe_27 ppa017140m.g

MGTREIKSPEGGLVTPASLDGNPDSNHRKKLGLYFIESDDRRTAFGRGYTGGTTP

VNIHGKPIADLSKTGGWIAAFFIFGNEMAERMAYFGLSVNMVAFMIYVMHRPFSSSSNA
VNNFLGISQASSVLGGFLADAYLGRYRTIAIFTTIYLAGLTGITLCATMDILAPKQDHCDQ
LALLLGECEPAKPWQMTYLYTVLYITGFGAAGIRPCVSSFGADQFDERSKDYKSHLDRF
FNFFYLSVTTGAIVAFTAVVYIQIKLGWGFAFGSLALAMGISNLVFFVGTPLYRHRLPGG
SPLTRVAQVLVAAYRKRNAPFSSSELIGLYEVPGKQSAIKGSGKIAHTNDFRCLDKAALQ
LKEDGVDPSPWRLCTVTQVEEVKILLKLIPIPACTIMLSAVLTEYLTLSVQQAYTLNTHM
GQLKLPVTCMPVFPGLSIFLILSLYYSTFVPLSRRITGHPHGASQLQRVGIGLAVSILSVA
WAAIFERYRRNYAIEHGYEGSFLSAMSDFSAFWLLIQYCLIGIAEVFCVVGLLEFLYEEA
PDAMKSIGSAYAALAGGLGCFAASILNSIIKSVTGSSEKPSWLSQNINTGRFDYFYWLLT
VLSVINFCVFLYCARRYKYRTEQGVKMEKQILANIKEQSLSG

Prunus persica Prupe_28 ppa017628m.g

GIVLLVLTETFNSLKPQPCVKEPDVCQPTSKLQHAILYTAIALATIGVGGTRYTMA
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VIFLCGARFYHFDKPQGSPFVGLARVVVASARKRNLQHSSGGSKDYYYGHGGVTDDLV
GSAAPSSSFRTGGGASTRDTRYGAVKMVVCSSWRTIVFLNRAAQKIEGDIKPDGSIGKP
WRQCTVQQVEDFKTLIRILPVWSTTIFLGTPVAVQYSLTILQALSMDRQIGPHFNIPAGSI
LVVVFFSTAISLTVIDRFLWPTWQKLTGQFPTFLQRIGLGHVLNILGMVVSALVESKRLKI
AKTHHLQDQLGAIVPMLALWLFPQLILVGIGEAFHYPGQVALFYQEFPVSLRSTSTTMA
SLIIGISFYLGTGVINLIQKVTRWLPDNINNGKLENVYWMLVVVGVLNFGYYLVCASLY
KYQNVAGADCNSGPDSEK

Prunus persica Prupe_29 ppa017670m.g

VFEVDQWKGGEKRLLNACTRDGSVDWYGKPALKGSTGGWRCGMLLLVNQGL
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CVTFQIVHTIGLIALSLSTNLFLLRPPGCGEIGQLCEPHRPMEVAMFYISIYLIALGNGAPE
PALAAFGADQFDEEDSEEKQAKTSFYSYFYVALNLGCLVAETVLVYMESMGHWVPAF
WICTGSSVVGSVLFLGGSCRYRHFKASGNPISRFSQVIVASTRKINHELPSNGEGLYETIG
RGSETNGSRRILHTKGFKFLDRAAFITCDDISLMSNQGQTPNPWHLCTVTQVEEVKCILR
LLPVWLCTVLSSMVFIQVLSLFVEQGAAMDRRVSNFQIPPASMTAFDIVSTSLFIILYDKL
IVPLYTKVTKREPKPPSALQRIGIGLTIGIVGLVIAGFVERKRLKYASNSGEETSSLSIFWQ
TPQYVLVGVSEAFVYVSQMEFYSSQTPDGLKSLGIALWMTSSAMGSYVASMILTVVME
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Prunus persica Prupe_30 ppa018162m.g

MDKKKGGFTASSFIFVLLALDNMGFVANMVSMVLYFMLVMKFDLAHSANTLT
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TIGVTFIVYVSTNVAWYWGFFISTIATFVGFAVLAIGKPFYRLQIPGDSPIIRIVQVIVVAIK
NRRLPQPGSPQELYEISEKESNYFEEKIAHTHQFRFLDKAAILGKDTKPQQWVVCTVTQV
EEVKVLTRMLPILFSTIIMNTCLAQLQTFSVQQGNAMNRYLGSFEVPAPSIPVIPLLFMSIL
IPIYEFFFVPFARKITNHPSGITQLQRVGVGLVLSAISMAVAGIVEVKRKNQVHKDITKPIS

LFWLSFQYAIFGIADMFTLVGLLEFFYKEAPAGMKSLSTSFTWLSLAFGYFLSSIFVDVIN
AVTKRIAPSKQGWLHGIDINKNNVHLFYWFLAILSCINFANYLYWASWYKYKTDEPAS
KIQLKPLNQIPLIN

Prunus persica Prupe_31 ppa018364m.g

MENPEEKGPAYGGQDFTQDGTVDLKGRPILRSKTGRWRACSFIVGYEIFERMAN
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IYLMGMSLLTLAVSVPALKPPACNHGIQAEDCTKASPFQVGIFYCALYMIAVGTGGTKP
NISTMGADQFDDFEPKEKAHKLSFFNWWMFAIFFGNLFSSTFLVYIQDNVGWTLGYGIP
TVGLVISVVVFLVGTPFYRHKLPSGSPITSIAQVLVAAVRKWKVPVPNDPKELYELSLEY
YADKSKLKIDHTSSLRSLDRAAVKSGPNTPWTLCPVTQVEETKQMMKMIPVLLTTFIPAI
IIAETHTLFIKQGTTLDASMGPHFKIPPASLGSFITLSMLVSLPIYDRLFVPAIRRYTNNPRG
ITLLKRMGIGFVMQIIIMVIACLAERKRLSVARENGIFGKGEKVPLTIFVLLPQFALMGVA
DTFVEVAKIEFFYDQAPQGMKSMGSSYFTTSFAVGNFLSSFLLKTVSDVTKRHGHKGG
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Prunus persica Prupe_32 ppa019863m.g

MKLRGDSMSEAEAVVEDMSVDWRGRPCKPTKHGGMKAAVFVLGLQGFEMMA
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ELSGFMLLCVQAHLPELRPPPCKIMSHEYCPEAKGYKALIFFAAIYLVALGSGCLKPNIIS
HGADQFRRDDSKQSKKLSSYFNCAYFAFCIGELIALTVLVWVQTHSGMDVGFGVSAAA
MAMGLICLTFGTPLYRNKPPRGSIFTPIAQVFVAAFTKRKQICPSNTEMLHGNQNNVPNH
LFVPMSPNISPLLHTEKFRFLDKACIKIEDGTQRNESPWRLCTVAQVEQVKIIISVVPIFAC
TIIFNTILAQLQTFSVQQATAMNTRITRGFKIPPASLQAIPYIMLIFVVPLYEIVFVPAARKL
TGRDSGISPLQRVGTGLFIATFSMVSAALIEQKRRNLALSSNEPLSIFWIAPQFLIFGLSEM
FTAVGLIEFFYKQSLEGMQSFLTAMTYCSYSFGFYLSSILVSVVNKLTSTSSRGGWLSDN
DLNRDRLDRFYWLLAALSLINFFNYLFWSNWYSYNPSLSLPSSPKQSYGKDLEINNFNPS
KHVEAHNIKT

Prunus persica Prupe_33 ppa021364m.g

EESLSASLVSNGRVDFHGKVADKKKTGGWKASPFIIVNEVAERLAFFAVAVNMV
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LTLSTSIDSLRPPPCTTRPCNKATDGQTAFLYGALGLIALGTGGIKPCVSSFGADQFDEAD
SREVQTKYAFFNWFFFAINIGALLGITVLVYIQDNKGWTWGFGIPTMAMICSIAILAAGV
PYYRYQKPMGSPFTRFIQVAVASVRNHFNGVEVVREADLYEVKTNQSDILGARKLPHTT
QYRFLDKAAVVTDPEGSPKSRWMLCTVTQVEEFKCFIRVLPVWTSTIALSISFSQLSTFF
VSQANKTNRHLGPNFEIPAGSVPVFAAINALILVPIYEKWMVPTIRRRTGHPRGLTSLQR
MGVGLFVSIFALGSAALVEKKRRDHLNPLSKMSVFWLLPQFFLIGTAEVFTYVGQLEFF
YDEATDGTRSISSAMFLSEIGIGSWLSTALVKIIDSATGGEEQGWLRNDLNMSKLDYFY
WILTAINGVNFLVYLWVARRYKGRHGSRTSVRHGDES

Prunus persica Prupe_34 ppa021603m.g

MSWTVADAVDYKGFPADKSRTGGWVAAALILGIEICERLSTMGIGVNLVTYLVG
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PQLRPPLCHATAASNNCKQANGFQMGIFYLALYTIGLGIGGLKSSVSGFGTDQFDEKDD
KEKAQMAYFFNRFFLFISTGTLVAVTILVYIQDEVDRSLAYGICSISMFMAILLFLAGTRR
YRYKKSSGSPIVQILQVIVAAIRKRKMITPVDTNSLYENSPEASRIDHTDQFRFLDKAAIL
AQGDFEERNAAGSLSPNPWKLRSVTRVEEVKMMVRLVPIWATTIMFWTAYAQMITFSV
EQASTMQRSIGKFQIPAGSLTVFFVLAIMITLAFYDRLIMPLWKKWNGQPGFTNLQRMAI
GLVLSTIGMAVAALSERKRLSVARAVGGTTKTLPISVFLLIPQFFLVGSGEAFIYTGQLDF
FITKSPKGMKTMSTGLFLSTLSLGFFVSSFLVSIVKAVTGSKDEQGWLTDNINYGRLDCF
YGLLTVLSVINFVVYLVCARWYKTHEPHPPALQMTSTTAKANGSSAEDRC

Prunus persica Prupe_35 ppa022075m.g

MEHATHSSSGGGLDSQSPPPKTPVGGWRAVRYILGNETFEKVASMSLVANLVM
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TLTAGLHELTPSACKGQTECPQPNAWQLAVLYSGLGLLVVGSGGLRPCNIAFGADQFDT
KTEKGRAQLDSFCNWWYLLFTVALLIALTGVVYIQTNVSWILGFSIPTACFGLSIIIFLLGT
KLYIRIKPQGSVFTDIIKVVVATCRKYGSNAGQTSGKLFYDPPSIGSESQTAARTDRLKFI
DKAAMIMDPSEVDSQGKPTNGWRLCSVQQVEQLKSVVWILPVWITGIFCFIGMNQMNS
FGIFQAIQMNKAIGPKFQIPPAWMGLAPMIALSIWIIIYESLYIPQMQKRNKNESGRLTME
QRFKIGIVMSVLCMVVAGLTEMKRRNSALKHGTFESPITVALLVPQFALSGLIEAFAAIA
LMELLTVQWPQSMRTFAGAVFFLSLSMASYLTSLLITIVKKVSGLNGNSSWLGGNDLNK
NRLDYYYYTIAGLGVVNFVYFHFYARHYLSDAAAVENSENQ

Prunus persica Prupe_36 ppa022076m.g

MPSHESPSSEPLLQQKDAITVQRRRNGWKAVPYILGNESIIKMATYGLQTNFMVY
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MSAFVPQLRPPPCILDGQKHLVQCVSNTKTQLGFLLAGLSLLAIGTGGIAPCSIPFSVDQF
DSTTVEGRKSVQSFLNWYYASSTVIMLINQTLVVYIQDSVSWALGFGIPTLLMSSVIPLFL
AGSKIYHHVKPEGTTFISFAQVLVAAYTKRHLKLHNDERVCGVFLDVSSDGNVVLSKHS
LTTKFSSLKKAALVVDDDLKDDGSCANPWRLCSIQQVEEVICFMKILPIWASGCICFMTS
SQEGTFVVSQALKMDRHIGPNFEMPAGSIKVMSLITLCLCIPLYNRVLQPALRKITKHEN
GITTLQRIGLGYLLSILFAVVAGLVEQQRRASALSQASADGVAPMSVFWLFPQLMLLGM
VELFGFVGHIELYNKEFPEKMRSIGNSLIYLCIAGATYLSTLMVSIVYSVTGKHGEPNWL
DNDINAGRLDYFFILIAALGVLNFAYFWSCARGYTYTSSECIKDV

Prunus persica Prupe_37 ppa023046m.g

MDESLSHNDEAHASSSHSGSRRGGWITFPFITGALVGLTLTAGGWLSNLIVFLIEE
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QPCLVGSELCQPTSTLQDAVLYTGIALASIGLGGTRYTLATMGANQFDKPKNQASFFNW
YFFTLYSATIVALTVIVYIEDNAGWRWGFGLCVLTNIIGLAVFLSGTRFYNIDKPQGSPFV
GLARVAVAAFRKRKLQLSSLSKDYYDRHDGVKEGIVTGTLSTSFRFLNRAAQKIEGDIR

SDGSIAKPWRLSTMQQVEDFKTIIRILPLWSTSIFLCIPLGVQSSMIVLQALSMDRHIGPHF
KMPSGSVIVIVLLSTAISLTLIDRFLCPVWQKLTGRSPTPLQRIGLGHVLNVLSMALSALV
ESKRLKLAKANHLQPVVPMLALWLFPQLVLAGIGEAFHFPGQVALYYQEFPVSLRSTST
AMISLVIGIAFYLSTGVINLVQRVTGWLPNDINNGKLDNVYWMLVVVGVLNFGYYLVC
AKLYKYQNVKGADVNSGSADNEK

Prunus persica Prupe_38 ppa023308m.g

GLDSEVGTKNLAYEPMKKLKHGGFKANYFIFAMMFLDNIGFVANMASLVLYFM
FVMHFDLSGSATTTTNYLGTTFLHTIVGGFISDAYMNRLNTTLLFGAIELLGYMLLIIQSH
DTKLQPLPCGESTCVHGTKALLFYASISFVGLGGGGIRGAVPALGADQFDHKDPEEHKY
IASFFNWFLLSITVGAVVGVTFVVYVSSNVGWDIGFIISLSCAAVGLIFVALGKPYYRVR
VPGKSPLTRVLEVLVVSVKNWRLEVPQSPDELYEIRDRESVSRGELIPHSNQFRLLDKAA
ILPKGTNGAGKWKVCTVTQVEEVKVLTRMMPILLSTILMNTCLAQLQTLSIQQGTLMDT
RIGDFDVPSASIPVIPLVFMSLLIPVYEFAFVPVLRKITGHPNGITHLQRVGVGLILSAISMA
IAGIVEVKRKHEIIHHNHKISLFWLSFHYAIFGIADMFTLVGLMEFFYTEAPVGMRSLSTS
FSWLSLSIGYYLSSVFVELINLITSKLTKSKTGWLEGRDMNKSHADLFYWFLAILSVLNF
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Prunus persica Prupe_39 ppa023384m.g

MESKPKEVEEVETFSEDGEDHPKRGGWITFPFVTGSMLGLSIAGGGWGSNLIVFL
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SLRPSSCPPGSLTCEGPSNFQYSVLYGALALASLGLGGTSFTIATMGADQFKNPKDQGVF
FNWYFMALYVANLISSTAIIYVEDNVGWGLGFGICFIANAIGILVFLLGKRFYRQVKPMG
SPFMSIARVLMRFLLTIQSQLNLSALKTEKDKQFNGSYTKSWQLCTVKEVEDLKTLIKIM
PLWSTGICLSITIAISSSLVVLQALSMDRHLGPHFRIPAGSFPVFNLLATAISIFIVDRFILHK
LRPLQRVGIGHVINIVGLVGSALLERGRLGVVRAHHLTNQPGTVVPMSALWLVAPMSV
MGIGEAFQFPGQVALYYEQFPKSLKSTSTAMMSLLIGIGFYLSTAITHLVKQTTGWLPNN
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Prunus persica Prupe_40 ppa023390m.g

MELSSEQSKPAQLVTSKKGGLRTMPCIISNEALEKVASYGLHANMILYLTSEYHM
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VHCDDPSKEKCISANTGQVMLLFASFGLMSIGSGGIKPCSLAFGADQLDKPDSPKNERVL
QSFFNWYYASVGVSVMFAVTVIVYVQVQFGWVVGFGVPVGLMLLSGLLFLLGFSLYV
KVPPNKNLSAGLVQAIAAAWKNRHLALPPKNFDAWYSPKGSKFVTPTDNLRYLNKAC
MIRSPEKDIGPDGLAKDPWSLCTVRQVEELKALIRILPIWSSGIMIGATIAQHSFPVLLANT
MDRHFLGKIEIPAASFSLFGILTLTVWVAIYDRILVPLVSKYTKRPRGFSFKQRIGAGLVIS
CLATAAAAEVERQRRKTAIQEGFLSNPKGVVSMSANWLVLQHCLTGLAEALNAIGQLE
FYYSQFPKSMSSIAVALLSLGFGFGSLVGSLVVSILDDVTKKYGVSWISSDLNRAHYDYY
YWLLTAMSVVNFFYFLLCSWLYGHCEDKKIWDESEGTKEMEDLSKSGEYAVIFSA

Prunus persica Prupe_41 ppa023462m.g

MASSVDLLNFTNEAARKVREDNRCTGESETVNRNLYEVEQKVIAGKSKTSLIRK
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CSLIGAFLSDSYWGRYLTCAIFQLIFVVGLVLLSLSSWLFLFHPSGCGDGEIVCMPASPVG
VAIFYLSIYLVAFGYGGYQPTIATFGADQFDEANPKEGASKAVFFCYFYFALNVGSLFSN
TILVYYEDTGKWTLGFVVSLGSAIIALLSFLLGTPGYRYLKPCGNPLPRVAQVFVAAARK
WDIVPVNSDDLYEVEGPDSAIKGSRKIYHSNEIEFLDKAATITEDDLCGPKNPWRLCTVT
QVEEAKCVLKMLPIWLCTIIYSVVFTQMASLFVEQGDVMKSNFGNFHLPAASMSAFDIC
SVLICTGIYRQVLVPLAGKLSGNTKGISELKRMGIGLVIGMLAMVAAGATEIARLKHVLP
GEKISSLNIFWQIPQYVLVGASEVFMYVGQLEFFNGQAPDGIKSFGSSLCMASMSLGNY
ASSFLVNMVMGITARGKDPGWIPDDLNTGHLDRFYFLIAALTAFDFVIYVFCAKWYKSI
NLEGSEKEIQIIEIQQDVVLRRV

Prunus persica Prupe_42 ppa023730m.g

MEKRRGEINTNRDDENWVYDSSVDHKGRVPLRASTGVWKASLFIITIEFSERLSY
FGIATNLISYLTQVIHQDIKTAAKNVNFWAGVTTIMPLIGGFLADAYTGRFNMVLFSSLIY
IMGLSLLTIAQFIPSLKPCNTKMCLEPRKIHEVVLFIALYFITVGTGGHKPCLQSFGADQF
DDDHLEERKKKMSYFNWWNFALCCGLLLGVTVIVYVQDYVSWGVADLILTITMAITIV
TFYMGKACYRYRVPEGSPLIPMLQVLVAAIRKRNLPNPSSPALLFEVPKSQKHCQGRLL
LHTNRLRFLDKAAIIEEHVSTSYEQKYNPWRLTTLTQVEEVKLILNMIPIWLTSLTFGVCL
AQASTFFVKQAATMNLNITDNFKIPPASIYSLGAIAMLISVTVYDKILVPILRKATGNERGI
NILHRIGFGMIFSVMAMSAAALVERRRLKADEPQSMSVFWLAPQYIILGLGDGFTLVGL
QEYFYDQVPDSMRSLGIAFYLSVIGVGSFISSFLIMAVDHVTEKGGRSWFGKDLNSSRLD
NFYWLLAAMNGLNLCFYGLLARGYTYKNVERRVVVVTDV

Prunus persica Prupe_43 ppa024635m.g

MENVNDSSSLREDPPLNPPSSNARKPGGWRAIKYILANESFEKLASMSLIANITVY
LTTRYNLSGIFVVNVVNIWNGSSNVASLAGAFVSDAYLGRFRTLILGSISSILGMGAMTIT
ASINQLRPPTCKEPPHCPEPQSWQLGFLFLALALLSIGAGGIRPCNIAFGADQFDTKTAKG
RAQLESFFNWWYFSFTVALVVALTIVVYIQTNVSWTIGFVIPTVCLASSISIFLFGRHTYV
YLKPQGSIFSDIAKVITASCRKCRVPVGQASEHSFYDPPLITNASDQTQMILKLPHTNRFR
FLDRSAIITSPDELDNQGKPKSGWRLCSLQQVEQLKCLVAILPVWITAIGTFMSVDQQNT
FGVLQALQMDRSIGPKFKFSPGWLNIISMLALAIWIFFYERIYLPLAQKKSTRRNKRLTM
QQRINTGIMLSIVSMLVSGIVEEHRRKSALRHGSYISPSSFALLLPQFFLSGLTEAFSAVSI
MEFFTMQMPESMRTIAGAVFFLSLSISSYIGSLIVNIVHKATEKKAKSPWLGGHDLNQNR
LNYYYYIIAGLGVLNLVYFNLFARRYVLVGRPVKGKRRMSQCVTTSSLIEKEENLLPEV
KKLVMKGLEYLSSGDSIRALPLGGQRQDKGCHYLRE

Prunus persica Prupe_44 ppa024795m.g

NESIEKMATYGLTTNFMVYLVREYHMDQVSAANILNIWTCGYCLLTVVGASVA
DIYLGKFLTIALASLASLLGMVTITLTALVPQLRPPPCVPDGQKHLVQCVSNTKTQLGFL
FAGLSWLAIGTGGIRPCSIPFGIDQFDSTTVEGRKNVSSFLNWYYASSTVVLLINQTLVIYI

QDSISWAWGFGIPTLLMSSSIPLFLAGSKIYHHVKPKRSTFSSFTQVLVAAYKKRHLKLH
NDERVCGVFLYVSSDGNLVLSKHSLTTKFSFLKKAALVVDNDLKDDGSCSNPWRLCSM
QQVEEVICFMKILPIWASGGICVMAYAQEGTFVVSQALKMDRHIGPNFEMPAGSVKMM
SLITLCICLPFYDRVLQPALRKITKHENGITPLQRIGIGYLFSILFMVVAGLVERQRRASAL
SQASEDGVAPISVFWLFPQLMLLGMVELFGIVGHIELYNKEFPEKMRSIGNSLIYLCTAG
ATYLSAVVASIVYSVTGKHGEPNWLDNDINAGRLDYFYFLIAALGVLNFVYFWSCARG
YTYTSSARAVESIEADILV

Prunus persica Prupe_45 ppa025891m.g

MAYDDYTNDGTVDIHKNPANKKKTGNWRACGFILGNECCERLAYYGMSTNLV
NYLGKHLSMGNVAASTTVTNWSGTCYATPLIGAFLADAYLGRYWTIAIFSVIYALGMTF
LTLTASIKGLKPWCDKSGCQATSSQRAACFVALYMIALGTGGIKPCVSSFGADQFDETD
ETERKKKSSFFNWFYLSINIGALIASTVLVWIQMTVGWNWGFGIPAVAMAIAVVFFFGS
KLYRLQKPGGSPLTRIIQVIVASIRKCNVKVPADKSLLYETPDEECNIQGSRKLEHTDKLR
FFDKAAVESETDHAKDLPNPWRLCTVTQVEELKSIIRLLPIWASGIVFAAVYSQMSTMFV
LQGNTMDQHMGPNFKIPSASLSLFDTVSVIFWAPIYDQVIVKLARRFTGHERGFTQLQR
MGIGLGLSIFSMVVAGILEVARLGIVRKNNYYDLEYIPMSIFWQVPQYFIIGCAEVFTFIG
QLEFFYDQAPDAMRSLCSALSLTTVALGNYLSTLLVTVVTKVTTRNGHLGWIPDNLNR
GHLDYFYWLLAALSIINFFVYLWIAKWYTYKKVTGQTNS

Prunus persica Prupe_46 ppa026167m.g

MELSSEQSTSTQLVTSKRGGLRTMPCIISNEALERVASIGLHANMILYLLYEYNM
DAATGASILFLWSAISNFTPIVGAFLSDSHLGRFCTIAWGSVVSLLGTTMLWSTAIIPHAR
PVHCNNPLKEKCVSANTAQLMLLLASFGLQSIGSGAIKPCSMAFGADQMDKPDNPKNE
RVLQSFFNWYYASVGVFVMFSVTAIIYVQTQFGWVVGFGIPVGLMFLSALLFFLGSSLY
VKVPPNKNLSAGLVQVIAAAWKNRHLALPVSPKNFDAWHCIKSSKFATPTDNLRCLNK
ACMIRSPEQDIASDGLANDPWSLCTVRQVQELKALIRILPIWSTGIIIAMTTTQHSFAVLQ
ANAMDRHILGKIQIPAASLSTFAVLTLVIWVAIYDRILVPLVAKYTKRPRGFTFKQRIGAG
LVISCLATAVAAEVARQRRKIAIEAGFLSNPGGIVSMSAMWLVLQYCLSGLSEALNSIGQ
LEFYYSQFPKSMSSIAMALLSFGGAFGSLLGSLVVNIVDDVTKKDGVSWVSKNLNKGH
YDYYYWLLTVLNVVNVFYFLLCGWLYGPCEDKNNWDEEEEGMKEMEEMEKLSIKSGE
YAVVYSSA

Prunus persica Prupe_47 ppa026888m.g

MASVEEKGSADGREDHTQDGTVDLKGRPILRSKTGRWRACSFIVGYEVFERMA
YYGIVSNLVIYLTTKLHEGTVTSANNVTNWVGTVWMTPLLGAYIADAHLGRYWTFVIA
SAIYLAGMSLLTLAVSLPALRPPSCGHGIKSEDCDKRASPFQVGIFYGALYIIAIGTGGTK
PNISTMGADQFDEFEPKEKTQKLSFFNWWMFSIFFGTLFSNTFLIYLQDNVGWALGYGL
PTLGLALSILVFLLGTKFYRHKLPSESPFSRIAHVIVAALRKWRVTIPDDQKELHELSLEA
YTKSGKFRIDHSPSLRFLDKAAVKSGPTSPWMLCPVTQVEETKQMIKLVPILVATFVSSM
MLAQGGTLFIKQGTTLDRSIGPNFEIPPACLSAFITIFMLISLVVYDRLFVPWIRRYTKNPR
GITLLQRLGIGLVLHVMIMVTAWLAERKRLSVVREHQLFGEKDTLPLTIFILFPQFALLGI

ADSFVETAKIELFYDQAPQAMKSLGTSYFTTSLGIGSFLSSFLLSTVSNITKQHGRGWILD
NLNISHFDYYYLFLAVLSSLNLLFFLFVAKYFVYNADTTEPKGDFAMETLANKPPAQAQ
TEASNALLVS

Prunus persica Prupe_48 ppa026947m.g

MCLTLAAGGWQSNLIVYLIQEYNVKSIDAAQVSNAVNGCTCLFPIIGAIIADSFSG
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GTRFTIATMGANQFDKPEEQGVFFNWFFFAMYTTSVISSTAIVYIEDNVSWGLGYGLCA
LVNLIGLLIFLSGSNFYRRDTPQGSPFVNIVRVLVASIRKRKVLLSSRSEDYHYHNDGEAK
MVPETHKKSLSFLNGAALKTEGDLKPDGSIAKPWSLCTFQQVEDLKTVIRIFPLWSSSLFI
STPIAIQSSLTTLQALTMDRRIVSHFKIPVGSLPVLVLLSTCISLPIIDRFLYPVWQKLTNQS
PTPLQRLGIGHVLNIISMVVSALVESRRLKTAHSSTLPMLVMWLFPQLALVGIGEAFHFP
GQLQLCYQEFPASLRGTATAMVAMTIGIAYYTGTALIGLVRRVTGWLPDDINQGRLDN
VYWMVVVIGVLNFGYYLSCAQLYKHQNVSEGVERSSGSAG

Prunus persica Prupe_49 ppb015207m.g

MAREKCFSNLSSDESSESSDALLPEKDDHLDLLDSSSAIQTKPGWKAMPYILANE
SIEKMATYGLTTNFMVYLVRKYHMDQVSAANILNIWICGYSLLTVVGASVADIYLGKFL
TIALASLATLVGMVTITLTAFVPQLRPPPCFVDGQQHLEHCISNTKTQLGFLLLGLSWLAI
GTGGIRPCSIPFGIDQFDSTTLEGRKSVHSYFNWYYTSSTVVMLINQTLVIYIQDSVSWA
WGFSIPTLLMSCAIALFLAGSKIYHHVKPEGSTYVSFAQVLVAAYKKRHLKLHDDERVL
GVFSDVSLDGNVVLSKLPLTAQLSSLKKAALVVDDDLKDDGSCANPWRLCSIQQVEEVI
CFMKILPIWASGGICFMTYAQEGTFVVSQALKMDRHIGPNFQMPAGSIKMMSLISLCICL
PFYDRVLQPALKKITKHENGITTLQRIGLGYLFSILFAAVAGLVEQQRRASSLSHASADG
VAPMSVFWLFPQLMFLGLFELFGVVGHIELYNKEFPEKMRSIANSLFYLCVAGGTYLST
LVVSIVYRVTGKHGQPNWLGNDINAGRLDYFYFLIAALGVLNFVYFWSCARGYTYNYK
ANEGGNGNDLNSHSINYRFIIGQLD

Ricinus communis Ricco_01 27847.t000005

VTDLSTRHGSPGWIPDNLNYGHLHYFFWLLAVLSLQIPEETMAEDDIYTKDGTLN
IKGEPANKKKTGNWKACRFILGNECCERLAYYGMSTNLVNYLQDRLNQGNVAASNNV
TNWSGTCYITPLIGAFLADAYFGRYWTIASFVMIYIFGMALLTISASAPGLKPFCDKHSC
HPTKTQTAVTFAALYLIALGTGGIKPCVSSFGADQFDETDDDEKKKKSSFFNWFYFSINI
GALIASSVLVWIQMNVGWGWGFGVPAVAMAIAVVFFFAGSKLYRLQRPGGSPITRLLQ
VIVASFRKLNVQVPDDKSLLYETTDEESQIQGSRKLEHTDKLKFFDKAAVETQTDSVKD
STNPWRLCTVTQVEELKAIIRLLPVWASGIVFATVYGQMSTMFVLQGNTMNQHMGPHF
KIPSASLSLFDTLSVIFWTPVYDRLIVPYARKYTGNERGFTQLQRMGIGLVISIFSMITAGV
LEVVRLNYVQRNNYYDLEYIPMSIFWQVPQYFLIGCAEVFTFIGQLEFFYDQAPDAMRS
LCSALSLTTVALGNYLSTVLVTVVTKVTTRHGKLGWIPDNLNRGHLDYFYWLLAILSLL
NFFVYLWIAKWYTYKKATGRAH

Ricinus communis Ricco_02 28035.t000014

GLLLLSLSSWFFLIKPEGCGDGVQVCNPASSLGVATFYLSIYLVAFGYGGHQPTIA
TFGADQFDEGKPKQKNSKAAFFCYFYFALNSGSLFSNTILVYYEDTGRWTLGFLVSLGS
AVVALISFLLGTPGYRYIKPCGNPLPRVAQVFVATARKWHVNPANPEDLYEIEGSESIIK
GSRKILHSNEFEFLDKAATITQDDTIRQNDRWRLCTITQVEEAKCVLKMIPIWLCTIIYSV
VFTQMASLFVEQGDVMNSNVGEFHLPAASMSAFDICSVLICTGIYRQILVPVAGKLSGNP
KGLSELQRMGIGLIIGMLAMVAAGATEIERLKNVTPGQRISSLSIFWQIPQYVLVGASEVF
MYVGQLEFFNGQAPDGIKSFGSSLCMASISLGNFVSSLLVNMVMGITAKGEKPGWIPDD
LNTGHMDRFYFLIAALTAFDFVIYLLCAKWYKPINLQEDDDGEDNEKECEMKQQEEEE
NNVVQRV

Ricinus communis Ricco_03 28320.t000046

MDGKMSWAVADAVDYKGFPADRSKTGGWLPAALVLGIEVCERLSTMGIGVNL
VTYLIGTMHLPSATSANVVTDFMGTSFLLCLLGGFLADSFLGRYKTIAIFALVQTLGTGM
LAAITKIPQLRPPPCNTNNSCVQANGFQMGILYLALYLIALGTGGLKSSVSGFGTDQFDE
KDEKEKSQMNYFFHRFFFFISIGTLMAVTVLVYVQDEVGRSWGYGICSVSMFVAILIFLS
GTKRYRYKKSSGSPIVHIFQVIAAAVKKRHMDLPYNVSLLYENTLEAARIQHTDQFHFL
DKAAIVAEGDFANGGTTPNPWKLCPVTRVEEVKMMVSMLPIWATTILFWTTYAQMITF
SVEQASTMERSIGSFQIPAGSLTVFFVAAILISLAAYDRIIMPLWKTWKGKPGFTNLQRISI
GLVLSTLGMAAAALVERKRLSVAKAVGGDTLTLPISVFLLIPQFFLVGAGEAFIYTGQLD
FFITQSPKGMKTMSTGLFLTTLSLGFFVSSFLVMVVKRVTGSNGGGQGWLADNINYGRL
DCFYGLLAVLGVVNFVVYLICALWYKPRNSAKSAALQMENVGNGSLAEEKC

Ricinus communis Ricco_04 28455.t000004

MASDLPQTQGKTLPDAWDYKGRPAERSKTGGWTSSAMILGVEAIERLTTLGIAV
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ITILTISTIIPSLRPPKCHNNTACIPASGTQLNVLYLALYLTALGTGGLKSSVSGFGSDQFD
DTDEKERKQMSSFFGWFFFLINIGALCAVTILVYIQDNLGREWGYGICACAIVLGLIVFLS
GTRRYRFKKLVGSPLTQIATVLVGAWSKRNLELPSDPSFLHDIDNFDEGSKKKKQKLPH
SDQFRFLDKAAIKDPKVTVVTKWNLSTLTDVEEVKMVVRMLPIWATTIMFWTVYAQM
TTFSVSQATTLDRHIGNFQIPAASLTVFFVGSILLTVPIYDRIIVPVLRNVFKKSNGLTPLQ
RIGVGLIFSIIAMIAAALTEIKRLRTAESHGLTHDPTAEIPTTVFWLIPQFILVGSGEALTYV
GQLDFFLKECPKGMKTMSTGLFLSTLSLGFFFSSLLVTIVHKVTGNSPWIADNINEGKLY
DFYWLLAILAGLNLVLFLGCAKWYVYKDKRLAEVGIELEELDEPAFH

Ricinus communis Ricco_05 29637.t000039

MAKLGEEEEEGPVDGKEDYTEDGTVDIKGKPVLRSKTGRWRACSFIVGYEIFER
MAYYGIASNLVLYLTKKLHEGTVASSNNVTNWVGTVWILPILGAYIADAHLGRFWTFLI
SSAIYLMGMSLLTLAVSVHALRPPSCGQGIKEELCDKRASPLQKGVFYGALYIIAVGTGG
TKPNISTMGADQFDEFQPKERIQKLSFFNWWMFSIFFGTLFSSTFLIYIQDNVGWSLGYG
LPTAGLAVSIIVFLIGTPFYRHKLPAGTPFTKIAQVLVAATRKWKDPVPNDPKELHELGIE
EYSRSEKFRIDHTLSLRFLDKAAVKSGSSSSSWILCPVTQVEETKQMIKMLPVLLTTLIPS

TVVAQVGTFFIRQGTTLDRSMGPNFEIPPACLTAFVTIFMLISLILYDRYAVPITRRYTKNP
RGITLLQRMGIGLFLHIIIMVIACIAERKRLSVAKEHKIFGKSDTVPLSIFILLPQFALMGVA
DAFVEVAKLEFFYDQAPEGMKSLGTSYFTSSLGIGNYLSSFLLTTVSDATKAHGHRGWI
LDNLNISHLDYYYAFLAILSFLNFLAYLLVAKFFVYNVDQESKRNMQEAIIESSPSRKI

Ricinus communis Ricco_06 29637.t000040

MDKVEEKGPANGRDDYTEDGTVDLKGRPILRSKTGRWRACWFIVGYEVFERMA
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IYLMGMTLLTLAVSLPSLRPPSCGPNIKEEDCDLKASALQKGIFYGALYIIAAGTGGTKPN
ISTMGADQFDDFEPKERTQKLSFFNWWMFSIFFGTLFSNTFLVYIQDNVGWTLGYALPT
VGLAVSIAVFLVGTQFYRHKLPAGSPFTRIAQVLVAAFRKQHVPLPNDPKELHELSLEEY
SRSGKFRIDHTPSLRFFDKAAVKTDSTSPWMLCPVTQVEETKQMMKMLPVLVVTFIPST
MLAQVHTLFIKQGTTLDRRMGPHFEIPPACLTAFVTIFMLISLVLYDRYFVPAVRRYTKN
PRGITLLQRMGIGFILHVIIMTAACLAERRRLNVAKEHNIVEKDAIVPLSIFILLPQFALMG
VADTFVEVAKLEFFYDQAPDGMKSLGTSYFTSSLGIGNFLSSFLLGTVADITKKHGHKG
WILDNLNISHLDYYYAFLTILTFINLLAFFVVAKFFDYNSDVDAKKDLQEAVETSPNKLH
TGDT

Ricinus communis Ricco_07 29637.t000041

MTYSGIASNLVLYLTRKLHEGTVASSNNVTNFRCIRCRCSSWPILDFYHCFCNLS
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DQFDDFEPKERTQKLSFFNWWMFSIFIGTLFSYTFLVYIQDNVGWALCYALPTIGLAVSI
AIFFAGTPFYRHKLLAGSPFTRIVQVFIAAFRKQHVPLPKDHKELHELSPEEFFDKAAVKT
DSTSPWMLYPVTQVEETKQMMKMLPVLVVTFIPSTMLAQVHTLFIKQGTTLDRRMGPH
FEIPPACLSAFMTIFMLISLVLYDRYFVLAVRRYTKNPRGITLLQRMGIGFILHVIIMAAAC
LAERKRLNAAKEHNIVEKDAIVPLSTFILLPQFALMGVADTFVEVAKLEFFYDQAPDGM
KSLGTSYFTSSVGIGNFLSSFLLKTVADITKTHGHKGWILDNLNISRLDYYYAFLTILTFIN
LSAFLIVAKYFDYNKDVDAKKELQEAIEASPDKLHTEDT

Ricinus communis Ricco_08 29688.t000012

MEGSLSTDPEVPNSGSAAKQRGKWITFPFVTGTMVGLTLAGVGYLSNIIVYLIEE
FHFESINAAQVSNVVTGGNNVFPIVGAILADSFLGNFSVVAISSCVSFLGLVLLVLTALLH
SLRPAPCETGSSLCQAPSGIQYAVLYGSLLLTSVGFGGSRYTLATMGANQFNKPEHQNT
FFNWFFFTLYSSSVIGATAIVIIEEDVSWALGFGICLAANFIGLVIFLLGNPYYRHDKPEGS
PFTGLARVAVATIKKRNVLLSSRSEDYYHEKDAKGKEAAASVLTKSFRFFNRAAMKTK
GDIKPDGSIAKPWRICSVQQVEDFKSLVRIFPIWSSNILVAIPIAVQASLTVLQALAMDRH
LGKHFKIPAGSISVLVLITNSISVPLIDRIFSPFWRMITRKFPTPFQIVGVGHVLNVLSMVVS
ALVESRRLSLAHNHQDSQMLALWLFPQLVLVGIGEAFHFPGQVALYYKEFPVSLRSTGT
ATITFIVGISFYLSTALIALVRSVTDWLPDNIDNGRIDNVYWVMVGLGILNFAYYIACAKL
YNYQNAENAAKESSSVSDMISE

Ricinus communis Ricco_09 29688.t000014

MDGSLSADPEAKMPSSSAKERGNWITFPFIIGTMAGVTLAGGGYLANLIVYLIEE
FNFKSIDAAQVFNVVNGASNLFPIAGAIVADSFLGNFTVVTISSCVSFLGVVLLVLTSLLD
FLKPKPCEIGSSLCQTPLKPQYAVLYGALVLTSIGFGGSRYSLATMGANQFNKPEDQNTY
FNWFFFTLYSASVISVTAIVYVEENISWALGFGLCLGANFIALVIFLLGKRFYRCDKPEGS
PFTALARVVVATIKKRKVLLSSRSEDYYYENDAKAKEAAATVTKSFRFFNRAAMKTEG
DIKPDGSIAKPWRICSVQQVEDFKTLIGIFPIWSSSIFLGTPIAIQSSLTVLQALAMDRRLGQ
HFKIPAGSVIVLILITTSICLTFIDRVFYPFWRMLTHKLPTPFQRIGVGHVFNVLSMGVSAL
VESRRLRIGHAQHHQDDQDSSTVPMLALWLFPQLILVGIGEAFHFPGQVALYYQEFPISM
RNTATAMISLIVGISFYLSTALIDLVRRVTDWLPDNIDDGRIDNVYWLMVVIGVINFGYF
LVCAKLYKYQNVEKADKVSVSDMTSS

Ricinus communis Ricco_10 29709.t000061

MACLNLCTELGEVDGKIIKKDIGVYTQDGTVDRHGHPAIRQRTGTWIAGILILVN
QGLATLAFFGVGVNLVLFLTRVLGQNNADAANNVSKWTGTVYIFSLLGAFLSDSYWGR
YKTCAIFQAIFVVGLVSLSLSSYIFLLKPHGCGSEKLPCGSHSNFEIALFYLSVYLVALGN
GGYQPNIATLGADQFDEEDPKEGHSKIAFFSYFYLALNLGSLFSNTILGYFEDQGMWAL
GFWTSAGSALLALLLFLCGTPRYRHFKSKGNPLSRFCQVLVAAFRNWKHNKRDLNEED
LFESNFCSQDGDHRKILHTDGFRFLDRAALITSEDNVNADIRNPWRLCTVTQVEEVKCIL
RLLPIWLCTILYSVVFTQMASLFVEQGAAMKTTISSFHIPPASMSSFDIVSVAVFIFMYRRI
LDPLVARIRKDPRGLTELQRMGIGLVIAILAMVSAGVVELFRLKYKNTQKAVCADCESE
SSLSIFWQIPQYVLIGASEVFMYVGQLEFFNAQTPDGLKSFGSALCMTSISLGNYVSSLLV
TVVMKISTRDEMPGWIPGNLNKGHLDRFYFLLAALTTADLIIYILTAKWYKYIKFQGKIS
ANIINQQV

Ricinus communis Ricco_11 29729.t000065

MESKGYTQDGTVDLHGRPVLASKTGKWKACAFLVGYEAFERMAFYGIASNLV
NYLTTQLHEDTVASVRNVNNWSGSVWITPILGAYIADTYMGRYWTFTVSSLFYVMGMI
LLTMAVSLKFMKPTCINGVCNKATPSQIAFFYTSLYIIAIGAGGTKPNISTFGADQFDDFD
PKEKKLKVSFFNWWMFSSFLGALVATLCLVYIQENMGWGLGYGIPTVGLILSLFIFYLG
TPLYRHKVSKTKSPARDLIQVPIVAFRNRKLQLPTDPSRLHEFELQYYIDTGKRQVHHTP
VFRCLDKAALKDGNTYDSSPPCTVTQVEGTKLVLGMILIWVVTLIPSTIWAQINTLFVKQ
GTTLDRGLGSNFQIPAASLGSFVTLSMLLSVPMYDRFFVPFMRKKTGNPRGITLLQRLGI
GFVIQVTAIAIAYAVEVRRMHVIRVQHTRSPTEIVPMSIFWLLPQYVLLGIADVFNAIGLL
EFFYDQSPEDMQSLGTTFFTSGIGAGNFLNSFLVTMVDKITGRGGGKSWIGNNLNDCHL
DYYYGFLLVISTLNLGAFLWASSRFIYKKETIKVNEGCVQMEGKTLDTSPLGLQV

Ricinus communis Ricco_12 29736.t000038

MQQGLVILTVQARSPSLKPPECDSGNPNISCQEVDGSKAAMLFIGLYLVALGVGG
IKGSLPAHGAEQFDESSPQGRKQRSTFFNYFVFCLSCGGLIAVTFVVWIEDNKGWEWGF
GISTIAIFLSIPIFLFGTPTYRNKIPSGSSLTTILKVLVAAAINTCTSRSPSNAVANLITNPSIV
NATSEGTKEKSKEMASTETATKAFSCLNRAVVKIPVHSALECTVKQVEEVKIVLKILPIF

ACTIMLNCCLAQLSTFSVQQAATMNTKLGSLKVPPASLPIFPVVFIMILAPIYDHFIIPFAR
KVTKSEMGITHLQRIGVGLVLSIVAMATAALVEIKRKRVATSSGLLDSEEPLPITFLWIAF
QYLFLGSADLFTLAGLLEFFFTEAPSSMRSLATSLSWASLAMGYYLSSVVVSIVNTITGN
YKHHPWLSGSNINHYQLERFYWLMCVLSAVNFLHYLFWTNWYKYRSTRATN

Ricinus communis Ricco_13 29736.t000050

MEVGEQKKNRSSYELYCFTKCFQNPSTREKEPEEKSGAFLSDDSKIIIAQQKQPG
GWRAMPYILGNETFERLATFGLLANFMVYLMKEFHMEQVTAANIINIWSGLTNFAPLLG
AFISDAYVGRFRTIAFASCAAFLGMVTVTLTAWLPNLHPQKCHQQSQQQYADNCESAT
PLQLAVLLMGLGFLSIGTGGIRPCSIPFGVDQFDPTTEEGMKGINSFYNWYYTTFTLVILIT
LTVVVYIQDSISWVIGFSIPTVLMLCSILLFFIGTKIYIHVKPEGSIFSGLAQVFVAAYKKRR
LKLPDHGEVVDGIFYDPTVKEAVLSKLPLTNQFRFLNKAAMIEKNDINPDGSCANEWRL
CSIQQIEEVKCLFKIGPIWASGIVSFTAILQQGTFTVSQAMKMDRHLGHKFQIPAGSISVFS
MITIAIWLPFYDRIAVPALRKITKHEGGITLLQRIGIGIVFSVLSMIVAGLVERDRRAAAIS
NPGTPMSVMWLVPQLVIMGLCEAFNIIGHIEFYNKEFPGHMRSMANSLFFCSFAGASYL
STLVISIVHKVTRTRDHPDWLTKDLNAGKLDRYYFVLAGMGILTFFYFLYCARLYQYKT
PVQIDNNSYRDVELSLGEKIPSS

Ricinus communis Ricco_14 29751.t000003

MEEEDIYTKDGTVDYRGNPASKKKTGTWRACPFIIGNECCERLAYYGMSSNLVL
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SASIPGIKPKCYAKDDCDPTDAQSAVFFLALYLVALGTGGIKPCVSSYGADQFDDTDEN
EKKHKGSFFNWFYFSINVGGLIASSVLVYVQMNWSWGWGFGIPAIAMAIAVVSFFSGTK
LYRNQKPGGSPFTRLFQVIVASIKKYKIKVPADKALLYEISNDAESNIKGSRRIDHTKDFS
FFDKAAVETETDNVKDSVDPWKLCTVTQVEELKSIIRLLPVWATGIIFAAVYSQMSNLF
VLQGDQMNKYVGNSSFKIPSASLSVFDTLSVIFWVPIYDRILAPFVRKFTGHKNGFTQLQ
RMGIGLVISVFAMVSAAVLELTRLQMVRRHNYYELKEVPISVFWQVPQYFLIGCAEVFT
FIGQLEFFYQEAPDAMRSLCSALSLTTVALGNYLSSLLVTITMSITARNGKPGWIPDNLN
YGHIDYFFWVLAVLSVLNLGAFLFISKWYTYKTPLGTLR

Ricinus communis Ricco_15 29780.t000060

MGSVEDQTILLEHGLLEENKSNGLYTGDGSVDLKGNPVLKQKTGNWKACPFILG
TECCERLAYYGIATNLVTYLTNKLHEGNVAAARNVTTWAGTCYIAPLIGAVLADAYWG
RYWTIAAFSTIYFIGMCTLTLSASVPALKPVECVGPLCPSASPAQYAVFFFGLYLIALGTG
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Ricinus communis Ricco_16 29794.t000123

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MDRHIISKFEIPAGSMNVFMVISLAIWVSLYDRVIVPLASKLRGKPVRLSLKQRMGIGILL
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Ricinus communis Ricco_17 29822.t000067

MENKEEKDDHAEQAVINYRGIKAMPFIIGNETFEKLGTVGSTTNLVVYLTTVFN
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Ricinus communis Ricco_18 29822.t000090

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K

Ricinus communis Ricco_19 29822.t000122

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Ricinus communis Ricco_20 29822.t000137

MANWAWDVLGQTRKARNQEQNCSTSCFFLLTTSIQMEITKKKSEPTKEDVVKY
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Ricinus communis Ricco_21 29822.t000138

MEGKDERRTDNNKEDVPKYRGVKAMPFIIGNETFEKLGTMGTVSNLIVYLTTVF
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GIGLIFSILTMIVSGLIEERRRRLAITGSTGISPKGGVISSMSALWLIPQLALAGLTEALNSV
GQTEFYYKQFPENMRSIAGSFFYLGLAGSFYLSSILVSIVHHVTAGSDGRNWLAEDLNK
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Ricinus communis Ricco_22 29822.t000139

MEFKEEKTGSTNKEDVVNYNGVKAMPFIIGNETFEKLGTMGTVSNLIVYLTTMF
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Ricinus communis Ricco_23 29822.t000140

MEGIVEKTASFRLSMEGIEERIASFRSSNKDGLESKTASFRSNKEGFEENITPNDED
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QKLKNPENPALSLYNYIPKDSINSKLPYTNQFRWVDKAAIITDEDEINSDGSPANPWKLC
GIQQVEETKCVMRVIPVWASGIIYYVPVVQQNTYAVLQALQADRKLGSGGFQIPAASIIV
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FAKWYRYKGKNTNTSEVMDGSIEA

Ricinus communis Ricco_24 29822.t000141

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INSFFNWYYCTYTFGMMISTTFIVYVQSNVSWIIGLAIPAVKPEGSAIVSVIQVLVASVKK
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QRMGIGVVLSIVTMVVSGLIEERRRHWALTRPAIGISPKGGAISSMSALWLIFQLALAGL
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Ricinus communis Ricco_25 29827.t000035

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NNNVEDNSEV

Ricinus communis Ricco_26 29912.t000215

MEIASDDTKKTREIKRQKGGLRTMPFIIANEAFEKVAGVGLHANMIVYLQNEYN
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IKFASV

Ricinus communis Ricco_27 29948.t000015

MVLVTSSGDKVAMQHETAVDFHGNPVDKSKTGGWLAAGLILGTELSERICVMG
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AIAVAILLCGTPWYRFKKPQGSPLTVIWRVFFLAWKKRGHPHPSHPSFLNDYQNSRVLH
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SLQRIGIGLIFSVVAMVAAALIEKERREFAVQYGTQISAFWLVPQYFLVGAGEAFAYVGQ
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Ricinus communis Ricco_28 29981.t000004

MVLCGDAVYEVFERMAYYGISSNLVLYLTKKLHEGTVKSANNVTNWVGTIWM
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QVPLTIFILLPQFVLMGMADAFLEVAKLEFFYDQAPESMKSLGTSYSTTSLGIGNFLSSFL
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Ricinus communis Ricco_29 30026.t000061

MIEKLEFIEGKVDWKGRQAVKYKHGGTGTSFLVLGTFGFEELASVALAVNLVTY
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TYVGLLEFFYSQAPKGIKSISTCFLWSSMALGYFFSTILVKMVNSATKDITRSGGWLAGN
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Ricinus communis Ricco_30 30074.t000069

MAISTTNTNTTAAASASASASTPLLEDKVDGSVDYNGRPAHRSSSGGWRSSSFII
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LVYIL

Ricinus communis Ricco_31 30128.t000453

MEVSKAEDNSLNKREEGKGGFRACMFVFVLVALDNMGFIANMVSLVLYFLKV
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KEPGESPLIRIVQVFVVAIKNRKLSLPENPEELYEISDEERIYSDEKIAHTDQFRFLDRAAIL
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FEVPAPSVPIIPLVFMVILIPMYEFFFVPFARKISGHPSGITQLQRVGIGLVLSAISMAVAGI
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YLCMASWYKYKADDIDLKMESKGSTDGLLPAKVASNPESSVVKKEEVEESTVEKVMS
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Ricinus communis Ricco_32 30131.t000349

MSHHETSTKYDYVTIYSPKILHFYSLFRPYPNSYTKATMDSTVSPVTIEEDGHELT
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KVEGDHEEKEMEEKEKGVES

Ricinus communis Ricco_33 30146.t000130

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Ricinus communis Ricco_34 30147.t000331

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SYTDQFRFLDKAAIKTLRDEINPDGSPVNPWKLCSLQQVEEVKCLIRVLPIWVAGVIFYM
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EKHVA

Ricinus communis Ricco_35 30147.t000332

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KGSDLHDSH

Ricinus communis Ricco_36 30147.t000341

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FLLGSPTYRNKVPSGSPITTILKVLIAAVYNTCKPQTPNNAVMGVDTSSSYTTETSEVEDS
YIREEALNQTPTESLEFLDRAVMNKSINPTLRCTVKDVEEVKVVIKILPIFMSTIMLNCCL
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Ricinus communis Ricco_37 30170.t000348

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Ricinus communis Ricco_38 30170.t000530

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Ricinus communis Ricco_39 30170.t000531

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Ricinus communis Ricco_40 30180.t000001

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PEHNIGGDSMA

Saccoglossus kowalevsky Sacko_01 XP_002739447

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Selaginella moellendorffii Selmo_01 102834

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Selaginella moellendorffii Selmo_02 103849

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Selaginella moellendorffii Selmo_03 109515

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MAK

Selaginella moellendorffii Selmo_04 126973

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Selaginella moellendorffii Selmo_05 135536

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Selaginella moellendorffii Selmo_06 21315

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VFMALARRYE

Selaginella moellendorffii Selmo_07 21531

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Selaginella moellendorffii Selmo_08 231062

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Selaginella moellendorffii Selmo_09 231569

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Selaginella moellendorffii Selmo_10 231570

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Selaginella moellendorffii Selmo_11 232069

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Selaginella moellendorffii Selmo_12 404409

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Selaginella moellendorffii Selmo_13 411211

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Selaginella moellendorffii Selmo_14 415640

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Selaginella moellendorffii Selmo_15 439656

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Selaginella moellendorffii Selmo_16 441824

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Selaginella moellendorffii Selmo_17 443914

MAFTSRAWRVAPFIFAVVTLEQAASFSIGINLFTFAFNTEHFSLATAANIVTNFMG
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Selaginella moellendorffii Selmo_18 444106

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Selaginella moellendorffii Selmo_19 78532

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Selaginella moellendorffii Selmo_20 78769

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Selaginella moellendorffii Selmo_21 84173

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Selaginella moellendorffii Selmo_22 88337

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Selaginella moellendorffii Selmo_23 91845

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IDPDITSTTTMALARESSLESQ

Selaginella moellendorffii Selmo_24 91962

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Selaginella moellendorffii Selmo_25 94418

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Selaginella moellendorffii Selmo_26 97069

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Selaginella moellendorffii Selmo_27 97154

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Selaginella moellendorffii Selmo_28 97239

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Selaginella moellendorffii Selmo_29 97590

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Selaginella moellendorffii Selmo_30 97655

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Selaginella moellendorffii Selmo_31 97812

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VYDRAFVPLARPFTRLSSGITMLQRIGTGLVLAMVAMAVAALVEMRRLGVARDAGLV
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Setaria italica Setit_09 Si001023m.g

MCHRSELLSLVLIQPAMADNVAGAADYRGQPASRAATGGWKSSVFVMAMEIAE
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KDPEESVARSSFFNWWYFGMCAGTAATTMISSYVQDNVGWGLGFGIPCIVIAASLAVFL
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LIGVADVFAMIGLQEFFYDQVPDAARSLGLALFLSIFGVGHLLSSLLISVIDKATAKSGTS
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Setaria italica Setit_10 Si003743m.g

MESGGGGELLPRPGPSSIIAKPGDGRGGWRAPLFIVAVGFFERIGFVGVSANLIMY
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Setaria italica Setit_11 Si004091m.g

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DGKKVQERAAWGAGGDGGGNLVQDAVDYRGCRADKSSTGGWVAAALVLGIE
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MTADEKC

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VAMAAAVASFLLGSRLYRHQRPGGSPLTRMLQVVVAAWRKRKSPVPADPSLLHEAPAS
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TST

Setaria italica Setit_15 Si004857m.g

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DMFTYVGLMEFFYSQAPRALKSMSSSFLWCSLSFGYFMSTIIVQAVNAATKGSTASGG
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Setaria italica Setit_16 Si006106m.g

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VIKG

Setaria italica Setit_18 Si006236m.g

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YDRVIIPLFNAVTRGTEGITVFQRIGVGMVLSVVAMVTAALVESWRLRVANASARLKIF
WLLPQYVLLGVSDVFTVVGMQEFFYTQVPASMRTIGIGLYLSVFGVGGFLGAFLITALE
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Setaria italica Setit_19 Si008270m.g

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Setaria italica Setit_21 Si009682m.g

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EVTDADAAGSSSWRLCTVTQVEELKILLRLMPIWATSIVLSAAYAQLNTTFVQQGGAM
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Setaria italica Setit_22 Si009734m.g

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RVSPATLFIIPTIFQMVMLPIYDQFLVPFLRKRTGYVNGITHLQRVGIGFASIILASVIAAV
VERKRKEAAEQMSLFWLTPQFFLLGVSDVTSFPGLLEFFNSEAPRGMKSIAAALFWCVL
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Setaria italica Setit_23 Si009745m.g

MAVGGFVDWRGSLIKKEVHGGVRAAWFMYFLTFVTSMVNIPFLLNSVIYLQGT
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Setaria italica Setit_24 Si011717m.g

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Setaria italica Setit_25 Si013456m.g

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Setaria italica Setit_26 Si013694m.g

MLTMVGSCERARGFKATIFFVALYLVALGSGCVMPNMTTYGADQFSGGGAFEK
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I

Setaria italica Setit_27 Si015162m.g

MAATGLVDWRGKPIDKKVHGGVRAAWFLYFLVVVNFLVHVPNLQNMVTYLR
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Setaria italica Setit_28 Si016679m.g

MVSAGGHGGGCGDGDDGQAVDFRGNPVDKSRTGRWLGAGLILGTELAERVCV
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Setaria italica Setit_29 Si016684m.g

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ATIFLYRRAICPFLARLTGRPAGPTELQRMGLGLVVGALAMATAGTVEHFRKAGATAA
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Setaria italica Setit_30 Si016740m.g

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SGIRRILHSDELRFFDRAATVTEEERSTPERMEDPWRLCTVTQVEEVKCILRMLPIWLCTI
VYSVVFTQMASLFVEQGATMNTTIGSFRIPAASMSLFDILSVLVFIAVYRRALVPAMARV
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Setaria italica Setit_31 Si016779m.g

MDAGDDMERGAGAPVLLPESNGPKIQDDSLQVPLLKDKKRAGSKAPAVVLGFE
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LISLVVYLLGMMFVTFSAFLPTAAMLGGSSVFGAQTVAFIGLYLVAIGSGGVRSSLLPFG
AEQFDDDNEKDRESKGSFFSWFYLCVSFGPIVSGLFIVWIQDNVSWGLGFGISTACIALA
FGVFVLATPVYKRRMPTGTPLKRLSQVIVAACRKISRKVPADASLLYEVSDKVDPQPKL
AHTGDFSLLDKAAVITESDFEEVTEEAGSSWKLCTVTQVEELKILLRLLPIWATSIIVSAA
YAQMNTTFIQQGSAMNMSILSVSVPPASMASFEVACVFSWVMLYSKVIVPALRGFSSGG
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FCYIAQLEFFYAEAPDTMKSTCTSLALLTIALGSYLCSFIYAIVAAFTATADSPGWICDNL
NQGHLDYFFWTMAAMCTLNFVVYSGFAKNYKLKTVLS

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MEAGDAMERGERAPLLPESHGPKVEDDSLHVPLLKDKKRTGSKAPTVVLGFQC
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VFVLATPMYKRRMPTGTPLKRLSQVIVAACRKISRKVPADASLLYEVSDKVDPQPKLAH
TGDFSLLDKAAVITESDFEEVTEEAGSSWKLCTVTQVEELKILLRLLPIWATSIIVSAAYA
QMNTTFIQQGSAMNMSILSVSVPPASMASFEVACVFSWVMLYSKVIVPALRGFSSGGDG
EPSLLQRMGAGRLLMALAMAVSGLVEMKRLDSAARGEEISIAWQLPQYFFLAGAEVFC
YIAQLEFFYAEAPDTMKSTCTSLALLTIALGSYLCSFIYAIVAAFTATADSPGWICDNLNQ
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MATWCPTWRAQAASCEHVPESAVTDCHFCLSRRRHRPPTWLLMRGCVVDAHQ
SKSTDGWMGFVDRAVGYVVVGSDDDKPARSGMADGGAGVIADGSVVEAVDHHGRPA
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AGTAVTLVFLSYVQDNIGWGLGFGIPCAVMAAALAVFLLGTRTYRYYVTSGKGSLFAR
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RLFPIWATCLIYAVAFSQSSTFFTKQAATLDRRIGDRFKVPPAALQSFISITIVVFIPIYDRV
VVPVSRQYSGKPSGITMLQRIGAGMFLSLLSMVIAALVETRRLRVARDAGVVDEPKIPV
PMSLWWMVPQYVLFGAADVFTMVGLQEFFYDQVPDKLRSLGLALYLSIFGVGSFISSA
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AVHAAVAG

Setaria italica Setit_34 Si021441m.g

MPSGSEPLLARADGMLPDAAVDHRGLPAERGTTGGWRSALFIIAVEIAERFAFYG
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LSLLSMVIAALVETRRLRVARDAGVVDEPKIPVPMSLWWMVPQYVLFGAADVFTMVG
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DYFYWLLAALSALELLAYVFFAVVYKYKNKGAVHAAVAG

Setaria italica Setit_35 Si021504m.g

MASTAVGRSGDGEQRKKKKGGFRTMPFILGNDICDRFATAGFGANMITYLTQQL
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WSAGIMLATAGSHNGSFTIMQARTMDRHVTRRFEIPPASMSIFGTTAMLVSLALYDRAF
VPLARRVTGLSSGITYFQRMGIGLAISILGVGAAALVETKRRGVAADHGFLDDPAAVIPL
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Setaria italica Setit_36 Si021532m.g

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VELEGKDSLKANGVPAPPPV

Setaria italica Setit_37 Si021539m.g

MAAEDGREEKRGAEAAVARKAKKQGGFRTMPFILANDFCDRLASVGFTSNLITY
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FVSGYSLYVRMPPAGSPMVRLAQVATAAFKKRKATVPDPSLLYEDKELDAGISTTGRLL
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HSFAIQQARTMDRDLTPHFKIPPASMLIFTNLAMLLTLAFYDRVLVRVLRRFTGRPNGIT
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ANAFMDVGRMEFLYDQAPESMRSTAAALYWLTFSIGSYLGTLLVTIVHAKTRRSGQWL
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TDGAKKQGGSFK

Setaria italica Setit_38 Si021542m.g

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PHRSNLITKIAYTDQFVCLDKAAVLTPEDELAADGSTAANPWRLCTLQQVEEVKCLARL
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VLQGNNDGLKVKAAAPPV

Setaria italica Setit_39 Si021590m.g

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RRCSSASDKDGDVSDATSLAAPSDSFSFLNRAALLTDGDVTPADGSVVRPWRICTVREV
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ASLILLDRALLPLWRRLTGHTPTPLQRIGAGHVLAVLSLAACAVVERRRMATVRAHGAE
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NVGK

Setaria italica Setit_40 Si021602m.g

MACQGLVDWKGRLVNPKQHGGAKATMFIYFLVVMTNIGNIPMLLNIVSYLHGT
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FYRHQKPTGSPLTRILQVFVAAFRKRNLSVPDDLMEMHQATQGTGTSIEVLERTSGFKFL
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VVALSTAAAVEARRRGMGAAAAAEMSVFWLAPQFFLLGVMDVTSFVGLLEFFYGEAS
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Setaria italica Setit_41 Si021631m.g

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CVVAFGADQFEEQKQQDNAEAAKAAAERKRRYFNLYFFTMGFAVLLALTVVVYIQEN
VGWGWGFGIPAVAMFVSIVVFVVGYPLYVLLKPGGSPFTRLVQVAAAAFNKRNVAVPE
DPRMLYQDKELDALISTNGRLLHTNQLTFFDRAAIVTPGDISASGLPNPWRLSTVHRVEE
LKSLVRLLPIWSAGIMLATAGSHNYTFTIMQARTMDRHMGPYFQFPPATLSIFSTAAML

VTLAFYDRVFVPLARRVTGLPSGITYFQRMGIGLAISILSVASAALVETKRRDAAARHGL
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GNYMGTVLVTAVQRATRGRGDWLQDNINRGRIDNYYWLVTCIMLLNFGYFLICFHFYT
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Setaria italica Setit_42 Si021690m.g

MASESDPGSTDPLLPRRRAPSKGGWRSALFIIWVEVAERFAYYGISSNLISYLTGP
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AEEVSGLTRLFPIWATCLLYGVVFAQPPTLFTKQAGTLDRRVGSSFQIPPAALQCFLGVSI
VSCIVLYDRVLVPVARRVSGVASGITMLQRIGTGIALSLVTLAVAALVEMRRLRAARDA
GLVDGGGSGGTAVPMSLWWIVPQYVLLGAADVFTMVGMQEFFYDQVPGALKSLGLAL
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Setaria italica Setit_43 Si021818m.g

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SGFKFLDKAAVDDGDTRGWSLCTVTQVEEAKIILRMVPIFLSSVLGNVPIPLLLSLTVQQ
GGTMDTRLGGTSIPPASLFIVPIVFQMLTLVAYDRLFVPWLRRATGYAGGVTHLQRVGV
GFVFSVMALAVAAAVEGRRRSGAFAGAPTMSVFWLTPQFFLLGVMDVTSFVGLLEFFY
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Setaria italica Setit_44 Si024257m.g

NDFCDRLANVGFSSNLISYLTLQLHLPLVEASNIITNFNGTANFTPLIGGLIADSFA
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IGTGGTRLCIMAFGADQLELDAHGRPREAKPKWSFFNIYFFGIELAKLTAATAVVYFQEN
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LKSIMRMLPIWAATILLMTSGSHNGSFAIQQARTMDRGITPRFKIPPASMLIFTNITMLLT
LTFYDRVLVRVLRRYTCHPTGTTHLQRTGVGMTLAMLANAVAAVVERRRRSVAAASE
LLDAPKATVPMSVLWLVSQYAIHGVADAFMDVGRMEFLYDQAPESLRSTAAALYWLT
NSVGSYLGTLLVTIVHDKTRRSGQWLQDNLNRGKLDNDYWLVVALQVLNLVYNFVCV
KYYTCKPLETTGDDKEVELDCVSGNGDDYAKKGASASKLQVA

Setaria italica Setit_45 Si024876m.g

MATVTAEREGNGEQHQKRWKQGGYKTLPFIMANEICDKFATAGFNANLISYLT

QQLNMTLVDASNTLTNFGGTTSLTVVLGAFFADSYIGRFWSIVAGSIFYQIGIMGLVLSA
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GVATLLALTLVVYIQDHVGWGWGFGIPAISMFVSIVEFVVAYPLYVRAKPGGSPFTRQA
QILAAAFRKRNAAVPEDRNMLYQDKELDALISTKGRFLHTDKLKFLDRAAIVTPGDVSD
SGRPKLWRLSTVHRVEELKSVARLLPIWSAGIILAAAGSHNGSFTIMQARTMERRITRNV
EIPPATLSIFTTGTTLVSIILYDRVFVPLARRVTGLPSGVTYFQRMGIGLTIAIFGVGAAAL
VETRHRGTAAAHGLLDTPKAIVPMSVFWLVPLYTIHGIADAFASVGQMEFLYDQSPESM
RSTAVALFWLCGSFGSYLSTVLVTVVQRATRGHGDWLQDNINRGRIDNYYWLITFIMV
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Setaria italica Setit_46 Si025147m.g

MATAAPADEDGSPRKTKQGGFKTMPFILANEICDRFATAGFNANLITYLTQQLHL
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FVVGYPLYVKVKPEGSPFKRLLQVVVAAFKKRKEDVPEDAGLLYHNKELDAPIAADGR
LLHTDQLRQLKWLSLFILAGLQPAVLTTDDVADSGEPHLWRVSTVHRVEELKSIVRMLP
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PLARRHTGRRSGITYFQRMGAGFAVSVLGVMAGAFVETKRRSVAAEHGLLDSPNAVVP
ISVFWLVPQYALHGMSDALSTVGHMEFLYDQSPESMRSSAAALFWVAGSLGNYLGTVL
VTVVQSASKGVWLQDNINRGRLDYYYWLVTFLLVLNLVYYIVCFHFYTLKTFEVDAGD
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Setaria italica Setit_47 Si026160m.g

MGGSSGLVDWRGRPVNTKKHGGVRASIFIHALVLLSNAANIANILNLVSYLRNE
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KAAVDTGKTGAWSLCSITQVEETKIILRMVPIFLSAVLGYIPVPLILNFTVQQGNTMDTRL
GAIHISPATLFVIPTVFQMVILIVYDRFIVPFLRRITGYVGGVTHLQRIGIGFLSATVATGIA
ALVEIKRKKVAEENGLMDATTGIPISVFWLTVQFFLLGIVDVTSFVGLLEFFYSEASMGM
KSIGSSIFYCILGVSAWLGSLLIQLANRVTRHSDGTGGWLDGTNLNRGKLDRFYGLLAV
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Setaria italica Setit_48 Si027549m.g

VFETMEGVHEEQHQAHVLGKKGLRLIPVIIANEVSERIVSASVGANLMIYLTTKY
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AIAQIEFYYAVLPKSMGSFVLALLFFGGGVASIMGTVIIKLVNVVTGGGGAVPWISDDLD
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Setaria italica Setit_49 Si029352m.g

MEEGGEHTSLLVKDDASCHREEPQNLLEANQGSQPKSKLSGWRAPALILGLECL
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TTFIQQGTVMNTKIGSLSIPPASLYSFEVICVTLWVLFVNKVVVPATRTYFANGAELTQL
QRIGIGRFLMIFAMAMAALLETKRLQSVQEGEPLSIVWQLPQYFVIAGAECFAIITQLEFF
HGQAPDSMKSMLTAFALLTTALGNYLSSAIITFIAGVTKIWQSPGWIPDDLNRGHLDYY
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Setaria italica Setit_50 Si032337m.g

MARPSVPGAGGHPDGAPAGDTILAVHDDGAGHYDTLDFAAPPVSREDAAAGHG
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EVPPASFTIFPMLALTIWIPFYDRLMLPWLRRLTGREEGITLLQRMGVGMVLSVVAMLIS
GMAEQRRRELALLHAAASGGSMSASRVSPMSAFWLVPQLAALGLSEAFNQVSQMEFY
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GRLPANN

Setaria italica Setit_51 Si034583m.g

MQGEQSGRRARVATEFNARIRSTSRELLHPERSRTAQAARQLAPSLTLTSDLERQ
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Setaria italica Setit_52 Si034741m.g

MAERLEAAPASGDEYTQDGTVDLHGNPVLRAKRGGWKACGFVVVYEVFERMA
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IFVLLPQFALMGVADAFLEVAKIEFFYDQAPEGMKSLGTSYAMTSLGVGNFLSSALLST
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Setaria italica Setit_53 Si034755m.g

MVAEKSPPGAAGSLAMESGGDMRAEEYAQDGSVDLRGNPVLRSERGGWTACF
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LGRYWTFVAGSAIYLVGMVLLVLSVSLPALKPPPCHGDVCPKVSALQLGVYFGGLYIV
ALGNGGTKPNISTIGADQFDEFDPREKMHKLSFFNWWMFTIFLGILFSSTVLVYLQDNVS
WSVGYGIPTLGLMVSIAIFLAGTKLYRHRLPQGSPFTSMGKVVAATLCKWNVPVPADA
KELHELDVEEYTRKRKFRMDSTNTMRFLNKAAVKVKDDVGNGGSPAKWSLCTVTQVE
ETKQIMKLVPLLVTMFVPCTLIAQTNTLFVKQGATMNRHMGPRFQIPPASLGAFVTLTM
LIAVVVYDLVFVKAVRRYTKNPRGITILKRMGIGMFLQVVTMAIASAIESQRLAYARRH
GLDITGGELRLTIFALLPQFVLMGLADAFLVVGKIEFFYDQAPQSMKSLGTAMSLTAYGI
GNILSSFLLSTVTRITRDRGNAWVTNNLNASNLDYYYAFLAVLGGINFFAFLALSAMYR
YKAESTETVDIAMGLEAEKAKLQAEPLG

Setaria italica Setit_54 Si034780m.g

MGGGGRRSRADERGVGPLLPEMQSGMSPPPGGSNGHHHHHHQQVSSMESGPA
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VPVIGAFLADSYWGKYRTILASISFYLVGLVLLTVSAAVPSLRPATACQMGESCAPASKT
QFSVFFAALYLTSIGTGGVKSALLPFGAEQYDDDAERPERKQAFFSWFFAAINLGIFIAGT
LVSWLQQNVAWALGFGVGTACLLAAALAFVAGTPWYRVQMPTGSPLKDIVRVLVAAF
RKRKARLAQADGAAVPLHEEEEDAAANGGQRLSRTKGLRCLDKAAVIVKEQDREQEG
EWSLCSVSEVEGVKILVRMLPIWLTCVLYAASLGQMTTTFIQQGMVMDARLGGRFKVP
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LVERRRLRQAPSAPMSILWQVPQFVLVAGSDVFCGIAQLEFFYGEAPAAMRSICSAFSFL
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ARYTPKQVAAAAVEPGGSSSSSD

Setaria italica Setit_55 Si034812m.g

MYPTYDNKTHSSAAPMIGAYPRAAGRWRRKGLFQKPDYESYTCNGSVDIRGNP
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TSYLTPLLGAFLADSYWGRHRTIVISLTTFTIGMILLTLSAIVPTSTNTVVMPLQHTLPFLG
LFLTALGLGGIWPCVPTFGADQFDDTDRAEKAQKEIYYNWYYFAVNGGFFIASTVLVWI
QDNWGWGLGFGIPTLFSVIGIVGFLSSMKLYRYQRPGGSALTRICQVLVAATRKINVDV
PNGSSLLYEMPGKESAILGSRKLMHTDGQRFFDRAATITSSDERFLDAPNPWKLCTVTQ
VEEMKILARMMPVLLAGIIFNTAEAFFPLFIEQGEVMDNQIDNFSIPPASVTTFNCLCILIL
APAYNKVLMPMVSKITGTKRGLSDLQRIGVGMFFAMLSMVSAAIVEMVRLDIAMKTGL
VHQSAAVPMNILWQAPQYFLVGVAKVFSVVGFIEFAYEQSPDAMRSLCQACSLIMVTL
GSYLVSVMLMFINSITEGRGSHGWIPVNLNEGRLDQLFWLMAGLQLLNLLAFAYCAMR
YKRKLAT

Setaria italica Setit_56 Si034824m.g

MATILPETSSDGKALTDAWDYKGRPASRASTGGWGCAAMILGAELFERMTTLGI
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ATGVMILTISTAAPGLRPPPCADAKGASPDCVPANGTQLGVLYLGLYLTALGTGGLKSS
VSGFGSDQFDEAHDGERSKMLRFFNWFYFFVSIGALLAVTVLVYVQDNVGRRWGYGV
CAAGILVGLAVFLLGTRKYRFKKLVGSPLTQVAAVTVAAWNKRALPVPSDPDMLYDV
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RMLPIWATTIMFWTIHAQMTTFSVAQAEVMDRGIGGSGFLIPAGSLTVFLIGSILLTVPLY
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MPQFVLVGAGEAFTYMGQLAFFLRECPKGMKTMSTGLFLSTCAIGFFFSTLLVTIVGKV
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ADEEAIAVGH

Setaria italica Setit_57 Si034826m.g

MASVLPETASDGKALTDAWDYKGRPASRATTGGWACAAMILGAELFERMTTL
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DRLIAPVVKRLTGNPHGLSPLQRVFVGLFLSVAGMAVAALIERHRQTTSEHGVTITVFLL
MPQFVLVGAGEAFTYMGQLAFFLRECPKGMKTMSTGLFLSTCALGFFFSTLLVTIVGKV
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ADEEAIAVGH

Setaria italica Setit_58 Si034833m.g

MAGAECGEEAAALEQGLLAPEEPNQLIYTGDGSVDFKGNPVVKERTGRWKACP
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LGFGIPTVFMGLAIISFFSGTSIYRFQKPGGSPITRVCQVVVASLRKWNVHVPEDSSLLYE
LPDGVSAIEGSRQLEHTDELRCLDKAATITDVDVKTADLTNPWRICTVTQVEELKILLRM
FPIWATTIVFSAVYAQMSTMFVEQGMVLDPSLGSFKVPPASLSTFDTLSVIVCVPIYDYIL
VPLARRFTGNERGFTELQRMGIGLVISIITMAVAAVLEIKRLAIARDHGLVDQNVPVPLSI
FWQIPQYFLVGLSEVFTFIGALEFFYDQSPDAMRSLCSALQLLTTAFGNYLSTFILTMVA
YFTTRGGNPGWIPDNLNKGHLDYFFWLLAGLSFLNLVIYVGCAGKYKSKKAA

Setaria italica Setit_59 Si034843m.g

MESSLEEERRQSLLVRATEPEDLAEYTGDGSVDFRGSPILKRNTGNWRACSLILG
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YRTIAVFSTIYFLGMAALTLSASVPSFMPPQCVGSVCPQPTLPQYLIYFVGLYMIALGAG
GIKPCVSSFGADQFDDTDPVEKTKKGAFFNWFYFCINIGSLISGTVLIWVQENYGYGIGF
GIPTFFIALAIGSFFLGSEIYRFQIPGGSPLTRACQVVVAATRKRKVDLPVDGSLLYELDG
KSSAIEGSRKLEHSSEFSFLDKAAVILWNERDGYHDPWRLCTVTQVEELKILLRMFPIWA
TGIVFFTVCAQNSSMFIEQGMALDNQIGSFKIPPATLSSLDVISVVVWVPIYERLVVPIAR
RFTGKERGFSELQRMGIGLFVSTIAVAVAALVEIKRLQVARAEGMVHQKVPVPMSILWQ
APQYLLVGVGEVFTSIGQAEFFYNQSPDAMRSLCSAFALVTVSLGSYLSSFILTLVSYFTT
RNGQLGWIPDNLNEGHLDRFFWLITGLSSLNLLVFLYYAQQYKCKRASVA

Setaria italica Setit_60 Si034862m.g

KYNFAVEVGNGAPMAECSSAVTCKGDTTTEAAAHSSGFAGSQPDHEQYTCNGS
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VISPQEFLPSLGLFLTALGLGGMWPCVPTFGADQFDDTDGTEKAQKELYYNWYYFAVN
GGFFLASTLLVWVQDNYGWGWGFGIPTLFSATGIAGFLACVKLYRYQKPGGSALTRICH
VVVAATRKINVDVPDDSSLLYEMPGKESAIIGSRKLMHTDGLRFFDRAATITSSDETSDN
VPNPWKLCTVTQVEELKILARMLPVLLAGIIFNTAEAFFPLFIEQGEVMDNDIGGFSIPPA
TLTTFNCLCILILAPSYNKVLVPILSSITGIKRGLSELQRIGVGMVFTMLSLVSAALVEMV
RLDIANNRGLVHYNSAVPMNILWQAPQYFFVGVAKVFTVVGFIEFAYEQSPDAMRSLC
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LAFAYCATRYKRKLAT

Setaria italica Setit_61 Si034896m.g

MEKSLRVGSMEDRREWVHDSSVDHRGRPPSRDATGSWKAAMFIIMIEFSERLSY
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VVYLLGLMVLATAQLSPRLTPNHSLRLHETLFFVGIYLVSVGTGGHKPALESFGADQFD
ESHAAERVQKMSFFNWWNCALCSGVLLGVTVIVYAQDRIGWGAASVVLAAVMAASL
VVFLAGWRFYRYRVPEGSPLTPLLQVVVAAVRKRRLALPADAGELYEVKPQNIKKRLL
CHTHQLRFLDKAAIVEHDGGEDAAGPWRLATVTQVEETKLVLAMVPIWVATLPFGMA
AAQVSTFFIKQGSMMDRRMGPHFVLPPASIFALSAISMIATVAVYDKVLVPFLRRATGG
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VGLQEYFYDQVPDNMRSLGIGLYLSVIGAGSFLSSLVITAADRASSRGGHASWFAKDLN
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Setaria italica Setit_62 Si034902m.g

MGTADEETPLVVHLQPPPQVVASEYAGDGSVDINKQPALKRSTGKWRACYLILG
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GADQFDINDRAELSQKGSFFNWYFFLTTTSCLLSGTVIVWLEDNVGWAVGYVVPAVLM
LFFFVVFIAGSRIYRFRGMEASPLTSIFQVVVAAVRKWHLQLPDDSSLLYELTSSPSTAEA
SQKNKHSNRFRFFDKAAIAPSDNESVVHMSSWRLCTVSQVEDLKMLLSMSPTWGLFVI
YFSVSALMQPTMVEQGMFMDNHVGSFAIPPASMPTVSVCSFLIWIPIYETILIPLARRFTG
KEKGISQSQRLGIGQALSTLTMVLAALLETRRLAIAEANGLKHQDVPVPMSILWQVPIYL
AHGATAVFGGIGLTEFFYDEAPVTMRSLCAALGQLATAAGSYFSSLVLSTVAVATTRGG
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Setaria italica Setit_63 Si034906m.g

METADEEIPLVAHHLQPPPQVVASEYASDGSVDINKQPAVKRSTGKWRACYLIL
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GRYWTIVASVPVYIIAMLILIASASLPVFSASSYHDVHSAAVYLGLYLLAISNGGLKPCIS
TFGADQFDINDRVELAQKGSFFNWYFFLTSTSSLLSGTVIVWLEDNVGWAVGYVIPAVL
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SQKNKHSNRFRFFDKAAIAPSDNESVVQMSSWRLCTVSQVEELKMLLSMSPTWGSFVIF
YSVSAQMQSTLVEQGMFMDKHVGSFAIPPASMPTVSVCSFLIWIPIYETILIPLARRFTGK
EKGISQSQRLGIGQALSTLTMVLAALLETRRLAIAEANGLKHQDVPVPISILWQVPLYLV
HGAAAVFGGIGLTEFFYDEAPVTMRSLCAALGQLATAAGSYFSSAVLSIVAVATTRGGE
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Setaria italica Setit_64 Si034923m.g

MDAERGDDQSPLLQHHPPNQTQVSPVNQHYNKPFSWKAPAVILAFEFLESIAYS
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QYNDSNLEESKNKQLFFSWFFIAINLGVFISGTVVVWIQQNVAWSLGFGISCVCLVIATV
TFFAGTPFYRVQLPTGSPLKSIVMVFVASFKKRRVAVPDDSSLLFEGDDAESSNTVPNKL
EHTDEFRCLDKAAVVLDEQEIKDSHRPWLLCTVTQVEEVKILIRMLPIWFTCVFYAAAM
CQTATTFVQQGNAMNTKIGSFSVPAASMNSASVIFMMIWVVFQDSVVIPIARRYTGNIA
GLTLLQRMGVGRFLAVPALAAAALMETLRLRRVRAGGNLSIGWQLPQFVILSCSDVFC
GIAQLEFFYAEAPTSMRSLCSAFQFLAMSLAYYVNTLVVSVVAAATTAGGGKGWLPAD
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Setaria italica Setit_65 Si034933m.g

MEATADEERPLIPHLQSQDVDSLYTGDGTVDINNQPALKRTTGNWRACFLILGTE
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WTIVISLSIYIVGMLTMTASAWLPLLMDPLHDSGIRHVVVYLGLYLVALAGGGIKACAS
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LVVFGLAAFVTGRRVYRYKKLQGSPLKRVSQVVVAAVRNYNLGLPEDCSTLHEVPSPT
KPNCRIQHTFQFRFFDKAAILVTSSHEKGQPVSENPWRLCTVSQVEELKMLLRMFPVWA
SMVLFSTVNAQMSSTFIEQGAVMDNRVGSFTVPPASLATFNVISVMVCIPVYDAVLVPL
ARRATGKERGLSQLQRLGVGLALSVAGMVYAALVEARRLVLQRTGTLMSIMWQAPAF
AVLGAGEVFTAIGILEFSYEQSPDGMKSLGTALAHLTIAAGNYLNSAVLGAVAAVTARG
GKPGWIPDDLNEGHLDYFFWLMAALGVVNLLHFLHCSLRYRGNNN

Setaria italica Setit_66 Si034934m.g

MDAQDEERPLIHHLHPQGESSEFTSDGTVDISNQPALKRSTGNWRACFFILGSEFT
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QFDATDPVERVTKGSFFNWYYWSVNIGSLLSATVLVWVQDNIGWGVGLAIPTVFMVCG
FSVFVGGRKLYRYQKVGGSPLTRLFQVVVAAVRNYHLVLPEDCSALHEVATSTEGNRK
IQHTSQFRFFDKAAIVAPFSGDKGPMSPWKLCTVSQVEELKMLLRMFPVWASMVLFFA
VTSQMSSTFIEQGAAMDNRVGPFTVPPASLATFDIISVMVCIPIYDGVLVPLARRTTGKER
GLSQLQRLGVGLALSVAGMLYAALVEARRLALARTGTPMSIMWQAPSFAVLGAGEVF
TAIGILEFFYDESPDGMKSLGTALAQLAVAAGNYLNSAVLAAVSAITARGGKPGWIPDD
LNEGHLDYFFWLMAALGVVNLLHFLHCSMRYRGNTNTVS

Setaria italica Setit_67 Si034988m.g

MEAADEERPLIHHLPPQDDEASKYTSDGTVDINNQPAPKQTTGNWRACFTILGSE
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TIVIFLLVYTIGMLILTVSASLPLIMVVPSNSGIRRVAVYLGLYLVALGTGGVKPCASALG
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VCGLVVFVAGRKVYRYKKLGGSPLTSVAQVVVAAVRNYHLVLPGDASGIEYARQFRFF
DKAAIVAPSTGEKCTAARTSPWRLCTPSQVEELKMLLRMLPVWASMVLFFAATAQMSS
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QRLGVGLALSAVGMAYAALIEAQRLSLARAGAPAISIMWQAPAFAVLGAGEVFASIGIL
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LDYFFWMMAALCLMNLAQFAHCSMKYRGKTIC

Setaria italica Setit_68 Si034990m.g

MLANQALVTFAVNCVGNNLVTFMAVVMRLENADAANKANNWAGTTYVFSIV
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VTAMAYLEDRGHWALAFWIATAAALVGVVLFALGTLRYRHFLPSGNAIVSVCQVTIAA
IKKRHVKAPQQAQDLYEEPPEATGDNETTKKLYNGQGRKMMLHTPEFRCLDKAAVVT
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RSLGSAMSVASMSAGNFVSSLLVTVVMAVTSKGGRPGWIPQDLNHGRVDLFFFVIAAL
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Setaria italica Setit_69 Si035552m.g

MFFLTLTAAADSLHPPECGVGETCEKATSYQFAVLFIAFAFLVLGSAGIRPCSMPF
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YYVAVVQQSTYVVLSALQSDRHLGRGSFEIPAASFTVFAMLAQTLWIPLYDRILLPKLR
KMTGKEEGFTLLQRQGIGIALSTVAMVISAIVEDRRRAIALSQPTLGKTMMGGDISAMSS
LWMVPQLMILGLSEAFNLISQIEFYYKEIPEHMRSVAGALAFCNLALGNYLSGFLVTIVH
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Setaria italica Setit_70 Si035858m.g

MMALGTGGIKPCVSSFGADQFDDSDPVERAKKTSFFNWFYFCISMGSFISGTIIV
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QVEELKILVRMFPIWATTIIFSAVYAQNSSLFVEQGMVLDKRVGPFNIPPASLSTFDVISVI
IWIPLYDRILVPIARKFTGKEKGFSELQRIGIGLVLSILAMVSAALVELKRLEVARSEGLIH
EKVDVPMSILWQIPQYFLVGAAEVFTAIGQVDFFYDQGPDAMRSLCSAFALVTVSLGDY
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Q

Setaria italica Setit_71 Si035868m.g

MIALGTGGIKPCVSSFGADQFDDTDPAERTKKGSFFNWFYFCINMGAFISGTIIVW
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PNDMSLLYEVDSQTSAIEGSRKLEHTNELKFLDRAAIVIAADVKSACTDPWKLCTVTQV
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VPLYDRILVPIARKFTGREKGFSELQRMGIGLVLSTLAMVAAALVELKRLEIARSEGLIHE
KDDVPMSILWQIPQYFLVGAAEVFTVIGQLEFFYDQGPDAMRSLCSAFALVTGSVGSYV
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Q

Setaria italica Setit_72 Si040184m.g

NSIERRIDIKGVKHHTTDSWRACTYILVTECFEELAYYGIQFNLVTFLKNVLHENN
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DCLQDGSSKSFAFFLGLYMMAIGAGGIKPCVSSFGADQFDDSIPADRLKKDSFFNWFFFA
IYIGSFVSGTAVVWVQDHYGWVVGLGIPTLFIAFAIATFMLGSGSYRVQKPLGSPIVGVL
QVIVAAARKWAVRVPHDDSLLHEAPDKASMVDGHKLQHTPELRFLDKAAVISSDEELA
DPWRLCTVTQVEELKVIVGMLPIWATGIVYFSVLAQFSSTFLEQGRTMDKQVGAFAIPP
ASLASFDAVSVIFWVPIYDRVLVPAARRLTGKERGLSELQRFGAGLVLSVLVMTAAALV
ETRRLALAHGEGLSSMSILWQVPQYFLVGASVVFACVGQTEFFYNEAPPSMRSLCSALA

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VWCARRYRRKNVY

Setaria italica Setit_73 Si040190m.g

MRNDGGILEIHCLVTAFSLLFKLKSSHASTCPKENSGAKRHSGSWRACSYILVTQ
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TVAFFTVYLLGMAAMSISASFLKGGSSQPAVFFLGLYMMGIGAGGIKPCVSSFGADQFD
DSSLAERLKKDSFFNWFFFATYIGSFVAGTAVVWVQDHYGWGVGLWLPTLFIALAIASF
LLGSSKYRVQKPLGSPIIRVLQVIFAAVRKCNVVLPYDDSLLHELPEKTPMADVHKLQH
TPVLRFLDKAAVISSTEDPSDSDPWRLCTVTQVEELKVIIGMLPIWATGIVFFAVLAQFSS
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QRLGAGLLLSVLVMVTAAVVETRRLASAHGEGRSSMSILWQVPQYFLVGASVVFACVG
QTEFFYNEAPPSMRSLCSALALLTVALGSYVSSLVVTMVEWLTTRGGGPGWIPDDLND
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Setaria italica Setit_74 Si040247m.g

MATNSFVTPLTNYLINRYNMEENAATNVNNVFSGMFSFAPVVGAFVADAFWGR
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VVSAAGLNPTALPFGADQFDETNERHKAGVTRYFNWYYASSMMATFLALTVIVYVQD
KVSWGLSFAIPTALTVVAFAIFLLGTTVYVYVPPEGSIFSSVARVAVASCRKWRLRLPHP
DDARRQEGVLYNPDPAAAANGRRRVFRLPLTLQLSFLNKAAIVTDAAGEVRPDGSPAR
PWNLCSVQQVEEVKFLVKIIPLWVSGVVWFIVLTEMINYTLIQAMTMDLRMGSRFTIPV
VSILAVFYLSVALFAPVFDLLASIAARYRTKAPPGGGVGGGITLLQRQGAGLVIGALAFV
VAASVEVERRRRGSALGHGGGRSPLSVFLLAPQLAMMGASGALSMVGQMEFYNTEFP
DQMRTLANAAFYCAQGAASYLATLVVSIVNARTRRRGGSAAGWVSDDINAGRLDYFY
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Sorghum bicolor Sorbi_01 Sb01g002990

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RSPRLHEALFFVGIYLVSVGTGGHKPALESFGADQFDEAHAAERVQKMSFFNWWNCAL
CSGVLLGVTAIVYAQERVGWGAATVVLAAVMAASLAVFLAGRRSYRYRVPKGSPLTP
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AFGPWRLATVTQVEETKLVLAMVPIWVCTLPFGMAVAQVSTFFIKQGSVMDRHLGPHF
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AAVERRRLLSSAEAAAQPPSVLWLVPQFALMGVADGFALVGLQEYFYEQVPDGMRSL
GIGLYLSVIGAGSFLSSLVITAADRASSRGGRASWFAKDLNHSRLDLFYWLLACIGAVNL
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Sorghum bicolor Sorbi_02 Sb01g009890

MAGAERVEAPSLEEQGLLALEESNQLVYTGDGSVDFSGNPVIKERTGRWKACPF

ILGNECCERLAYYGIATNLVTYLTKKLHVGNASAASNVTTWQGTCYLTPLIGAVLADA
YWGKYWIIATSSIVYFIGMVILTLSASVPMLMPPSCEGSFCAPASPFQYTVFFLGLYLIAL
GAGGIKPCVSSFGADQFDDTDPDERIQKGSFFNWFYLSINIGGLISSSFLVWVQDNVGWG
LGFGIPTVSMGLAIISFFSGTSLYRFQKPGGSPITRVCQVIVASLRKWNVHVPEDSSLLYE
QPDGVSTIEGSRQLEHTDELRFFDKAATVAKVDVKTADFNNPWRICTVTQVEELKILVR
MFPIWATTIVFSVAYAQMSTMFVEQGMVLDPSLGSFKFPPASLSTFDTLTIIICVPMYNYI
MVPIARRFTGNGRGFTELQRMGIGLVISIIAMSVAAILEIKRLEVAREAHLVDQNIPVPLSI
FWQIPQYFLIGLAEVFTFIGALEFFYNQSPDAMRSVCSALNLLTVSFGNYLNTFILTMVA
YFTTRGGNPGWIPDNLNEGHLDYFFWLIAGLSFLNLIVYVICASKYKSKKAA

Sorghum bicolor Sorbi_03 Sb01g009900

MAGAERAEAVALEEGLLAPEESNQVVYTGDGSVDFSGNPVVKETTGRWKACPF
ILGNECCERLAYYGISTNLVTYLTKKLHAGNASAASNVTTWQGTCYLTPLIGAILADAY
WGRYWTIATFSTVYFIGMSILTLSASVPMLMPPSCEGSFCPQASPFQYTVFFLGLYLIALG
TGGIKPCVSSFGADQFDDTDPAERIQKGSFFNWFYFSINIGALISSSFLVWVQDNVGWGL
GFGIPTVFMGLAIISFFSGTSLYRFQKPGGSPITRVCQVIVASLRKWNVPAPEDSSLLYELP
NGVSTIEGSRQIEHTDELRCLDKAATVTEVDVKMADFSNPWRICTVTQVEELKILVRMF
PVWATTIVFSAVYAQMSTMFVEQGMVLDPSLGSFKIPPASLSTFDTLSVIVCVPMYDYIV
VPIARRFTGNERGFTELQRMGIGLVISILAMSVAAILEIKRLAVAREAHLVDQNVPVPLSI
FWQIPQYFLIGLAEIFTFIGALEFFYDQSPDAMRSLCSALNLLTTAGGNYLSTFILTMVAY
FTTRGGNPGWIPDNLNEGHLDYFFWLLAGLSFLNLIVYVICAGKYKGKKAA

Sorghum bicolor Sorbi_04 Sb01g011700

MRVGGGRDDEEVSRKLKSMDVDKLENGGGGGEESPHPPRPAVKYHGWKAMPF
IIGNETFEKLGTLGTSANLLVYLTQVFHMRSVDAATLLNGLNGTTSLAPIIGAFLSDAYL
GRYLALAIASVASLIGMFLLTLTAGADSLHPPECNVGETCEKATSYQFAVLFIAFAFLVL
GSAGIRPCSMPFGADQFDPTTESGKRGINSFFNWYYFTFTAAMMVSATVIIYVQSNVSW
PIGLGIPTALMFLACVLFFMGTRLYVRVTPEGSPFTSVVQVLSAALKKRSLKQPKDPKQD
LFDPPHTSAIVTKLAHTDQFRCLDKAAIVASQDEVRPGGAAPADPWRLCSVQQVEEVKC
LIRIVPVWSTGIIYYVAVVQQSTYVVLSALQSDRHLGRGGFQIPAASFTVFAMLAQTLWI
PFYDRLLLPKLRKITGKEEGFTLLQRQGIGIALSTVAMVISAIVEDRRRAIALSQPTLGTTI
TGGAISAMSSLWMVPQLMILGLSEAFNLISQIEFYYKEIPEHMRSVAGALAFCNLALGNY
LSGFLVTIVHRTTGSGQNWLAQDLNKGRLDLFYWTIAGIGVFNLIYFVICARWYRFKGA
SN

Sorghum bicolor Sorbi_05 Sb01g019630

MAERLEAAAPAAADEYTQDGTVDLHGNPVLRSKRGGWKACGFVVVYEVFERM
AYYGISSNLVLYLTKKLHQGVVPSANNVTNWVGTIWMTPIIGAYIADAHLGRYRTFMIA
SVIYLCGMILLTLAVSLPALRPPKCGPNTADPNCVQQATSAQLGVFFLALYTLAVGTGG
TKPNISTIGADQFDDTHPRERSHKLSFFNWWMFSIFFGTLFANTVLVYIQDNVGWTVGY
ALPTFGLAVSIAIFTAGTPFYRHKPTSESPFAKMARVIVASARKLAVSVPVDPRDLHELD
DEYYAKKKAVPLPHTHNLTVLSKAAVKTTTGGEKEGRWSLSTVTQVEETKQMLKMLP

VLAITFVPSAMMAQINTLFVKQGTTLERHIGRRFEIPPASLQGFVTISMLVAVVLYDRVF
MPFARRITGNPRGISLLQRMGVGLVIHIVIMGIASATERHRLAVAHEHGLYDSKNTTTPL
TIFVLLPQFVLMGVADAFLEVAKIEFFYDQAPEGMKSLGTSYAMTSLGIGNFLSSALLSA
VSHITERHGRTGWIINNLNASRLDKYYAFFAILNCANLAAFFFVCRFYVYNAEVSRVVD
VDSGSTKQKQREVAMQAPASVGAVEVAL

Sorghum bicolor Sorbi_06 Sb01g019640

MENGEGGGGEYTKDGSVDLRGNPVLRSKRGGWTACTFIVVYELFERMAYYGV
AANLVVYLTERLHQGTVQAANNVTNWSGTVFLTPLLGAFLADAYLGRYWTFVAGSAV
YLLGMLLLMLAVSVPALKPPPCDPGAGATCPRASALQLGVYFGGLYTIALGNGGTKPNI
STIGADQFDDFHPAERLRKLSFFNWWMFTVFTGILFSTTVLVYLQDSVSWSWGYGVPTL
ALAASVAVFLAGTPLYRHKLPQGSPITKMGKVVCAAVRKCRVAVPGDLTELHELEPEQ
YASKKRFRVNPTSSMAFLNKAAVKAEDAPGWTLCTVTQVEEMKQIAKLVPLLATMFVP
CALMAQVGTLFVKQGVTLDRRVGRGTGTFRVPPASLGAVVTLTMLVCVVIYDRAIVPA
VRRRTKNPRGITLLQRIGAGLVLQVVTMATTAAVESRRLSFARRHHAGEPLPLTIFVLLP
QFVLMGAADAFLVVGQIEFFYDQAPESMKSLGTAMSLTAYGVGNMLSSAILSAVVRVT
AAGRRGTPWVTDDLNASRLDCYYAFLAALAAVNLAAFVALSCRYSYRAESTEAIGVTA
RVHSEPVAAVAP

Sorghum bicolor Sorbi_07 Sb01g027040

MEAADEENALLLHLQPTPQAVASEYASDGSVDINKQPALKHSTGNWRACYTILG
VGFSECMVFSAIATNLVTLLTTVLHESKVDAARNISSWAGVCYLTPLLGAFVADSYLGR
YWTMVVFLPVYIVAMLVLIASASLPTLFHSDVHPAVVYLGLYLAAIASGGVKPCISAFG
ADQFDVNDPVELVKKGSFFNWYFFLTTTSSLLSGTVIVWLQDNVGWAVSYVIPTVLMLI
CFPAFLAGSRVYRFRKMGVSPLTSILQVVVAAVRKWHVKLPDDSSLLYEQASSPSTTEH
KNKHTNQFRFFDKAAIVPSGNESTAQSSPWRLCTVTQVEELKMLLSTLPTWASFLVFYA
VTAQMQSTMIEQGMLMDNHVGSFAIPPASMPIIGVLSFLICVAVYETILVPLARRFTGNE
KGFSQWQRLGIGQALSILTMALAALLETRRLEIAEANGQEVPVPMSILWQGPVFFVHGA
AEMFGSIGMTEFFYDQAPVTMKSLCAAFGQLAIASGSYLNTAVLSVVAFGTTRGGETG
WIPDNLNEGHLDYFFWMMAALSLLNLALFVRYSMRQRGKET

Sorghum bicolor Sorbi_08 Sb01g027050

MVVLIASASLPIFSTSSDHGGSVHRAFVYLGMYIAAIASGGVKPCTSSFGADQFDT
NDHAELVTKGSFFSWYFFLINTSNLLSGTVIVWLQDNVGWAVSYVIPTVLMLICFPAFLA
GSRVYRFRKMGVSPLTSILQVVVAAVRKWHIKLPDDSSLLYEPSGTDASYKIEHTNEFRF
FDKAAIVSAPSDNESTVPLCSWRLCTVTQVEELKMLLRMSPIWASFVIVYAVDAQMPST
LVEQRMFMDNRVGSFTIPPASMSVVGVISCLVWVPIYEMALVPLARRFTGKEKGFSQAQ
RLGIGLALSMLTMVYAALLETRRLAVAEASGMRDPDAPVPMSILWQVPLHVVHGAAQ
VFAGVGATEFFYDQSPETMKSLCAALGQLALAFASYMNSLLLSIVAVATTRR

Sorghum bicolor Sorbi_09 Sb01g027250

MDTQDEERPLIHPLPTQDECSEFTCDGTVDINNQRAPKRSTGNWRACFFILGAEF

TECVAVYAITKNLVSYLTGVLHESNVDAATTVSTWIGTSFFTPLIGAFLADTFWGRYWT
VVVFLSVYAIGMLTLTASAFLPLLMGSSYNRGIHRAATYLGLSLTALGNGGIKPCVPAL
GADQFDATDPVERVKKGSFFNWFYFSVNIGSLLSATVIVWVQDNIGWGVGFAIPAVLM
VSGLPLFVAGHKVYRYQRVGGSPLTRVSQVVVAAVRNYRLELPEDCSALHEVPGNCKI
QHTSQFRFFDKATIVVAPSSNEKAPTANSPWRLCTVSQVEELKMLLRMFPVWASMVLFF
AATAQMSSTFIEQGAAMDNHVGPFTVPPASLATFDVVAVMVCVPIYDTVLVPLARRGT
GKERGLSQLQRLGVGLGLSVAGMAYAALVEGRRLSLARSTQPSASMSIMWQAPAFAVL
GAGEVFTAIGILEFFYDQSPDGMKSLGTALAQLAIAAGNYLNSAMIAAVAAVTTRNGEP
GWIPDDLNNGHLDYFFWLMALLGVVNLLYFLHCSIRYGGNKNNTCS

Sorghum bicolor Sorbi_10 Sb01g027280

MDAQDDERPLIHRLPLQQDETSEFTSDGTVDISNLPARKQRTGNWKACFFIIAGE
FTESVAFFAIAKNLVTYLTGVLHESNVDAATTVSTWIGTSFFTPLIGAFLADTFWGRYWT
IAIFLSVYVTGMMILTGSALLPLLMGLSYNRGIHRLTAYLGLYLIALGSGGIKPCVCSLGA
DQFDAADPVERVTKASFFNWYYFSVNIGSLLSATVVVWVQDNIGWGLGFAIPTVLMLS
GLAVFVAGRKVYRYQRVEGSPLTRVSQVLVAAVRNYHLVLPEDSSALYQVPSPTEGNH
CKIQHTSQFRFLDKAAIVAPSSGDGEKVRTSPWRLCTVSQVEELKMVLRMFPVWASMV
LFFAATAQMSSTFIEQGETMDNHVGPFTVPAASLAIFDVISVMFCIPIYDKVLVPLARRAT
GKERGLSQLQRLGVGLALSVAGMVYVALVEARRLSLTHAAPDRQSSMSIMWQAPAFA
VLGVGEVFTAIGALEFFYDQSPDGMKSLGTALAQLATAAGNYFNSAVLAAVAAVTTRN
GKPGWIPDDLNKGHLDYFFWLMAVLGVVNLLYFLHCSIRYRGNNSSRAYS

Sorghum bicolor Sorbi_11 Sb01g027290

MKGDSIMSEAEESSLLPLLPLLHGTPSQDYEQYTCNGSVDIRGNRASKRHTGNW
RACYSILGGEFCGAMAYYGVGTNLVSYMTKVQKQSNVAAASNIAFWQGTCYLTPLLG
AFLADSYLGRHRTILVSLMIFTMGMLLLTLSAIIPASIRVVVNSHSQDALSSLGLFLTALG
LGGIWPCVPTFGADQFDDTDTAEKEQKKLYYNWYYFAVNGGFFFASTVLVWVQDNHG
WGLGFGIPTVVSTVGIAGFLACMKLYRYQKPGGSALTRICQVVVAATRKVNVDVPTDS
SLLYEMPPGKESAIAGSRKLMHTDGLKFFDRAATITTSEDASNPWKLCTVTQVEELKILA
RMLPVFLTGIVFNTAEAFFPLFIEQGQVMDSHIVAQFWIPPATLTTFNCLCVIILAPAYNR
VVMPMVCRITGKKRGLSELQRIGVGMVFAMFSMASAALVEMVRLDIAKNRVLMNILW
QAPQYMFAGVAKVFSVVGFIEFAYEQSPDAMRSLCQACSLLMVTLGSYLVSIMLKMIDS
VTAGRGSHGWIPENLNEGRLDQFFWLMAGLHLLNLLAFAYCATRYKCKLAT

Sorghum bicolor Sorbi_12 Sb01g027300

MKGGSISDEEHGGLVPLHGKFSQDYAPYICNGSVDIRGNPASTIHTGKWRACYSI
LVAEFCGSLAYYGVGTNLVSYLSNVQQQSNIDAASNIAFWQGTSYLCSLLGAFLADSY
WGRHRTIVISLSTFTCGLMLLTLSAIVPANILTVVTSPQDALAFLGLFLTALGLGGIWPCV
PTFGADQFNDTDGEEKEQKEIYYNWYYVSVNGGFLFASTVLVWVQDNYGWGLGFGIP
TVFSAVGVAGFLACMKLYRYQKPGGSALTRICQVVVAATRKVNVDLPTDSSLLYEMPG
KESVIVGSRKLMHTDGLRFLDRAATITTAEEKFLDTPNPWKLCTVTQVEELKILARMLP
VFLAAMIFNTAEALFPLFIEQGQVMDNHIHSFSIPPASLTTFNCLCIVILAPAYNKVLMPIA

SRITGVKRGLSELQRIGVGMAFAVLSLVSAAIVEMARLDMAKKTGLVHQSTAVPMNIL
WQAPQYILVGVAKVFSVVGFIEFAYEQSPDAMRSCCQACALVMVSLGSYLVSVMLKMI
DSVTEGIWGHGWIPENLNQGRLDLFFWLMAGLQLLNLLGFAYCAMRYKNKLAG

Sorghum bicolor Sorbi_13 Sb01g027320

APLSACSPPQVIASKADSVQGAAHSTVFTASSAEYEPYTCNGSVDIKGNPASKKH
TGKWRACYSILGGEFCGSLAYYGVGTNLGMVLLTLAAVIPASTHTLEISPQDALPSLGLF
LTALGLGGIWPCVPTFGADQFDDTNGTEKMQKGLYYNWYYFAVNGGFFFASTLLVYV
QDNWGWAWGFGIPTLFSVIGIAGFLACMKLYRYQKPAGSALTRICQVVVAAVRKVHV
DVPNDSSLLYEMPGKEAAIVGSRKLMHTEGLRFFDRAATISSSEETSSADVPSPWKLCTV
TQVEELKILARMLPVLLAGIIFNMAEAFFPLFIEQGEVMDNYIYGFSIPPASLTTFNCLCILI
LAPCYNKVIMPMLSMITGMKRGLTELQRIGVGLVFAMLSLVSAALVEMARLKIVDERG
LVHRSTAVPMNILWQAPQYFFVGVAKVFTVVGFIEFAYEQSPDAMRSLCQACSLIMITL
GSYLVSVMLKFMDSATVGRGRQGWIPDNLNEGRLDRLFWLMAGLQLLNLLTFAYCAT
RYKRKLANT

Sorghum bicolor Sorbi_14 Sb01g027730

MGGGSGGGRRSRVGAGAAETGVGGPLLPETQSGMSPPPTGGSNGRHQRQQEAV
SSMESGGDVSGAATKRFTWKGPVIVLVFELLESIAFSGVALNLVVYLATVLHGSTAFNA
AHVDTWNGTTFVVPVIGAFLADSYWGKYRTILASIVFYLVGLVLLTVSAAIPSLRPATAC
QVGQPCAPATKTQFSVFFAALYLTSVGTGGVKSALLPFGAEQYDDDAQRPERKQAFFS
WFFAAINLGIFVAGTLVSWLEQNVSWALGFGIGTGCFFVAALAFVAGTPCYRVQMPTG
SPLKDIIRVLVAAVRKRNVRMERDDGAAVLLHEDDDDGNGEQHRLSRTKGLRCLDKA
AAIVVKAEQEGEWSLCTVSEVEGVKILVRMLPIWVTCVLYAASLGQMTTTFIQQGMAM
DTRLGGRFKVPVASLVSVEVVFMLLWVVLHDAAIIPAARRLTGRPGGLTQLQRMGVGR
FLVVLALGTAALVERRRLRGIHGGSGTMSIAWQVPQFVLVAGSDVFCGIAQLEFFYGEA
PAAMRSICSAFSFLALSLGFYVNSLVVTLVAAVTKRPGWLAPDLNAGHLDYYFWLWTII
SVANLLLYMVLAARYTPKQVAAAVEPMRSSSSDE

Sorghum bicolor Sorbi_15 Sb01g027740

MDAETGDARSPLLPHHLPSQTQVSSANQHYNKPFSWKAPAIILAFEFLESIAYSGI
ALNLVVYLGTVLHGTTASNAATVDAWNGATFLTPVLGAFLADTYWGKYKTAAISIIFY
VVGLLIITASAVIPSLRPATCEGGSCPPATGFQYFVLFGSLYLISIGTGGVKSALLPLGADQ
YNDANLEESKNKQLFFSWFFMAVNLGVFISGTVLVWIQQNVAWSLGFGISSICLVIAAV
AFLVGTPLYRVQLPNGSPLKSIVMVFVASFKKRRVVLPVDSTLLFQGDDAESSSIVPNKL
EHTDEFRCLDKASVVEDQEMKDRDRTWLLCTVTQVEEVKILIRMLPIWFTCVFYSAAM
SQTATTFVQQGNAMNTKIGSFSVPAASMNSAEVIFMLIWVVFQDSIVIPIARRYTGNPMG
LTLLQRMGVGRLLAIPSLAAAALVETWRLRSVRAGHNLSIGWQLPQFVILACSDVFCGI
AQLEFFYAEAPASMRSLCSAFQFLAMSLAYYVNTLVVSLVAAVTTAWGGQGWLPADL
NDGHLDYYFWLWTGISVVNYVVYTAFARRYTVKKVVLQ

Sorghum bicolor Sorbi_16 Sb01g029470

MASVLPDTASDGKALTDAWDYKGRPASRATTGGWACAAMILGVELFERMTTL
GIAVNLVPYMTGTMHLGNASAANTVTNFIGASFMLCLLGGFVADTYLGRYLTIAVFTA
VQATGVMILTISTAAPGLRPPPCGDARGASADCVPATGTQLGVLYLGLYLTALGTGGLK
SSVSGFGSDQFDESHDGERSKMLRFFNWFYFFVSIGALLAVTALVYVQDNVGRRWGYG
VCAVGILCGLAVFLLGTRRYRFKKLVGSPLTQVAAVTAAAWTKRRLPLPSDPDLLYDV
DAALAAGADVKGKEKLPHSKECRFLDHAAIIDGTGGDSAASKWALCTRTDVEEVKQV
VRMLPIWATTIMFWTIHAQMTTFSVAQAEVMDRAIGGSSGFHIPAGSLTVFLIGSILLTVP
VYDRLVAPLARRVTGNPHGLTPLQRVFVGLFLSVAGMAVAALVERHRQTAASAEHGV
TLSVFLLMPQFVLVGAGEAFTYMGQLAFFLRECPKGMKTMSTGLFLSTCALGFFFSTLL
VTIVHKVTGRHGGRGGWLADNLDDGRLDYFYWLLAVISAINLVIFTFAARGYVYKEKR
LADAGIELADEESIAVGH

Sorghum bicolor Sorbi_17 Sb01g041710

MESSLEEERRQNLLLRATEPPEDLAVAGYTGDGSVDFRGFPILKHNTGNWRACS
LILGTEICERLAYYGISKSLVTYLSTRLHEGNVSAARNFTTWQGTCYLTPLIGATLADSY
WGKYRTIAVFSTIYFLGMAALTLSASVPSFQPPQCVGSICPQPTLPQYLIYFVGLYMIALG
AGGIKPCVSSFGADQFDDTDPVEKTKKGAFFNWFYFCINIGSLISGTVLIWVQENYGYGI
GFGIPTFFIALAIGSFFIGSERYRFQIPGGSPLTRACQVVVAATHKRKADLPVDSSLLYELD
GKTSAIEGSRKLEHSSEFSFLDKAAVVLWNEHDGSRNPWRLCTVTQVEELKILLRMFPI
WATGIVFFTVCAQNSSMFIEQGMALDNQIGSFKIPAATLSSLDVISIVVWVPIYERLVVPI
ARRFSGKERGFSELQRMGIGLFVSTVAVAVAALVEIKRLQVARAEDLVHQKVPVPMSIL
WQAPQYLLVGVGEVFTSIGQAEFFYNQSPDAMRSLCSAFALVTVSLGSYLSSFILTLVSY
FTTRNGQLGWIPDNLNEGHLDRFFWLIAGLSSLNFLVFIYYAQQYKCKRASVA

Sorghum bicolor Sorbi_18 Sb01g041720

MAAMSISASFPTCAGPDCLQDGSSKSFVFFLGLYLMAIGAGGIKPCVSSFGADQF
DDSNPAERLKKDSFFNWFFFAIYIGSFVSGTVVVWAQDHFGWVVGLWIPTLFIALAITSF
VLGSSSYTVQKPMGSPIVRVFQVIVAAVRKWDVGLPNDDSLLHELLQEKASMADGDKL
QHTPVLRFLDKAAVITSAEELNDPWRLCTVTQVQELKVIIGMLPIWATGIVYFAVLAQFS
STFLEQGRTMDKQVGAFAIPPASLASFDAVSVIFWVPIYDKVIVPAARRLTGRERGLSEL
QRFGTGLVLSVLVMTAAALVETRRLALAAAHGEGEVPMSILWQVPQYFLVGASVVFAC
VGQTEFFYNEAPASMRSLCSALGLLTVALGSYLSSLVVTAVAWLTTRGGEPGWIPDDLN
DGHLDRFFWLLAALSALNLAVFVCCAGRYRRKSVY

Sorghum bicolor Sorbi_19 Sb01g041730

MDEAPGLLLQEEGGGRDHEPLLLPLPQDAGLYTGDGSVDVKGCPALKGTTGNW
KACFFILGNECCERLAYYGIAKNLVTYLKVKLHLGNLEAARHVTTWQGTCYLTPLVGAI
LADSHWGKYWTIAVFSSVYFIGLAILTLSASVPALQPPSCLRTVCPEASLLQYGVFFVGL
YMIALGTGGIKPCVSSFGADQFDDTDPAERAKKGSFFNWFYFCINIGAFISGTIIVWIQDN
TGWGIGFAIPTIFMALAISFFLTASNKYRFQKPGGSPLTRVCQVVIAAFRKWHIEVPHDTS
LLYEVDGQTSAIEGSRKLEHTNELEFLDRAAVISSADLKSESFTDPWKLCTVTQVEELKIL

IRMFPVWATTIIFSAVYAQNSSMFIEQGMVLDKRIGSFNIPPASLSTFDVISVIIWVPLYDRI
LVPVARKFTGREKGFSELQRMGIGLALSILAMVSAALVELKRLEIARSEGLIHEKAAVPM
SILWQIPQYFLVGAAEVFTCIGQVEFFYDEAPDAMRSLCSAFALITVSLGSYISSIILTLVS
CITTQGGDPGWIPDNLNEGHLDRFFWLIAGISFVNLIVYMGCAVRYRYKKAS

Sorghum bicolor Sorbi_20 Sb01g047690

MGAGARDEEAAAAGAGAHHGSLAMEKPQHGAAEYAQDGSVDLRGNPVLRSQ
RGGWTACSFIVVYELFERMAYYGIASNLFIYLTEKLHQGTVEASNNVTNWSGTVFLTPL
LGAYVADAYLGRYWTFVIGSAIYFLGMVLLVLSVSLPALKPPPCDAAKVCPKASALQV
GVYFGGLYIVAFGNGGTKPNISTIGADQFDEFDPREKMHKLSFFNWWMFTIFLGILFSSS
VLVYLQDNVSWPIGYGIPTLGLLVSIIIFLAGTRLYRHKVPQGSAFTSMGRVIAAALLKW
SVPVPADAKELHELDLEEYTRKRRFRMDSTNAMRFLNKAAVPVNDDKDGGGSAAPTW
SLCTVTQVEETKQILKLMPLLVAMFVPCTLIAQTNTLFVKQGTTMDRHMGPHFEIPPASL
GVFVTLTMLVSVVVYDRVFVKAVRRYTGNPRGITLLKRMGTGLALQVVTMAVASVIES
RRLAYARSHGLVATEDQLGLSIFVLLPQFVLMGLADAFLVVGKLEFFYDQAPEGMKSL
GTAMSLTAYGIGNFLSSLLLSTVTRITRKRGNAWVKNNINDSNLDYYYAFLTVLGGVNF
AAFLVLSTMYRYKAESTDTIDIVIGLETEKAKLQAEPLG

Sorghum bicolor Sorbi_21 Sb01g050410

MADHDASSVPQTAAEGKLTTTTTMMDAWDYKGRPAVRGSSGGWSSAAMILVV
ELNERLTTLGVGVNLVTYLMDTMHLGGAASANAVTNFLGASFMLCLLGGFVADTYLG
RYLTIAIFTAVQAVGMCVLTVSTAAPGLRPPACADPTGPNHCVEPSGTQLGVLYLALYL
TALGTGGLKSSVSGFGSDQFDESDGGERRSMARFFSWFFFFISIGSLLAVTVLVYVQDHL
GRRWGYGACVVAILVGLLLFLAGTPRYRFKKLVGSPLTQIAAVTAAAWRKRAMPLPSD
PAMLYDVDDAVAAGEDVKGKHKMPRTKQCRFLEKAAIVELEVEVQGSGNGKGKGKK
WAACTLTDVEEVKQVVRMLPTWATTIPFWTVYAQMTTFSVSQAQAMDRRLGSSFEIPA
GSLTVFFVGSILLTVPVYDRLVVPLARRLTANPQGLSPLQRISVGLLLSVLAMVAAALTE
RARRSASLAGGATPSVFLLVPQFFLVGAGEAFTYVGQLDFFLRECPRGMKTMSTGLFLS
TLSLGFFFSTAIVSAVHAVTTSGGRRPWLTDDLDQGSLHKFYWLLAAISAVDLLAFVAV
ARGYVYKEKRLAEAGIQLVAHDASASA

Sorghum bicolor Sorbi_22 Sb02g000260

MAAMASGGDETTTTTLDGTTDHSGKPAVRSKTGTWRACPFILGNECCERLAYY
GMSSNLVNYMIDRLHQGNAAAANNVSNWSGTCYVMPLLGAFLADAYLGRYRTIAAF
MALYILGLTLLTMSAAVPGLRPPPDGAGAVTAGQSAAFFVALYLIAVGTGGIKPCVSSF
GADQFDDADPRERQSKSSFFNWFYMSINVGALLASSVLVWVQMNVGWGWGFGIPAAA
MAVAVASFLMGSKLYRHQKPGGSPLTRMLQVVVAAWRKGKQPVPADASLLHEASSAS
ASAIQGSRKLEHTEQFRWLDRAAVVTSTDEDGKNNPDPWRLCTVTQVEELKSVIRLLPV
WASGIVMSAVYSQMSTMFVLQGNTLDPRMGSGAGAFKIPSASLSIFDTLSVIAWAPAYD
RLVVPAARRWTGHPRGFTQLQRMGIGLAVSVLSMLAAGALEVARLRVAASHGMLDDS
TNYLPISIFWQVPQYFIIGAAEVFTFIGQIEFFYDQAPDAMRSMGTALSLTSSALGSYLSAL

LVSVVTAITTRNGGLGWIPDNLNRGHLDYFFWLLSVLSVINFVVYLWIAKWYRYKQAT
TSYELSSV

Sorghum bicolor Sorbi_23 Sb02g005420

MARPSVPGTGEHPAAPAGGDTILAVVHDDGTGHHDSLDAAGREVRYRGWKAM
PFVIGNETFEKLGSIGTAANLMVYLTSVFHMTNLRAAVALNVFGGTTNLATVFGAFASD
LCLGRYATVGFGCVATLIGMIILTLTAGVPALHPPPCSAVAGGQQCAGATKGQLAVLAL
SFLFIVVGAGGIRPCSLPFGADQFDPNTESGRRGINSFFNWYYFTLTIAVVGSSTGIIYVQS
NVSWCIGFAIPTALMFASCVLFFAGAGLYVRVRPEGGIPLASVFRVAVAAARKRRAPAP
QDPAASLFRTRHASSLVSRLPYTDQFRFLDKAAVVESDSEVVDDSSGGGGGKPRDPWR
LCSLQQVEEAKCVLRIMPVWATCIVYYVAFAQTNTYVVLQAAQSDRRLGPGGFEAPPA
SFTIFPMLALAVWIPFYDRLVVPWLRGLTGVEGGMTLLQRMGVGMALSVVAMIVAGV
VEQRRRELAVLHQAEANRDLLSVTLVSPASAFWLVPQLAALGLSEAFNQVSQMEFYYK
QFPENMRSVAGSLIFTGLAMSMYLSGLLVVVVHRATADPVLGDDGWLAENLNRGKLD
WFYFLIAFIGAVNFFVFLACAKWYRYKGLDDGGRGGADDDGVHVHVHQWQPTTVQV
VDDCPEEGRVVRRRSF

Sorghum bicolor Sorbi_24 Sb02g007605

EGSWTPTAELPLQQGTPGGEVEEHGGGSAAAAAATTATAAATTDGSVGWNGKP
CRRDRSGGWFAGFLMLANQALVTFAVNCVGINLVTFMSVVMRLDNANAANKASNWN
GTTYVFSIIGAIVSDSYWGRYKACTIFQLIFVAGLVELAVACHVFLDKSCHFGDGGGRQE
HCKPPTTVQAAVFYISIYQIALGNGAYQPAVTTFGADQFDETDARERKSKSAFFGYFFVA
NNLGGILAVTALAYMEDKGEWVQAFWIATAAALLGYLLFAVGTLRYRHFLATGNALV
SVCQVVVAAVRNRRVRAPVREQDLYDPDAADGGHVETGVRKMVHTPEYRCLDKAAV
IKDPASGLQLQVRPADHEPNPWRLCTIKQVEELKCILRLVPIWLCSILFSTSYSQMTSVFIE
QAQAMDDSLWKLTIPPAGMDVFEILGVTAFVFIYRFCIVKVMTKVSHEPTELQRMGTGL
VISTAAMITSGVVEQQRLMRATGGVGVGVDASSTLSILWQIPQYLLIGASEVFMYVTMT
EFFNDQLPEGLRSLGSAMSVASMSAGSFASSLLVTLVMTITCRGGRPGWIPQDLNKGHV
DWFFYLIAALNAVDLLAFVVFAKRYRPAPVVIHGADENGNGVEKGQDGEECI

Sorghum bicolor Sorbi_25 Sb02g031360

MAPASAMELEAPPPASASAAAAKEIKSPEVLPEPSSLSALQRKKLGAHFLESDER
RFSRGCRTPLGGGYDEPPSSAAGAGGTTPVNIRGEPIRDLSRTGGWVAAFFIFGNEMAER
MAYFGLSVNMVIFMFKVMHRPFTSSANAVNNFLGISQASSVLGGFLADAYLGRYWTIAI
FTTMYLLGLIALTVSASVPALVPTQEGCDKLAMLLGACAPAAPWQMAYLQTALYVTAF
GAAGIRPCVSSFGADQFDERSAGYKRRLDRFFNLFYLAVTLGAIAAFTAVVYIQMQHG
WAAAFGTLALAMGASNALFFVGTPLYRHRLPGGSPLTRVAQVLVAAFRKRNAAFDSG
DFVGLYEVAGAKSAIRGSAKIDHTDDFRWLDKAALQLEGDLAGGGEEAVNPWRLCTV
TQVEEVKILLRLLPVPACTVMLSVVLTEFLTLSVQQAYTLNTRVAALHLPVTCMPVFPC
LAIFLILALYYQTFAPLARRLTGHPHGASQLQRVGLGLFFSILSVAWAGLFERYRRGYAV
RHGYLALFLTPMPDLSAYWLLIQYCLIGVAEVFCLVALLEFLYQEAPDAMRSVGSAYA

AVAGGLGCFVASAINTAVDAATRNDAEGRPSWLAQNINVGRFDYLYWLLAVLSTINLL
VFVYFAKRYKYRVRVDTQQTTVVVNNKQ

Sorghum bicolor Sorbi_26 Sb02g038680
MEEGGEHTSLLVKDDASCHGEETQSILEANLGPQLKSKCSDWRAPALILGLECLE
SMAFNGIATNLVVYLRSVLHGGIASSASTVSLWYGTSFFVPMLGAAIADTCLGNYKTILI
SLIMYLIGMVLITVATFLPSTSILCDASSCLSSNGTQTVIFFAGLYLTAVGCGGVRSALLPF
GASQFNNENNLVDIKRRRNFFSSFYICVIFGVITSGTIIVWVQENVSWAIGYGVATTCIGL
ALIGFLVGTPIFQQDEPCGSPVKSIFQVIVASFRNMSLEVPADSSLLYEVRSNHVQRTILA
HSDDFRFLDKAAVISDPSLVYGGCRSSWSLCTVTEVEELKILIRLLPIWVTGIFFAAAISQ
MHTTFIQQGAVMNTKIGSLSIPPASLYSFEVICVTLWVLSVNKVLVPATRTYFANGAELT
QLQRIGIGRFLMIFAMAMAALLETKRLQSVQEGELLNIVWQLPQYFVIAGAECFAVITQL
EFFHGQAPDSMKSILTAFALLTTALGNYLSSAIITLIAGVTRVWHSPGWIPDDLNKGHLD
YYYWCLTALSLVNFVVYLYFASKYKLKKVVIC

Sorghum bicolor Sorbi_27 Sb03g006420
MGEVADMYTQDGTVDRKGNPALKKDTGNWRACPYILANECCERLAYYGMSTN
LVHYMKTRLGQVNSVASNNVTNWSGTCYITPLIGAFFADAYLGRFWTIASFMVIYIFGL
ALLTMASSVKGLVPTSCDNDGVCHPTDAQSAVVFVALYLIALGTGGIKPCVSSFGADQF
DENDEREKKSKSSFFNWFYFSINIGALVASTVLVYVQTHIGWGWGFGIPAVVMAIAVVS
FFVGTPLYRHQKPGGSPLTRIAQVLVACARKWNVAVPADKSRLHETLDKESGIEGSRKL
EHTDQLACLDRAAVVTAEDSAAGAATATSPWRLCTVTQVEELKSVIRLLPIWASGIVFA
AVYSQMSTMFILQGDTLDQRMGSKFKIPSATLSMVDTISVIFWVPVYDRVIVPVVRSYT
GRPRGFTQLQRMGIGLVVSIFSMVAAGVLDIVRLNAVARHGLYGKDDHVPISIFWQIPQ
YFIIGCAEVFTFVGQLEFFYDQAPDAMRSMCSALSLTTVALGNYLSTVLVTIVTHITTRN
GNIGWIPENLNRGHLDYFFWLLAVLSLLNFLVYLVIATWYKYKKTADDIPDAKGEH

Sorghum bicolor Sorbi_28 Sb03g024850
MVQERAAWGASDGGGNLVQDAVDYRGCPADKSSTGGWVAAALALGIELCERL
STMGIAVNLVTYLTGTMHLPSAAAANVVTDFMGTSFLLCFLGGFLADSFLGRYLTIAIFA
LVQAIGTGLLAVSTEVRQLRPPPCGSGAAGSCEQATGLQMGVLYVCLYLIALGTGGLKS
SVSGFGTDQFDERDARERAAMGLFFNRFLFFISVGTLLAVTVFVYVQDHVGRSWAYGIC
AGAMLVAIAVFLSGTRRYRYKRSSGSPIVHILQVLVAAARKRNVVKQPLTASALYEDRP
EHARIPHTAQFPCLDRAAVMAGDDDNEVGRDGRPTPNPWKLCNVSRVEEVKMVARLM
PVWATTILFWTIYAQMITFSVEQATTMDRRMGGFEIPAASLTVFFVGAIMLTLAFYDRVF
VPLCRSFMTGRQGFTNLEKIGIGLVLSIVGMAAAAICEKKRLAVAATSRGAGHGSLPISV
FMLTPQFLLVGAGEAFIYTGQLDFFITRSPKSMKTMSTGLFLTTLSLGFFLSSALVSLVKS
CTRWLGDTINHSRLDYFYWLLAVLGVVNLVAYLVCAMWATAPASRQAEQPQSAMAA
DEKC

Sorghum bicolor Sorbi_29 Sb03g034595
EVIEGKVDWRGRPALRGRHGGLGNCFFILANFGFENMATLSLAVNLVLYFIGVM

HMNAEDSSNLLTNYMGASYMIAVLISVFADVFVGRYMTVILSSLVELVGILLLFLQARS
DRLKPPMCDPRQPLTCLRVHGGNEVHLYLALYLIALGSGGIKAALPAHCADQFDAKHP
KEKQQMSSCFNYLLLSLCTGGVVSVTLFLWIQGLPDRGWEKGFAAATGVMGLAVIVFI
AGMPRYRIATVQGSSALKEICQVYVAAIRNRKQQLPEDPDELYEISRSKASPDMEFLSHR
DRPFRLTLTTVLDRAAIVQTDKDAAANPWRQCRVTQVEQAKTVLAMVPIFCSAIIMGTC
LAQLQTFSMVQGSTMDTTLGPHFKMPVASMLIIPLGLLIFAVPIYEQLFVPLARRLTGIPT
GITYLQRVGVGLVLSIVSMVIAAVVEAQRKKVATRNGMLDMIVGVQHLPMSCFWLAPQ
FAVFGIADMFTYVGLMEFFYSQAPAALKSMSSSFLWCSLSLGYFMSTIIVKAVNAATRR
STASGGWLAGSINRNHLDLFFWLLAVLSTLNLFNYLFWARWYKYRPQ

Sorghum bicolor Sorbi_30 Sb03g035260

MEERSLAFETESAGEDECFKGNKGGFRALPFIFANEMLEKVAGFGLNTNMITYLT
DKYHLSTVTSQTMLFVWGAISNFAPIPGAIVADMYLGRFMAVALGSVACLIGMVFLWL
TATVPGARPPPCNGDQCAPPGARHLAWLLAGFAFLSLGAGGVRPCSMAFGADQFSRHP
KQRRLRILQAYFNAYYASIGVAFMVAVTAIVYLQDNVSWNVGFAVPMGLMLLSTVSFF
LGSGLYIKEKGKRQMFAGIGAAVGAAIRNRGARLPDKTVDGVYHHLKDCKLAVPTDKL
RFLNKACLLRATKEDAPCNGSDAAASERHGHDGKRPCTVDQVEQLKSAIRVLPIWSSTI
FLALAMNQSFAVKQADTMDRRVGAGGFRVPSGSLAVFNMATMSLWSASYDRWVAPA
LQRYTGNQRGLTMKQRIGGGLLLATASTAVSAAVEGARRRLALSGVTISAFWLVPQFA
LVGLAEAFGVIGEIEFFYTELPKSMASFSMSLLYMAFGVGNLAGALIVKVVQVASMRGG
RTGWLVDDLNAGHYDYYYWLLTGYGVANFVYFAWCCWVYGEEGKNVEWEEEGNTE
QP

Sorghum bicolor Sorbi_31 Sb03g035270

MEVSAMEDAFPKATARRKGGLRTIPFIISNEIFEKVATFGLTANMILYLIERYLMS
SAVATEVLYFWNAISNFLPIFGGVLADVRLGRFRVIALGSCVSLCGMCLLCLTAILPVYK
KTPECAAGSGCVVLPWQLPLLFTSFALMSLGSGGIRPCTLAFGADQLDKRDNSAKNVRT
LQTFFNWYYTVLGLSIVFAATVIVYIQQARGWVVGFAVPVVLMVTALTLFLLGSPFYVK
EAADRSVIIGFVQVLVASYKNRREPLPPETADSSSFYNKAGCKPRTPTNKLRYLNRACVL
RNPGKVDGAACDPWRLCTVQQVEDAKAVIRVLPIWSTGIMPGVVVGQQMFPTLQAKT
MERRVGKLDIPAASFGVFAILTLTVWVAVYDRVLVRPLSRLTGHARGLSLRQRMGAGL
ALFAVAMAVAAHTESVRRAAAIAQGLLDRGKEKEEPVVHMSAMKLVPQHCLTGLAEG
LNLIGQIEFYYSEFPKTMSSIGVSLLALGLGFGAVLGSAIVGVIHAGTAWLPSNLNEGHY
DRYYLVLAVLCAANVVYFVVCGWAYGEEGKNRVVAADAAAAEDDQEEEEEHKAGII

Sorghum bicolor Sorbi_32 Sb03g041190

MDANTLLLPCSDGAVAGAVDFRGRPASRSGTGRWSAAMFVLGVEIAERFAYHG
VSANLISYLTGPLGESTAGAAAAINAWSGVATMLPLLMACVADAWLGRYRTIVLASLL
FVVSMGMLTVSALPAFHHDGCSSYASSSLACSPSPAQVGVFYVSLYLVALAEAGHKPC
AQAFGADQFDQNDPKESVSRSSFFNWWYFGMCSGTAVTTMVSSYIQDNVGWGLGFGIP
CLVMVFALLMFLLGTRNYRYYTSTESSPFARLARAFIALIKGSKSSQSDGTLASDDDAG
HREEVKGVLRLFPIWATCIIYAVIFSQSSTFFTKQAATLDRRIGPTLRVPPAALQTFISVTI

MVFIPVYDRAFVPLARRLTRLSSGITMLQRIGTGLVLALVAMVVAALVEMRRLGVARD
AGLVDQPKAALPMSLWWMVPQYVLFGLSDVFAMIGLQEFFYDQVPDALRSLGLALFLS
IFGVGHLFSSFIISAIDGATKKSGASWFSNNLNRAHLDYFYWLLAGLCAVELAAFVIVSR
VYVYKKRVSHDNNDAVM

Sorghum bicolor Sorbi_33 Sb03g041200

MCHRSELLSLVLYQPAMVDTVAGATDYRGQPASRAATGGWKPSVFVMAMEIA
ERFAYKGVAANLITYLTGPLGQPMARAAASIDAWKGVSQMLPLPLACVADAWLGRYR
AIVLASLIFVVSMGSLSLSAALPALRGGHVAIFYVALYLVALGEGAHKPCAQAFAADQY
DEKDPKESVARSSFFNWWYFGMCAGTAVTTMVSSYVQDNVGWGLGFGIPCIVIVASLA
LFLLGTRSYRFYTTTEASPFSRVGNALLALIHSWAPKHRTRKLGDGDEDNAVAVEEVKS
VLRLLPIWASCIIYAIIFSQTSTFFTKQAATLDRRIGARFKVPPAALQTFISVSIVVFIPVYD
RLFVPLARRYTGRPTGITMLQRVGAGLALSLVAVALSALVEMKRLRVATEAGLVNTPK
AQLPMTLWWMVPQYILIGVADVFAMIGLQEFFYDQVPDAVRSLGLALFLSIFGVGHLLS
SLLISVIDKTTARSGTSWFSNNLNRAHLDYFYWLLTGLCAVELVAFVLFSRVYAYKRKS
GNDGGSGDLV

Sorghum bicolor Sorbi_34 Sb03g043020

MEMEAVESNGSHGAADRRTPKRDHRIFWASVFILANNCFQCIAYFGVSTNLVNY
LKDQLHEGSKAAANGVTNWLGTSSITPLVAAFLADAFLGRYWTIALFMVISVVAYVVL
TVSAAVALESAAFYAGLYLLALGGALQPVLSSFGANQFDESDEGERGRQSSFFNWFYLS
INVGSLVGGTVLVWVQSSVSWGLGYGIPALFSVLAAAVFLAGTTAYRRHQPPAGSPLTR
VAQVVVAAFRKCGVEVPEDASTLHECEDVDGMSAIQGSRRLAHTDQFRFLDKAAVETA
ADKAARPSSSWRLCTVTQVEELKCVLRLLPVWASGIIFAAAYTQMTTTFILQGDTLDPY
VGGFRVPAAVLSVFDTLSVMLWVPLYDRVVVPLARRATGHDRGFTQLARMGVGLVVL
TLAMLAAGALEVARRGVIARHGMYDTNTGGGGDDGRYLPLSIFWQVPQYVVVGASEV
FTFIGQMEFFYDQAPDAMRSLCSGLSMTSFALGNYVSSALVTVVARATARGGRDGWIP
DDINRAHLDYFFWLLAMLCVGNFGVYLLIARWYTYKKSVG

Sorghum bicolor Sorbi_35 Sb04g024090

MVSAGVHGGGGDGQEAVDFRGNPVDKSRTGGWLGAGLILGTELAERVCVMGIS
MNLVTYLVGELHLSNSKSANVVTNFMGTLNLLALVGGFLADAKLGRYLTIAISATVAA
TGVSLLTVDTTVPSMRPPACANARGPRAHQDCVPATGGQLALLYAALYTVAAGAGGL
KANVSGFGSDQFDAGDPREERAMVFFFNRFYFCVSLGSLFAVTVLVYVQDNVGRCWG
YGVSAVAMLLAVAVLVAGTPRYRYRRPQGSPLTVIGRVLATAWRKRRLTLPADAAEL
HGFAAAKVAHTDRLRCLDKAAIVEADLSAPAGKQQQQASAPASTVTEVEEVKMVVKL
LPIWSTCILFWTVYSQMTTFSVEQATRMDRHLRPGSSFAVPAGSLSVFLFISILLFTSLNER
LLVPLAARLTGRPQGLTSLQRVGTGLALSVAAMAVSALVEKKRRDASNGPGHVAISAF
WLVPQFFLVGAGEAFAYVGQLEFFIREAPERMKSMSTGLFLVTLSMGFFLSSFLVFAVD
AVTGGAWIRNNLDRGRLDLFYWMLAVLGVANFAVFIVFARRHQYKASNLPAAVAPDG
AARKKETDDFVAVAEAVEGMDV

Sorghum bicolor Sorbi_36 Sb04g029890

MDPTTIDSKWTSPITEDGSMDRRGNPAVKTTTGGWRSAILLLANYGLATCAFFG
VGVNLVVFLRRVLHQGNAEAANNISKWTGTVYIFSLIGAFLSDSYWGRYVTCAIFQIIYV
TGLVILSLASWFLLVKPSGCGGVKVHCDEPSAPGVALFYLSTYMIAFGNGGYQPSIATFG
SDQFDETDPKEGRSKVAFFSYFYLALNVGSLFSNTVLVYYEDSGRWVMGFWVSAAAA
ALALVLFLLGTPNYRHFKPSGNPLTRVAQVFVAAFRKWHAEVPRGELLHEVEGEDPKIS
GIRKILHSDELRFLDKAATITEGEKMENPWRLCTVTQVEEVKCILKMLPIWLCTIVYSVV
FTQMASLFVEQGATMDTNIGSFHFPAASMSLFDVLSVLAFIAIYRRVLVPVMARLSGNP
QGLTELQRMGVGLVIGMAAMVVAGVVEVERLKRVAAPDQPSSLSVLWQVPQYALIGA
SEVFMYVGQLEFFNGQAPDGVKSFGSALCMASISLGNYVSIMLVSVVTSLTAGEKRPG
WIPGNLNSGHLDRFYFLLAALSLVDLAVYIACAMWYKGIKLDGGDGDDSRKVSAHV

Sorghum bicolor Sorbi_37 Sb04g031320

MKMRAIVVEGGEMSAPTPTPKQDKCCEYTLDGSVDIKGRPAVKGKSGGWLAGA
LILVNQGLATLAFFGVNVNLVLFLTRVLGQSNEDAANNVSKWTGTVYMFSLIGAFLSDS
YWGRYKTCAIFQAIFVLGLALLSVSSHLYLIRPDGCGMEHAPCGPHSGKELGIFYIALYM
IAFGNGGYQPNIATLGADQFDEDDPAEAHSKVSFFSYFYLALNLGSLFSNTFLSYLEDKG
SWALGFWASTAAAATALLLFLSGTLRYRYFQPGGNPIGRICQVAIAASRKWKAGASTTG
VVSLYEGDEKADAAGGRKLLHTQGFSFLDRAAHADTDSKLGARDPWKLCTVTQVEEV
KSILRLLPIWLCTILYSVVFTQMASLFVVQGAAMRRTTPFSGFSVPPSSMSAFDILAVATT
IFLYRRAICPFLARLTGRPAGPTELQRMGLGLVVGALAMATAGTVEHFRKARATAAMS
SDLHIMWQVPQYALIGVSEVMMYVGQLEFFNGQMPDGLKSFGSALCMMSMSLGNYFS
DVIVSAVTRLTTTRGRSGWIPADLNEGHLDKFYFLLAVLAVADFAVYLVCASRYGSGK
VDGRSSDDEEEGAAGQVTSLPAYA

Sorghum bicolor Sorbi_38 Sb05g007450

MDVESRQGSKGDAMAAAAAAVSVDWRGRTCDPVKHGGMKAAVFVLGIQAFE
MMAIAAVGNNLITYVFGEMHFPLSEAANIVTNFIGTVFLLSLLGGFLSDSYLGSFWTMLI
FGFVELSGFILLAVQAHLPQLRPPPCDMMAAAGQACEQASGLKAGIFFAALYLVALGSG
CLKPNIIAHGADQFRRGSAGDARRLSSYFNAAYFSFCVGELVALTVLVWVQTRSGMDV
GFGVSAAAMAIGLLSLVAGVAFYRNKPPQGSIFTPIAKLHWSLYFYLGQVGRASGSAFH
WVSQQQHTFLDKACVKAPDSTGGSSAGTKESPWRLCTPAEVEQVKLLLCVVPIFACTIV
FNTILAQLQTFSVQQGSAMDTRLAASGFHVPPASLQAIPYIMLVALVPAYEAAFVPAMR
RLTGVATGITPLQRIGVGLFAVTFSMVAAALVEARRRHAADGGRLLSIFWIAPQFLVFGL
SEMFTAVGLIEFFYKQSLAGMQAFLTSMTYCSYSFGFYLSSVLVSLVNRITSSSTSTAGN
GGGGWLANNDLNKDRLDLFYWLLAALSILNFFNYLFWARWYSRSVERVQVVGVGSGG
GAGEQDDEKDTLNAETN

Sorghum bicolor Sorbi_39 Sb05g010070

MGGSSGLVDWRGRPVNPKKHGGVRASIFIHALVLLSNAANIANILNLVSYLREE
MHMDVAKASTIASNFFAALQMFSIPAAFLADSYVKRFYTVLIFGPIEILGYILLAVQAHV
PSLHPPRCVSGQQTTTTCDSVHGSNLSLLLLGLYLIPIGDGAARACLPALGGEQFDTSDP

VEQRQESSFFNWYTFSISTGGFVGLVFIVWVENSKGWDLGFVVCALFVILGMLIWIAGLP
FYRNQLPTGSPITRILQVLVAAFKKRKVALPANPSELKRQDDASALEMLHRTDGFHCLD
KAAVDTGKAGAWTLCSVTQVEETKIILRMVPIFLSAVLGYIPVPLILNFTVQQGNTMDTR
LGAVHISPATLFVIPTVFQMVILVVYDRFIVPFLRRITGYVGGVTHLQRIGIGFLSTIVATGI
AALVEAKRKKVAEDSGLVDATTGIPMSVFWLTIQYFLLGVVDVTSFVGLLEFFYSEASM
GMKSIGSSIFYCILGVSAWLGSLLIQLANRFSRHSDGTGGWLDGTNLNKGKLDRFYWLL
AVLEVVSLLLYGFFAWRYVYRNDQRVVVDGDNNASSDGAINVI

Sorghum bicolor Sorbi_40 Sb06g017470

MDVEMSCAAAVSVDWRGRPCRPRRHGGMRAAVFVLGIQALEIMSIAAVGNNLI
TYVFGEMHFPLSQAANVVTNFVGTIFLLALLGGFLSDSYLGCFWTMLIFGFVELSGFILL
SLQAHLPQLKPPPCNMASSTDVGGGGCEKASGFKSTVLFLALYLVALGSGCLKPNMIAH
GADQFDGGAARRLPTYFNAAYFSFCAGELVALTALVWVQTHSGMDVGFGISAVAMAA
GLVCLVSGAAFYRNKPPQGSIFTPIARVFVAAFTKRKQVCPSNSNSVNAGACEPARLAG
NFRHSNKFRFLDKACIPVAPQGPNTKPESAWRLCTAAQVQQAKTLLAVTPIFACTIIFNT
VLAQLQTFSVQQGSAMDTALPPGSGSFRIPPASLQAIPYAMLLALVPAYELLLVPLMKR
VTGTRSGITPLQRIGVGLGTVAFSMVAAADVERRRRVAAAEGRQMSVLWIVPQFLVFG
VSEMFTAVGLIEFFYKQACAAGMQAFLTALTYCSYAFGFYLSSVLVSLVNRVTARHGG
GGWLGDNDLNKDRLDLFYWMLAALSVLNFFVYLLCARWYNAGADGCDAPASAGQV
ASEVDDGKEII

Sorghum bicolor Sorbi_41 Sb06g021020

MAIRGFVDWRGNPIHREVHGGVRAAMFIYFLTVVTSMVNVPNLLNLVTYLHGT
MHMGVSSSATTVTNFVGATSGFALIGAFLSDSYISRSRTILLFGPLEFLGFGLLALQAYLP
SLHPPSCDIEDERTVCKEVHGWNATLLYATLYISAFGEGCIRACSPSLGADQFDHEDPTE
SRQQSSFFNWYTFGISLGGLVGLILIVWLENYKGWDIGLGLCAILVLLGLIVVATGLPFY
RNQVPEGSPLTRILQVLVVAFRNRRLELPEKLEEAQEISTGAGTIEALSRKNNLKFLDKA
CINRGKDGAWSCCSVAKVEETKIVLRMLPLFVSSMIGYVSNPIILTFTVQQGSMTNTRLG
RIHISPASLFIIPITFQMVMLAIYDRFIVPFLRKRTGYASGITHLQRISLGFACMILASVIAAL
VERKRKDSATQMSLFWLAPQFFLLGVSDVTSFPGLLEFFNSEAPRGMKSIATALFWCEL
GLASLLATFLVKAVNAATRRGHQRGWLEGTSLNNSRLDLFYWVVTVVGLLAFLNYLY
WAKKYVYQQDPRLPDEPSVDQDSP

Sorghum bicolor Sorbi_42 Sb06g021030

MTIRGFVDWRGNPINREVHGGVRAAWFIYFLTVVANIVNVPNMLNMVTYLHGT
IHMGVSRSATTVTNVLGATSGFALIGAFLSDSYITRSRTILIFGPLEFLGYGLLALQAHLPS
LHPPPCNIEAEPSNCKEVHGWNSTLLFAALYISALGDGCMRACMPSLGADQFDHENPSE
SRQQSSFFNWYTFGISFGGFIGLILVVWLQNDKGWDIGFGLCAILILLGLLVVAVGLPFYR
NQIPEGSPLTRILQVVLLPSVLVVAFRNRSLELPEKLEEAQESSTEPGCIEVLPETNSLKVL
DKACINRGKDGVWSLCSRTKVEETKIVLRVLPLFISSIIGYISNPVLFTFTVQQGGMTNTR
LGKIHVSPATLFIIPTIFQMVMLPVYDQFLVPFLRKRTGYASGITHLQRVGIGFTSIILASVI
AAVVERKRKEAAVQMSLFWLTPQFFLLGVSDVTSFPGLLEFFNSEAPRGMKSIAAALFW

CVLGLSSLLATFLVQIVNRATRHGHQAGWLEATSLNSSRLDLFYWVVAVVGFLAFLNY
MFWAKRYVYRHNPRIVVR

Sorghum bicolor Sorbi_43 Sb06g021040

MASGGFVDWRGNLIGRQVHGGVKAAWFLHFLTFVINMVNVPILLNLVTYLRGT
MHMGVSDSATTITNFVGATSGFALIGAFLSDSYITRSRTILLFGPLEFLGYGLLALQAYVP
SLHPPTCNIEDEPSNCKEAHGWNATLFYTALYISAFGEGCIRACLPSLGADQFDHEVPSES
HQQSSFFNWFTFGISFGGFVGLIFIVWLENYKGWDIALGLSAILILLGLLVFAAGLPFYRN
QVPEGSPLARILQVLVVAFRNRRFGLPEELEEAHESSAERGSTKALSQTNSLKFLDKACI
NHGKEGAWSLCSVTKVEETKTVLRMLPLFVSSMIGYVSNPIIFTFTVQQGGMTNTRLGK
IHVSPATLFIIPITFQMVMLAIYDRFIVPFLRRRTGYASGITHLQRIGIGFASMILASVIAAV
VERKRKEAAVQMSLFWLAPQFFLLGVSDVTSFPGLLEFFNSEAPRGMKSIATALFWCEI
GLASLLATFLVQAVNSITRHGHYGGWLEGSSLDSSQLDLFYWVVAVIGLLGFLNYLYW
AKKYVYRQDTRIVDEPSVDQDSH

Sorghum bicolor Sorbi_44 Sb06g021050

MRACIPSLGGDQFSNSDPKKSQLQSMFLTRLKFTNSLGAIIGLAFLVWIENNLGW
DIGFMMCALIVLVGLLVAASGYPFYRMQKPSGSPLTRTLQVLIISSNKKAVANVDVIELQ
ETNTQDHVFKFGTNQADETKVLIQMLPVFISCFLVYLPFTLLMTLSIQVGRAMDKGAGVI
QIPSASLIAIPTTFHVLMQPCYSRILTILLRRTTGHEHGVTPLQRIGAGSICGIAAACVATLV
EARRLNVAKQQGLTSIGTGVPMSIFWLVIQFFLLSIMDIASFGGLIEFIESEAPSTMKPIAP
AVQSCIAGLAAWSCSGFIQLVNRMTRSGNGGGGWLDGTNFNKTRLDHFFLLLGAFELL
ALINYTFWARRYARKLRRISTVETHEDDTRH

Sorghum bicolor Sorbi_45 Sb06g023230

MACEGLVDWKGKPINTKVHGGVRAAWYLYFLIVVNFLVHVPNLQNMTTYLRE
VMHMGVSDASTTLTNFIGAMCGFALLGGFLSDSYITCARTMLLSVPLVILGYGLLTLQS
HFPWLHPAPCNPSEAAADATSGSSSCRQVDGWRSAMLYTSLYTIALGEGVMRACIPAL
GSDQFDGDNPSEARQQSSFFNWFTFCLSIGSVAGLILVVWLEDTRGWDIGFGLSALLILV
ALLVSAAGLPLYRNRVPQGSALTRVLQVFVVAFKNRKLQIPEKKMEETQQNSYGADSQ
QVPCHTPTTNNSLKFLDKACVETNTGGGEGEGDGPWSVCSAAKVEETKIVLRMLPLVFS
ATVAHVSSSLLIAFTVQQGATTNTKLGKVHVYPAMLFIIPSIFQTLMLVAYDRLLVPLLR
RRTGYTGGITQLQRVAVGFLAASVAPAVAAVVERKRKDTVAAAGGHISLFWLAPQFFLI
GVEDTTAFAGLLEFFTAEAPDGMKSIGVAFFWCQAGMASLLGTLLVRLVNRVTHSSSAP
GWLEGKDLNSSHLDLFYWVVTAVSFLGWLNYLYWANRYKYRHDPRISTKSPDEEDSM
P

Sorghum bicolor Sorbi_46 Sb06g027310

MDAGDAMEKGQPERGSPKIQDESLTVPLIQDKKTGSKAPAVVLAFECLESTAFN
GIGTNLVVYLETVLHGSNLASASSVTSWFGTSYLTPIFGAIVADTFWGNYNTILVSLLVY
LLGMMLVTFSAFLPTTELCGVGSSCHPVLGSQNVAFLGLYLVAFGSGGVRAALLPFGAE
QFDDDNAVDRERKMSFFSWFYICVDFGMIISGVFIVWIQQNISWGLGFGIATACVALAFG

GFVLATPMYKRRMPTGTPLKSLGQVVVAAFRKVSLRVPADAGLLYEVHDMIEQPKIAH
TDEFGFLDKAAVVAESDDPEEVTNDAAAAAAGSSSWRLCTVTQVEELKILLRLLPIWAT
SIVLSAAYAQLNTTFVQQGGVMDMRVMSSLTVPAASMVSFEVLCVLAWVLIYDAVILP
ALRAISPARGEPSQLQRMGAGRLLMACAMAVAALVEMRRLDAAGRGESISIAWQMPQ
YFVLAGGEVFCYIAQLEFFYDEAPETMKSMCTSFALLTVALGSYMSSLIYAVVDALTAT
GGGGRPGWISDNLDEGHLDYFFWTMAALCTLNFVVYSGFARNYKVKTVVS

Sorghum bicolor Sorbi_47 Sb07g003690

MVGLLPETNAAAETDVLLDAWDFKGRPAPRATTGRWGAAAMILVAELNERLTT
LGIAVNLVTYLTGTMHLGNAESANVVTNFMGTSFMLCLLGGFVADSFLGRYLTIAIFTAI
QASGVTILTISTAAPGLRPAACSANAGDGECARASGAQLGVMYLALYLTALGTGGLKSS
VSGFGSDQFDESDRGEKHQMMRFFNWFFFISLGSLLAVTVLVYVQDNLGRRWGYGAC
ACAIAAGLVIFLAGTRRYRFKKLVGSPLTQIAAVVVAAWRKRRLPLPADPAMLYDIDVG
KAAAVEEGSGKKSKRKERLPHTDQFRFLDHAAINEEPAAQPSKWRLSTLTDVEEVKTV
VRMLPIWATTIMFWTVYAQMTTFSVSQATTMDRHIGSSFQIPAGSLTVFFVGSILLTVPV
YDRIVVPVARRVSGNPHGLTPLQRIGVGLALSVIAMAGAALTEIKRLHVARDAAVPAGG
VVPMSVFWLIPQFFLVGAGEAFTYIGQLDFFLRECPKGMKTMSTGLFLSTLSLGFFVSSA
LVAAVHKVTGDRHPWIADDLNKGRLDNFYWLLAVICLANLLVYLVAARWYKYKAGR
PGADGSVNGVEMADEPMLH

Sorghum bicolor Sorbi_48 Sb07g005100

MACEGLVDWRGKPINTKVHGGVRAAWYLYFLIVVNFLVHVPNMQNMTTYLRG
PMHMGVSDASTTFTNFIGAMSGFALLGGFLSDSYITCARTMLLSVPLVILGYGLLTLQSH
FPSLHPPPCNDSDSEASSCRQVDGWRSTLLYTALYIIALGEGVMRACIPALGSDQFDGDN
PSEARQQSSFFNWFTFCLSVGSVAGLILIVWLENTRGWDVGFGLSALLILIALLVSAAGL
PLYRNRVPQGSALTRVLQVFVVAFKNRKLGLPDKMEETQQNSHEVDSQEVPCPTTNHS
LKFLDKACCANTNTGRDDGPWSVCSAAKVEETKIVLRMLPLVFSSTVAHVSTPLLVAFT
IQQGMTTNTKLGKVHVYPAMLFIVPSIFQTLMLVTYDRVLVPLVRRRTGYTGGITQLQR
VAVGFLATTVAPGVAAVVERKRKDTVAAGGQISIFWLAPQFFLIGVADTTSFVGLLEFF
TGEAPDGMKSIGVAFFWCQAGMASLLGTLLVRLVNRVTHSGSAPGWLEGKNLNSSHL
DLFYCVVTAVSFLGWLNYLYWAKRYKYRQDPRISTKSPDEDDSTMP

Sorghum bicolor Sorbi_49 Sb07g006540

MLTMAGSCEPASGSKAAIFFVALYLVALGTGCVMPNMTTYGGDQFAGAAAEK
DASKRLSTYFNLSYFGYCVAEVVALTAVVWAQTRFGMAVGFGLAAAALGAGLVTLVS
GAVLYRNKPPRGSVIFTPIARVFVAAFSKRKQICPSGSSNPAHTAAGDPAVVDGDGDFR
HANKFRFLDKACIRDAADTVPESEWRLCTAAEVQQTKTLLAVLPIVACTIVTNTVLAQL
QTFSVQQGSVMDTRLAPGSSSSFRIPPASLQAIPYAMLLALVPAYELLLVPLMRRLTGTR
SGITPLQRIGVGLCLVALSMASAAAVERRRRDAALSSRQLSVLWLVPQFFVFGVSELFTN
VGLMEFFYKQAATAGTMQMQAFFMAFFYCSFSFGFFLSSVLVSLVNRVTASGGRRGWL
GDNDLNKDRLDLFYWVLAALSVLNFFCYLLCARWYNSGAGGSETDEAVAPGEIASEEE
DDDKGLI

Sorghum bicolor Sorbi_50 Sb07g028040

MRTGSWRSAIFIIVAEIGERFAFYAVAANLITFLTGPLQEGIAAAAAATNAWNGT
ALMLPLLGGAIADLWLGRYLTIILASLLYTLGLGLLAVSTLVGQHCNTATTAGEKCPPPP
TVQVTLFYASLYMVAVGEGGHKPCTHAFGADQFSQSDPGESVSRGSFFNWWYFGVCA
GTAGTLLVVSYVQENLSWGLAFAIPCAVMAFTLVVFLLGTRTYRYADTSGTRNLFAHA
GEAFTGWRRRQRRRQCMPRASHRGVGVSAQELEISRVDEEAQVAAATTTTNAAGEAK
DVLRLFPIWAMTLVYAVVYSQSMTFFTKQAATLDRRVGEVVKVPPAALLSFISISIMVL
VPVYDRVVVPLSRRYTGRPSGITMLQRIGAGMFLSVVSTVIAALVEERRLRVARDAGLT
DKPKAQLPMSLWWMVPQYVVFGAADVFAMVGLQEFFYDQVPDRLRSIGLALYISIFGI
GSFVSSALVSGIHRATAASGQSWFSDNLNHGHLDYFYWLLAALSALQFFAYVFFAWRY
KYKNVGDEHM

Sorghum bicolor Sorbi_51 Sb08g007700

MALQCLVDWKGRPVNPNRHGGVKATMFIYFLVVMTNIGNIPMLLNVVSYLHGK
MHMGIADASTTATNFFGAICVFTFFGAFISDSYVKRFYTILIFAPIEILGYMLLACQAHFPA
LHPPPCDIVNHPSECTAVSGRNLSLLTLGLYVIPIGEGAVRVCAAALGGDQFDGDDPREL
RGKTSFFNWYAFCISLGGFVGLVFVVWVQNSEGWDLGFVLSALVALLGMLVLVAGLPF
YRHQKPTGSPLTRILQVFVAAFRKRNLSVPEDLVGMHETTSIEVLERTSGFKFLDKAAVD
DGDARRWSQCTVTQVEEAKIILRMLPVFVSSVLGYLPIPLLLTFTVQQGGTMDTRLGGT
HVPPASLFVIPIVFQMLILVVYDRAVVPWLRRATGYAGGITHLQRIGVGFASNVVALAV
AAAVEARRRRHGGAAAAEMSVFWLTPQFFLLGVMDVTSFVGLLEFFYSEASAGMKSIG
GAVFFCILGVASWLGSVLIRVVNRVTARHGAGTGWLDGASLSAGRLDLFYWLLALFGL
VALLLYLLCAWRYTYRYHPSRMQSAMEDHRVSPASKKLDAAL

Sorghum bicolor Sorbi_52 Sb08g007710

MALQGLVDWKGQPVTGKRHGGVKASVFIHVLIVMANISNIPLILNLVSYLHGTM
HMGVKDASTTSTNFFGAICFFSFLGAFISDSYIKRFYTILIFAPIEIMGYVLLACQAHFPSL
HPPPCDMINHPNDCSVVSGRNLSLLTLGLYLIPVGEGSMRACAAALGGDQFDGEDPAEL
HAKISYFNWFAFSISLGGFVGLVFLVWVQDNEGWGLSFALAALMVFVGMVVVASGLPF
YRHQKPMGSPLTRIFQVFVAAFRKRKLAIPENLMEMHELTDGTGKTAEFMERTPDFMFL
DKAAVDNGDKRAWSLCTVTQVEEAKIILRMMPIFLSSILGNVSIPLLLSLTVQQGGTMDT
RLGGTSIPAASLFVVPIVFQMLTLVAYDRAIVPWLRRVTGRAGGVTHLQRVGVGFVFSV
MALAVAAVVEGRRRRTMAAATPMSVFWLIPQFFLLGVMDVTSFVGLLEFFYSEASAG
MKSIGGAIVFCILGVSSWLGSFLIQVVNHATAHRGGGHGRLDGANLNASRLDLFYYWLL
AVFGLVSFFLYLLCSWSYVYRHDPRMQDATLDDDI

Sorghum bicolor Sorbi_53 Sb08g007720

MALQGLVDWRGHPVNQKKQGGVRASVFIHFLIVMSNMANIPMIMNLVTYLHGT
MHMDVKDASTTSTNFFGAICFFCFLGAFISDSYIKRFYTMLIFAPIEILGYMLLAYQAHVP
SLHPPPCDMINNPSDCTPVSGRNLSLLTLGLYLIPLGESSLRTCAAALGGDQFDEDTPSEL
PGKISFFNWFEISISLGAMVGVVFLVWVQDNVGWDLGFALAALMVLAGTLGVAVGLPF
YRHQKPAGSPITRILQVFVAAFRKRKLRVPENLMEMHNKVTDGTGTSVEFVDRATGGF

MFLDKAAVNDGDTRAWSLCTVAQVEEAKTILRMIPIFLASILAYIPFSLLLSLTVEQAGT
MDTRLGGIAVPPASLTVIPVTVQVLILLVYDRAVVPWLRRATGYAGGVTHLQRAGVGF
ASSVLAIATAAVVEDQRRRRRRSGGPPVSAFWLAPQFVLLCVLDVTSFVGLLEFFYSEVS
TGMKSIGGSVVFCILGVASWLGSLLIQVVNDVTARRAGHGWLGGANLDASRLDLFYWL
LAVLGLVSFGLYVLCAWSYTYRHDPRMQATTTMDSSEVADDQHTC

Sorghum bicolor Sorbi_54 Sb08g022290

MAQQHDKASTFAAAQEMATTTKTKQQLSDDESDAGEPEENYRGWKSMPYVIG
NETCEKLGTIGTTANLLVYLTTVYGMTGASAATLLNLWSGTVSMAPLLGAFLSDSYLG
RYTTIAFASVASFLGMIILTLTAAVPSLHPNDPTAGAPHPNNGPSSLQMAVLLASFALLA
VGAGGIRPCNLAFGADQFDPRTPAGRRGINSFFNWYYFTFTIAMMISATVIIYLQSDVNW
ALGLAVPATLMGVSCVLFFMGTRLYVRVRPDGSPFTSFAQVLVAAARNRRLPAPPSPAD
DLYDPPHRSSLVSKIAYTHQFLCLDKAAVRTSTTSDDHHPWRLCTLQQVEEVKCLARLL
PVWSSGIVYYIVLTNLGNYNVLQAMQTDRHVVAGGSFQIPAGSFVVFNMLALTLWLPF
YDGVLVPAMQRVTKREGGITQLQRIGVGIVLSIVTMLVAAAVERHRRRVGDATSCFLLV
PQQMLAGLSEAFAIIGQVEFYYKQFPENMRSVAGALLSLGFAIASYASGLMVSVVHRTT
GGGRDGRPDWLAQDLNQGRVDLYYLLIAAMAAVNLVYFVVCARWYRFKKPAAAAHA
DADVELELEGKAAAPPV

Sorghum bicolor Sorbi_55 Sb08g023060

MKQLSHDDDDDESSDAGEPAENYRGWKSMPYVIGNETCEKLGTIGTTANLLVY
LTTVYGMTGANAATLLSLWSGTVNLAPLLGAFLSDSYLGRYTTIALASVASFLGMIILTL
TAAVPSLHPINNGPSSSLQMAVLLSSFALLAVGAGGIRPCNLAFGADQFDPRTPAGRRGI
NSFFNWYYFTFTIAMMISATVIIYLQSDVNWALGLAVPATLMGLSCALFFMGTRLYVRV
RPEGSPFTSFAQVLVAAARNRRLPAPSPADLYDPPHRSSLVSKIAYTHQFLCLDKAAVRT
DDVDNKPVNPWRLCTLQQVEEVKCLARLLPVWSSGIVYYIVLTNLGNYNVLQAMQTD
RHVARGSSFQIPAGSFVVFNMLALTLWLPFYDGVLVPAMQRVTKREGGITQLQRIGVGI
VLSIVTMLVAAAVERHRRRVGDATSCFLLVPQQMLAGLSEAFAVIGQVDFYYKQFPEN
MRSVAGALLFLGFAIASYASGLMVTVVHHTTGGSDGRPDWLAQDLNKGRVDLFYLLIA
AMAAVNLVYFVVCARWYRFKKPAAAADVELELEGKAAAPPPV

Sorghum bicolor Sorbi_56 Sb09g016180

MVSVYSISNSMYDSWLGLTGRLLQGMVLITLAVSLKSLHPQCTPDGACAAASRQ
QVAFFYGAFYTMAIGAGGTKPNISTFGADQFDDFDARAREVKASFFNWWMFSSFTGGL
VAVLVLVFVQENVGWGVGYTIPTVGLALSLLLFYVGTPFYRHKPVQRDTAAGPARLVG
RVFSEAFANRRRRLPGDAAELQEHDTAWYTAAGKRRLLHTRAFPFLDRASLRSDTRRLP
CTVTEVEEVKLIIGMIAVWLSTLVPCTIWAQVNTLFVKQGTTLDRSMGGVRIPAASLGSF
VTISMLLCIPAYDRVLVPLVRRRTGNPRGITLLQRLGIGCALQVLVVACAYLVEVRRMR
VIRERSVHRAGDTVPMSIFWMLPQYVLLGVGDVFNSVGILEFFYDQSPDGMRSLGTTFF
TSGLGVGNFLNSLLVTFVDRTTRGRGTAGKSWIGDNLNDSHLDYYYVFLLLLSVLNMA
MFVWVAKRYKYKREFLEVEHRESENACDQGSGKLMDAPLTINGAQPGSHQ

Sorghum bicolor Sorbi_57 Sb09g020240

MPCSACEHHTHQSLAITSSESSLHPAMATTTAVGRNGEGEQKRREKGGFKTMPFI
LGNDICDRFATAGFGANLITYLTKQLHLPLVEASNLLTNFGGTSSLTTILGALAADSFAG
RFWTIVAGSVFYQLGMLGLVVSALLPWLRPSPCSAPPGGPECHRASGLQLAVLYLSLLC
TAFGSGGLRPCVVMFGTDQFDHETSEKQVTAEAAEAVAERKRRYFNLYFFTMGVAALL
ALTVVVYIQDNVGWGWGFGIPAIAMFVSIVVFVIGYPLYVQVKPGGSPFTRLAQVAAA
AFKKRNAAVPEDTGMLYQDKELDVLISTNGRLLHTNQLTFLDRAAIVTPGDISASGQPD
LWRLSTVHRVEELKSIVRMLPIWSAGIMLSTIESHNGTFIIVQAGSMDRHITRHFEIPPAT
MSIFGTAVFLVSLALYDRAFVPLARRVTGLQSGITYFQRMGVGLAIHILGVATAALVETK
RRHAAADHGLLDNPTAVIPLSVFWLVPQFAVHGVAGAFSSVGHMEFLYDQAPESMRST
AAALFWLAGAFGNYLGTVLVTVVQRTTRARGNDWLQDNINRGRIDNYYWLVTCLMV
LNLGYFLICFRFYTMKPLEMADEQDDHDGECELSTLQKNDTGAGGVV

Sorghum bicolor Sorbi_58 Sb09g020250

MATTTTTVGSKNGEGEQKRREKGGFKTMPFILGNDICDKFASTGFGANFITYLTD
QLHMPMVEASILLTNFGGTSSLTPILGALAADSFAGRFWTIIVGSVFYQLGMLGLLVSAL
LPSLRPSPCSAPPSGAGCQRASGLQLTVLYLSLLCKSVGTGGLRPCVVMFGTDQFDHEP
GPGAEQQQQVVTAEAAEAVAERKRRYFNLYFFAMGVASLLALTVVVYIQDNVGWGW
GFGIPAIAMFVSIVVFLIGYPLYVRLKPGGSPFTRLAQVAAAAFKKRNAVVPEDTGMLY
QDKELDVLISTNGRLLHTNQLTFLDRAAIVTPGDISASGQLDLWRLSTVHRVEELKCIVR
LLPIWSAGIMLATVEAHGPFTILQARTMDRHITQHFEIPAATMSIFGTMAFLVSLALYDR
AFVPLARRVTGLQSGITYFQRMGIGLAIHILGVATAALVETRRRHAAADHGLLDKPTAV
VPLSVFWLVPQFAVNGVAGAFSSVAQLEFLYDQAPESMRSTAAALFWLSSSIGHYLSTV
LVTVVQRTTRAHGNDWLQDNINRGRIDNYYWLVTCLMVLNLGYYLICFQFYTTMKPLE
MADEKDDHDAECELCALQKNGTGAGGAV

Sorghum bicolor Sorbi_59 Sb09g020280

MGTTTATMDRNNADGGLGRRKKGGFRTMPLILASEVCDRFATAGFSANLITYLT
QQLHLPMVEASNTLTNFGGTSAFTPILGAFAADSFAGRFWTIIAGSVVYQFGMIGVVVS
ALLPSLRPPPCKPPATPCQRASGWQLALLYLSLLLTSLGSGGIRPCVVAFGADQFEQDSS
GAAEAAAKAEAERKRRYFNLYFFTMGFAVLLALTVVVYIQENVGWGWGFGIPAIGMFI
SIVVFLAGYPLYVLLRPGGSPFTRLAQVVAAAFKKRNAAVPEDPGLLYQDKELDALIST
NGRLLHTNQLTFFDRAAIVTPGDITPSGQPDLWRLSTVHRVEELKSILRLLPIWSAGIMLA
TAGSHNYTFTIMQARTMDRHLGPGHFQLPPATLTIFSTAAMLVTLAFYDRVFVPLARRV
TGLPSGITYFQRMGIGLAISVLSVASAALVETKRRDAAARHGLLDSPAAVVPISVFWLVP
QFAVHGIGDAFSSVAHMEFLYDQAPESMRSSAVALFWLAGSIGSYMGTVLVTAVQSAT
RGAWLQDNINKGRLDYYYWLVTCIMVLNFGYFLVCFYFYTMKPLEVAGDDNGGDHD
KECELSSSSLRKNGGGGTGGGMV

Sorghum bicolor Sorbi_60 Sb09g020290

MATAALADEDGSPKKTKQGGFKTMPFILANEICDRFATAGFNANMITYLTQQLH
LPLVEASNLLTNFNGTAAFTPVLGAIIADSCAGRFWTIAGGGALYQLGMLGLVVSALVP

ALRPASCSAGAGAGATATACQRAGAGQLAMLYVSLLLTALGGGGIRPCVVAFGADQF
ALRGTGRRPGGDQKWSYFNLYFFSMGLAVLLALTVVVYIQENVGWGWGFGIPAIAMF
VSVLSFVVGYPLYVKVKPEGSPFKRLLQVLVAAFKKRKESVPEDVGLLYQNKELDAAIA
ADGRLLHTDQLRFLDRAAVLTTGDVVSDSGEPDLWRVSTVHRVEELKSIVRMLPLWAA
SITLVAAASHNFTFAIQQARTMDRHLTPRFQIPPATMIIFTTLTMLVSLALYDRVFVPVAR
RYTGRRSGVTYFQRMGAGFAVSVLGVMAGALVESRRRRVAREHGLVDSPGAVVPISVF
WLVPQYALHGMSDALSTVGHMEFLYDQSPESMRSSAAALFWVAGSLGNYLGTVLVTV
VQSATRGVWLQDNINKGRLDYYYWLVTFLLVLNLFYYIVCFHFYTLKTFEVDAGRTNG
GEEQVGERQAEAAEPCHVQVASF

Sorghum bicolor Sorbi_61 Sb09g020300

MAEDARGEKKDADLSAAVKMPAKQRGGFRTMPFILANDFCDRLASVGFTTNLIS
YLTLQLHLPLVQASNIITNYNGTANLTPLIGGLIADSFAGRFWTITFGSIIYQLGMVCLTLS
AALPSLHPPPCAKHAADCQRASSYQISVLYLSLLCTSIGTGGTRPCTMAFGADQLELNDA
HSRHKPKWSFFNLYFFAVELAKLAAVTAVVYIQDNVGWGWGIGVPTVAMVAAVIIFVS
GYKLYIRMPPGGSPLVRLAQVATAAYKKRNAVVPDPSLLYEDKELDAGISTTGRLLHTD
QLKFFDKAAIVTDGDVLPSGQPNLWRLSTVHRVEELKSIIRMLPICAAGIILVTSASHNHS
FAIQQARTMDRDITPHFKIPPASMLIFTNVGMLLTLAFYDRVLVRVLRRFTGRPNGITHL
QRTGVGLTIAMLSNVVAAVVERRRKSVAAASGLLDAPKGATLPMSVFWLVPQYAIHG
VANAFMDVGRMEFLYDQAPESMRSTATALYWLTFSIGSYLGTLLVTIVHDKTRRSGQW
LPDNLNRGKLDNYYWLVVALEVVNLVYFFICAKYYTFKPLEMVSGEEVELHHHGNGN
GTDDAKKQGASFK

Sorghum bicolor Sorbi_62 Sb09g021320

MASDSGPASSDPLLPGRRAPSTGGWKSALFIIWVEVAERFAYYGISSNLISYLTGP
LGQTTAAAAAAVNAWSGAASMLPLLGAAVADSWLGRYRTIVASSVLYITGLGMLTLSS
MFSSPQQCRDSADGQGVCPPSSLQTAFFYISLYLVAIAQSGHKPCVQAFGADQFDATDP
DESVSRASFFNWWYMGLCTSATVTIALMSYVQDNIGWALGFGVPSLAMLLALAIFLLG
TRTYRFYGGGGSASASTFSLVRKAFVAWRIQKRSREAGSVELGHGDGELPQDAVLAEE
VKGLARLFPIWATCLLYGVVFAQPPTLFTKQAATLDRRIGQSFQVPPAALQCFLGTSIIAC
IVLYDRVLVPVARGVSGVASGITMLQRIGTGIALSLVTLVVAALVEMKRLRVARDAATA
SGGLLVVVVDGSGTSAVPMSLWWIVPQYVLLGAAEVFIMVGMQEFFYDQVPGALKSL
GLALYLSVLGVGSFISSFLITVIDGVTTRNGGTSWFADDLNRGHLDYFYLLLAALTALEL
LAFAYFSTSYVYKAKAGNH

Sorghum bicolor Sorbi_63 Sb09g021330

MPSGSDDYSDPLLAARADGSMAGGDAAALDYRGRPADRGATGGWRSALFIIAV
EIAERFTFYGVSSNLINYLTGPLGEGTAAAAAAINAWNGVAQLLPLLGGALADKWLGR
YRTIVIASLLYVLGLGMLAFSTMLSSGSGHQCTTARGQTQTCAPSTLKATFFYVSLYIVA
VAQGGHKPCVQAFGADQFDQSDPKETVSRSSFFNWWYFGMCAGTAVTLVLLSYVQDN
IGWGLGFGIPCAVMAAALAVFLLGTRTYRYYVTAGERGLFARAAEAFAEWRSRRKTLQ
HRDRPAAEGALGFSAGVDEEEQAAVSNSAGLVKEAKAIIRLFPIWATCLLYAVAFSQSS

TFFTKQAATLDRRIGRHGLQVPPAALQSFISITIVVFIPIYDRVLVPVSRRYSGKPSGITML
QRIGTGMLLSLLSMVIAALVEKHRLGVARDAGLVDKPKVPLPMSLWWMVPQYVLFGA
ADVFTMVGLQEFFYDQVPDKLRSLGLALYLSIFGVGSFISSALVSVIDRVTTARGGSWFN
NNLNRGHVDYFYWLLAALSAVELLAYVFFAVTYKYKNKRAVHATVES

Sorghum bicolor Sorbi_64 Sb10g009530

MAMEETSKITGRKKGGLRTMPFIFANEVAEKLAVVGFSTNMLTYLTTQLHMPLA
KAATTLTNFGGTSAATPLIGAFLADACIGRFWTIAAASVVYQVGMALLTVSAALPQFRP
PPCKPGGAVTCQEAAPWQLAVLYVSLLLNAVGAGGYRPCIVAFGADQFDESRAAERAR
SWGFFNWYYFCNGASMLLAVTAVVYVQDNVGWGWGLGVPAFCMGVSVAAFVAGYP
MYRRLEPAGSPFTRLAQVVVAAVKKRRLPAADVVPARLYENDDLDAPISMYGKLVHT
DQLSFFDRAAIVTDGDMVTQTDADSGKPSAAPVPNPWRLSTVHRVEELKSVIRMGPIW
AAGILVITGSSTQHTFSLQQASTMDRRLAPGLSTFQIPAGSMTVFALLAMLLTLFLYDRV
LVRVARRFTGLDRGISFLHRMGVGFAISVVATLVAGFVERHRRDAAAAVAGATDAGTS
PLSAYWLVPQYALHGVAEAFTSVGHLEFMYDQAPESMRSTATALFWLSISLGSYASTLL
VDAVHHWSAGPGGANWLPDNINHGRLDYFYWVVTMLQVMNLIYYAICAKRFRYKPV
QLHKKEEEESGKALVELQEKV

Sorghum bicolor Sorbi_65 Sb10g011200

MATTPTEGDGEQSKWKQGGYKTLPFIMANEICDRFATAGFNANLITYLTQQLHM
PLVEASNTLTNFGGTTSLTVVLGAFAADAFIGRFWSIVAGSLFYQLGMLGLVMSAVVPS
LRPAPCPASTPAACPRASGGQLAVLYLSMLCACLGTGGIRPSVVAFGADQFDDDQHGA
AAAAAWADRKRRYFNVYFFTMGSAALLALTLVVYIQDNVGWGWGFGIPAISMFVSIV
VFLVAYPLYVRAKPGGSPFTRLLQVLVAAFRKRNAAVPEDTGMLYQDKELDALISTKG
RLLHTDKLRFLDRAAIVTPGDVSESGGRPNPWRLSTVHRVEELKSIARMLPIWSAGIVLA
TAGSHNGSFTIMQARTMERHITGSLEIPPATLSIFTTGTTLVSIILYDRVFVPVARCVTGRP
SGVTYFQRMGIGLTIAVFGVGAAALVETRRRGVAADHGLLDTPKAVVPMSVFWLVPQ
YAVHGVADAFASVGQMEFLYDQAPESMRSTAVALFWLCGSLGSYLSTVLVTVVQRAT
RRHGDWLQDNINRGRIDNYYWLITFIMLLNLGHYLCCFYFYTLKPLEVQADDEHKERD
DDLHPEQKNNGIMESVNIA

Sorghum bicolor Sorbi_66 Sb10g012270

MGSSSNSSPALSETKNTTPSVYTEDGTVDFRGNRAVRATTGGRKTAAILLVSYAL
MNFAFYGVAVDLVVFMRRVLHQENATAASFISMWTGTVYIFSLFGAFLSDSYMGRYRT
CVMFQIIFLIGLVLLSFSSLFLLVEPSRCGDNQQHRPCQPPSQLGVVMFYISTFTTAFGIGG
HYMERRSKLSFFSYFYLALNIGSLFSDSFLAFYEDKGMWVMGFGVSAVAVALGLLLFLL
GTPYYRHCKQSGNPLTRMAQVFVAAFCKRHLQPPPGEVLHEVEGEDSETQGIRKLLHSD
QLRCLDKAAIVTEEDYHAGKAKNPWRLCTVTQVEEVKCILSLIPIWMCTIIFSVEFTQMA
STFVEQGTAMDTNLFGNFYMPAASMSMFDIASVILSVFAYNFFFVPMATWFTKNPAGIT
ELQRMGTGLVIALVGMLAAAIVEVYRLRRVLAKDQPSPMSVLWQAPQYMLIGASEVF
MYIGQLDFFNEQTPDSMKCFGSSLCMASISLGNYASMLMVSAVTSITNRQNKNGWITKN
LNYGHLERFFLLLAVLSVIDFIFFALFSMMYKGIQFQGREKDISPNYN

Sorghum bicolor Sorbi_67 Sb10g022800

MEDGARDAERWEGYVDWRNRPATRGRHGGMVAASFVLVVEVLENLAFLANA
SNLVTYLMGFMHYSPSQSATTVTNFMGTAFLLALLGGFLSDAFFTTYTIYILSAFIEFMG
LVILTVQARTPSLMPPQCAAKPAACEPVSGAKKAMLFAGLYLTALGVGGIKGSLPSHGA
EQFDEHAPRGRKGRSTFFNYYVFCLSCGALIAVTFAVWVEDNKGWQWGFGISTIAILLSI
PVFVAGSRMYRNKVPTGSPLTTIAKVLVAAALAGRRRGGCGYGAQSAISNGAVIDRAPS
PTGSTDMKEYDCKPGAGDMVEDAAAIVAASSAAAELPSQELAFLNRAVQCQPPRQGRL
ACTVQEVEDVKIVLMVLPIFLSTIMLNCCLAQLSTFSVEQAATMDTRVGSLTVPPASLPV
FPVTFIIILAPVYDHAIVPFARRVTGTEMGITHLQRIGTGLVLSVVAMAVAAVVEVKRKD
VAASNGMLDSAKPLPITFFWIAFQYLFLGSADLFTLAGLLEFFFSEAPPRMRSLATSLSW
ASLALGYYLSSVLVSIVNSATGRGDHRPWLQGASLNHYHLERFYWVMCVLSTLNYLFF
LVLAIRYKYRNAGVIKG

Trichoplax adhaerens Triad_01 XP_002109263

ILLTELCERLTYYSVSANLVLFANTHLGFTNPEAASINFIFTGTGYAIPIISGYIADSF
IGQYNTIFGSSLIYIVGSVALVLVAAPYDLPFSTSAQSAFYIGGLAFIAIGTGGIKSNVSPFG
ADQLKDSGPLLIQRFFSWFYFFINVGSLVSFTAVAYIQQNVSFFYGYMIPAISMALAIIIFIS
ARSYYVVRSPKGSLLIDAVRMMWQGLRVKLCCRNAGARNGRITSIFDYAKQENGGSFE
SSQVEKIKPLGRVIPVFILIILYWTVYFQMQTTWFIQGESMNLKLGSFKLPAAALSSFDTV
SVLVFIPIINYGVYPLYKKIFGRSLTQLQRIGIGMIFASLAMLAAGILEGYRLIDVHENPLP
QVVAGSTFNASGNISVLAQIPQFALIGLSEVFTSITGLEYAYSEAPEELKGLIMGLYLLTSG
LGSYLGSLIIVIVNAASRNPKVQNSEWIPKDINNGHLDYYCYFLAGM

Vitis vinifera Vitvi_01 GSVIVG01001106001

MAAREIKSPEVQPETPASLGGNSESFRRKKLGIYFLESDDRRTAFGGGYVGGTTP
VNIHGKPIPDLSKTGGWVAAFFIFGNEMAERMAYFGLSVNMVAFMFYVMHRPFSSSAN
AVNNFLGISQASSVLGGFLADAYLGRYWTIAIFTTIYLAGLTGITLCATMNIFVPNQDQC
DQFSLLLGSCEPAKPWQMFYLYTVLYVTGFGAAGIRPCVSSFGADQFDERSRDYKTHLD
RFFNFFYLSVTIGAIVAFTAVVYIQIKRGWGSAFGSLAIAMGISNLVFFIGTPLYRHRLPG
GSPLTRVAQVLVAAFRKRNVSFSSGEYVGLYELPGKQSAIKGSRKIVHTDDFRCLDKAA
LQLKEDGAAPSPWRLCTVTQVEEVKILVKLLPIPACTIILSLILTEFLTLSVQQAYTLNTHI
GRLKLPVTCMPVFPGLSIFLILSLYYSIFVPISRRITGHPHGASQLQRVGIGLAVSILSVAW
AGYCLIGIAEVFCIVGLLEFLYEEAPDAMRSIGSAYAAVAGGLGCFGATILNSIIKSITGDR
QQMHPSWLSQNINTGRFDYLYWLLTVFSVINFCIFLYSAQRYKYRVAQEGTMEEEAVS
KKASTPSVES

Vitis vinifera Vitvi_02 GSVIVG01001292001

MSLPQTQGDTILDAWDYKGRPAERSRTGGWMSAAMILGVEACERLTTLGIAVN
LVTYLTGTMHLGNASSANTVTNFLGTSFMLCLLGGFVADTFLGRYLTIAIFATVQATGV
TILTISTTIPSLRPPKCAMETGPLCTPASGMQLVVLYLALYLTALGTGGLKSSVSGFGSDQ
FDDSNKEERNQMTNFFNWKWGYGICACAIAIGLVVFLSGTRKYRFKKLVGSPLTQIATV
FVAAWKKRNLELPTDSSFLFDIDYAAAEGQKKKKQRLPHSKQFRFLDRAAIKDPQMGN

GINAVVNKWQLSTLTDVEEVKLVLRMLPTWATTILFWTVYAQMTTFSVSQATTMDRHI
GKSFQIPPASLTVFFVGAILLTVPVYDRILVPIAARILKNPQGLTPLQRIGVGLVLSILAMV
AAALTELKRLHVARSHGLTDDPTAVAFTYIGQLDFFLRDSLLVSIVHKLTGDRKPWLAD
NLNQGKLYNFYWLLAILSVFNLGFYLIGAKWYVYKDKRLADEGIELEDQNDFPLSLLFF
FSLFLYFSFAVTKVVIPSVQKNGKGDSMKSVLCTQFLLSTSENELGHKSPLPHQIL

Vitis vinifera Vitvi_03 GSVIVG01008064001

MTLSITSLSNSNNILAIKSSITRDPTQAGKEMDGEQQLSTWEGYVDWRNRPAVKG
RHGGMLAAFFVLVVEVLENLAYLANASNLVLYLSKFMHFSPSSSANIVTNFMGTAFLLA
LLGGFLSDAFFSTYLIYLISAAIELVGLLILAIQAHVPSLKPPACDLGNISNPCREADGGKA
GMLFAGLYLVALGVGGIKGSLPPHGAEQFDDNTPKGRKQRSTFFNYYVFSLSCGALIAV
TFVVWIEDNKGWQWGFGISTASILISIPIFLLGSATYRTKIPTGSPITTIVKVLVAAICNAYK
LRNCSNSVMSMATSPSYTTEIGGKEESCSKEMVPRQAPTESLKFLNNAVIDKPFHSALEC
TVKQVEEVKIVLRILPIFACTIMLNCCLAQLSTFSVQQAATMNTKLGTLKVPPASLPIFPV
LFIMILAPTYNHIIIPFTRRTTKTEMGITHLQRIGTGLILSIVAMVVAAFVEIKRKRVAAESG
LVHSSEPLPITFFWVALQYLFLGSADLFTLAGLMEFFFTEAPTSMRSLATALSWASLAMG
YYLSSVLVSIVNSVTNSYSHHAWLFGNNLNHYHLEKFYWLMCGLSGLNFLHYLLWASR
YKYRTASPDN

Vitis vinifera Vitvi_04 GSVIVG01008073001

MIYWQFLMRCLCAFFIGLIPKSVTENGSTLSSPLERGSLLWATMEKNEKAGTADE
PNFEYRGLKAMPFIIGNETFENLGTVGTSSNLLVYLTAVFNMKSITAVTLINIFYGTTNLG
TLVGAFLCDTYFGRYKTLGFATVASFMGMLVITLTALISKLHPPHCEIEQTGTCIGPTSW
QIAFLLLGFGLLVIGASGIRPCNLAFGADQFNPITESGKRGLSSFFNWWYFTGTVAMMIS
LTLVIYVQSDVSWALGLAIPTFLMLLACVLFFMGTRIYVKLEPKGSPLKSVVQVIVAAAR
KRQLKLPEQPWLTLFSHVPSNSINSKLPYTDQFRFLDKGAIITPEDQINSEGLAADPWRLS
SIQQVEEVKCLMRVIPIWASAIIYYVALAQQQTYTVFQSLQSDRHLGHSNFKIPAASYSIF
SMLGLIIWIPIYDRIMVPLLQRFTGKEGGITVLQKMGVGMFLSIVTMLVSAFVEHQRRTL
ALCAISSMSGLWFIPQLTLVGVSEAFTVIAQVEFFYKQFPESMRSVGGSFSFLGVAVSSYL
SSFLVSTVHRMTAGAASGNWLPEDLNKGRLDYFYYLVAALGVINLGYFLLCAKWYKY
KGSACSTQEVPMERVESEKPLRISSLRETMEKNEEIDTADEPEVNYRGVKAMPYIIGNET
FEKLGAI

Vitis vinifera Vitvi_05 GSVIVG01009579001

MQQLSQLIKSSYTHWLLHSSVYKASGFTRLNTTLQLSEKKKTEGKIGLAFWVTG
ESSQHRMGICRDAKTGPRREAMTGGTRAAIFVYAMEGLENMAYVANAVSLVTYFYGY
MNFSLTKSATTLTNFMGTSLLLTLLGGFICDTYLSRFKTCVLFGCIELVGYALLTVQAHF
SQLRPFPCKNVARDKMDQCEAADSGQVAILFTGLYLVALGTSGVKAALPALGADQFDE
KDPKEAPLISTFFNWFLFSLTVGAIFGVTFVVWISSNQGWDLAFGVSTLVVLFSIIFLCMG
KSVYRHNAPKGSPILRIVQVFVAAIRNRALPVPEKSEELHEIHDKEVGMENEILARTDQF
RFLDRAAIVSTASGTSPSITPRPWRMCTVTQVEETKILIRMLPIILSTFFMNTCLAQLQTFSI
QQSTTMDRNLLGFQVPGPSIPLIPLLFMFILIPIYERIFVPLARKVTGIPTGIRHLQRIAIGLV

LSTISMAVAGVVETRRKSAAIQHNMVDSPDPLPISVFWLGFQYAIFGAADMFTLVGLLE
FFYAESSLGMKSLSTAIAWCSVAFGYFTSTIVVEVVNRVSGGWLASNNLNRDKLNYFY
WLLAGLSVVNFGVYLVCASWYRYKKVEVKQLGSSAGDDEGKA

Vitis vinifera Vitvi_06 GSVIVG01009804001

MDRMEPALDLPQKASFNGAEEGHKQNKEEVGVSTTLVSNGCVDIRGRIADKQR
TGGWKASPFIIVNEVAERLAFFAIAVNMVQYLVLQMNQSLPKAATHVTDWIGAAYVLTI
LGAFLADAYLGRFRTIIIFSSVYTVGMVLLTLSASIDSLRPPQCPTRPCEPASRGQTTFLYG
ALALIALGTGGIKPCVSSFGADQFDEADGEEVQKKYSFFNWFFFAINMGALLGITILVYIQ
VEKGWNWGFGIPTAAMFCSIIILAAGIPYYRFQKPMGSAFTRFLQVIVASVRNHFKGVEA
GHGAELYEVKTTESDILGNRKIAHTVQYRFLDKAAVITDAEANTKSRWRLCTVTQVEEF
KSFVRILPVWASTIALSISFAQLSTFFISQAHIMDRKLGPDFVIPAGSIPVFSAMNALILVPI
YEKWIVPILRRHTGHRRGITSLQRMGIGLFVSIFALASAALVEKRRRDHSRASTMSVFWL
LPQFFLIGSAEVFTYVGQLEFFYDEATDGTRSLSSAMFLSEIGIGSWLSTAIVKIIEGTTGG
EEKGWLRNTLNTSRLDYFYWVLTGINVANFFIYLWIAGLYKEKGGASGSVRDEPMAEL
GGEEESLRTTLVSNGRVDFRGRIADKRTTGGWKASPFIIANEVAERLAFFAIAVNMVSYL
VFEMHQSIPKAATHVTDWIGAAYVLTILG

Vitis vinifera Vitvi_07 GSVIVG01011563001

MGSQEEEEVRSLLETGLLQNENSDLHTGDGSVDIHGKPVLRSNTGNWRACPFILG
TECCERLAYYGIATNLVTYLTSKLHEGNVSAARNVTTWQGTCYLTPLIGAVLADAYCG
RYWTIAAFSTIYFIGMCTLTLSATVPAFKPADCVGSVCPPATTAQYAVFFFGLYLIALGT
GGIKPCVSSFGADQFDDTDPKERVKKGSFFNWFYFSINIGALVSSSFLVWIQDNAGWGL
GFGIPALFMGIAIASFFSGTPLYRFQKPGGSPITRMCQVLVASFRKWKLEVPKDSNLLYET
PDKNSAIEGSRKLEHSNELKCLDKAAVISDAEIKSGDFSNPWNLCTVTQVEELKILIRMFP
IWATGIVFSAVYAQIILWQIPQYFLLGAAEVFTFIGQLEFFYDQSPDAMRSLCSALSLLTT
SLGNYLSAFILTVVTTLTTEDGKTGWIPDNLNKGHLDYYFWLLAGLSFLNLLVYMICAK
IYKRKKGS

Vitis vinifera Vitvi_08 GSVIVG01011908001

MEKKGSHGGRTKGGLITMPFIFANEACEKLAVVGFSANMITYLTQQLHLPLTKA
ANTITNFSGTASLTPLLGAFISDAYAGRFWTITVASILWQMGMTSLTLSAVLPQLRPPPC
KGEHQVCQEADGGQLAILYGSLLLTALGAGGIRPCVVAFGADQFDETDPKEKTKTWNF
FNWYYFVMGASILVAVTVLVYIQDNVGWGWGLGIPTTAMFLSIITFVVGYPLYRNLDPV
GSPFTRLLQVCVAASKKRNLRMVSDPNLLYENDELDASISAAGKLLHTNELKFLDKAAI
VTEEDDIKSSQAPNLWRLNTVHRVEELKSVIRMGPIWASGILLITAYAQQGTFSLQQART
MDRRLINSFQIPPGSMTVFSMSSMLITIALYDRLLIRVARRFTGLDRGITFLQRMWIGFVIS
IVATLVAGFVEVKRKQAASAYGLVNSPKSTIPISVLWLVPQYSLHGIAEAFMSIGHLEFF
YDQAPESMKSTGSALFWTAIAFGNFVSTFLVSLVHKYSAGPDGSNWLPDDNLNKGKLE
KFYWLLTLLQVVNLIYYSFCAKFYTFKPIQIRMKEVDTSEEDGIQLTSRVYKAMGNMAQ
EEESVKATPLAAMAEAFEELSKLVKTCPSYHLRLITFCDACSLVSVLFGCLGIAFKFAELE
YVSKIRDL

Vitis vinifera Vitvi_09 GSVIVG01013493001

MVITDDGLQETAISSKTNPSKGRWRAAIFIIFVEMAERFAYYGVAGNLFTYLTNV
LGEHTATAAKNVNTWVGVSAIFPLLGGFIADSYLGRFKTIIASSVIYLAGLLLMTLSVSV
QSLRHHRAVFFTALYILSIGEGGHKPCVQTFAADQFDEDTVEEKKDKSSFFNWWYVGIV
VGSTTAILVVIYVQDNVGWGLGFGMLAAAVAAALLLFLIGIRSYRRQRPVGSPLTRVMQ
VLVATARKLRVNETRYGRGVCLEDEGDDGVEEGGRRGRSLAPTNQFRFLDKATIIDDID
ASTKVRNHWRLCPATQVEEVKLLFSLFPIWLSCLTFATVIAQMSTYFTKQGSTLERSIGS
HFSIPPASLQVCTGLTILVSVGLYDRVLVPVARKFTGLPSGITMLQRIGTGIFFSMLTMVV
AALVETKRISVAIDHGLTDSPRTTLPMKIWWLLPQYMLTGMCDVFTIVGMQELFYDQM
PEEMRSIGAALYISTVGVGSLMSSAAISIVQAITSRAGGKWLGDNLNRAHLNYFYSVLA
GCSALNLIVYIWVAKRFVHTGLQFHLAHASFPSLGNLGFLENLASRAANVSRIHLLDHN
WSFESLPSQHQDLPNEILNLYLRVSISLIVPSMDNSQAPERIVIDHEETKLSAQQKPSKGG

Vitis vinifera Vitvi_10 GSVIVG01015522001

MSWTVADAVDYKGFPADRSKTGGWVPAALILGIEICERLSTMGIAVNLVTYLVS
TMHLPSATSANTVTDFMGTSFLLCLLGGFLADSFLGRFRTIAIFATVQAMGTGMLAIITR
LPQLQPPPCKNTPTQTCKQANGFQMGILYLALYLIALGTGGLKSSVSGFGTDQFDDKDE
KEQSQMIYFFSRFFFFISTGTLMAVTVLVYIQDEVSRSLGYGICCVSMLIAILVYFSGTKR
YRYKKSVGSPIVHISQVIVAAMRKRKMDLPFNASLLYEDSAEGSRIQHTDQFRCLDKAAI
LAGEFDKTASSDPNPWKLCSVTRVEEVKMMARLLPIWATTIIFWTTYAQMITFSVEQAS
TMERSIGNFQIPAGSLTVFFVAAILITLAVYDRFIMPMWKKWRGKPGFSSLQRIALGLILS
IVGMTAAALAERRRLSVAKAVGDNTATLPISVFLLIPQFFLVGSGEAFIYTGQLDFFITQS
PKGMKTMSTGLFLSTLSLGFFVSSFLVSVVKRVTGSRDGQGWLADNINYGRLDCFYGLL
AILSFINFAVFLVCAVWYKPQKPNDGMQMETMANGSCPEEKC

Vitis vinifera Vitvi_11 GSVIVG01015523001

METEERKALVLDAYDYKGAPADRAQTGGWVSAATILGIEVSERFTTMGIAVNLV
TYLDNTMHQPSATSSTIVANFSGVSFLLCLLGGCVADSFLGRYWTIAIFAVIEALGACVL
AISATLSHLRPPPCNPSVAIKCVKANNLQMGVFFLGLFAMALGIGGVKSSVSALGTDQF
DQTDEKEKTQMEYFFNRFYFLINIGTILAVTLLVYIQDEVSRGVGYGICSAAMLMAVIVF
LSRTRRYRYKKLTGSPLIQVIQVIVAAIQKRKLEFPSDLSLLYEDSSAKSKICRTDQFRWL
DKATIRSDGDLGKNGSETPNPWRLSTVTRVEELKMMIRLLPIWATTIIFWCVHAQVITFS
VQQAASMDRSIGKFHVPAASFSVFFIGATMITLALYDRMVMKKSRGSRGLTNLQKIGLG
LAISVIAMAVAAAMEQKRLKVIRANRNTPTSTLPLTAFILIPQFAIVGIAEAFMYSGQLAF
FISEAPKGMKAISNSLFLTTISFGYFVTTILVDLIKKITPGKDGGHGWLAPKINDSRLDYFY
ALISVLSFINLGLYLVCARWYKPNSSENAKDSDVNASHDEEKPQDVSNS

Vitis vinifera Vitvi_12 GSVIVG01016458001

MERRERGHGEEGEGGDEKWVHDSSVDYKGRVPPRASTGVWKAASFIITIELSER
LSYFGLATDLFNYFSKVLNQDSKTAAKNVNYWIGVTTVMPLLGGFLADAYTGQFYTVL
LSSIIYVMGLSLLTMSQFIPRLKPCSNRKHCGHPRKVHEVVFFLGMYCVSLGTGGHKPCL
ESFGADQFDDNHPVERKKKMSYFNWWNFALCCGLLAGVTVIVYVDEYVGWGASYLIL

TSCMAFTILTFYAGKRFYRYRLPEGSPLTPMLQVLVAAIAKRNLPYPSNPDLLYEVPKSH
KSKGRLLCHTNKLRFLDKAAIIEDKESLQSVEKKQSPWRLATVTKVEEMKLVLNMIPIW
FTTLTFGLCVAQATTFFIKQSDTMNLEIIKDVSIPSASIYSISAVGMIISVTIYEKILVPLLRR
ATGTERGIKILQRIGFGMIFSVLSMSTAALVERKRLRQSKRENPRLFLQNNHPQLFSTFQH
APVHQLHCPDQNPNPAGFVNSEGVHVVGPSSASFSFPSCGDHSLSSIHNAKDLDHRFSFG
ADAVSLSLAPHHRHQRCAPLELNAKRYDVVSVRGGTPKPNNELRSSVPLGPFTGYASIL
KRSSFLSPAQQLLDDFCGVGRGVSDSASFDPPLEGSGTAEDPIGCSHGSEHFWKSSRLAP
MLDEVYRRYKLYCQQMHSVVASFETVAGLQNAAPYISFAFKAMSNHFRYLKNAILDQI
QFTGKALVGHNIGKDETPRVWTADQGFHSQKAVQSSMFLQHPIWRSQRGLPDHAVAV
LRAWLFEHFLHPYPTDLEKQILAQRTSLSR

Vitis vinifera Vitvi_13 GSVIVG01017052001

MEVEANSEQRKMSQRAKGGLITMPFIIANEAFERVASYGLLPNMILYLIQDYHLG
VAKGTNILFLWSAATNFLPVVGAFLSDSYLGRFLTIGLGSITSLLGMILLWLTAMIPKTKP
PHCDLLTQSCKAPTAAQFILLYSSFALMSIGAGGVRPCSLAFGADQLDKRDNPKNERVL
ESFFSWYYASAALSVVIALTGIVYIQVHLGWRVGFGVPAILMFFAALLFFLASPFYIKQK
ASRSLLTGFVQVLVVAYKNRKLAFPPRNTDGWYHYSKDSKLVVPTDRLRFLNKACIIRS
PERDINSDGLASNPWSLCTVDQVEELKALIKVIPMWSTGIMMSINTSNSSFPVLQANSMD
RHVFSSFQIPAGSYAMFLVIVLFLWVALYDRVILPLASKVRGKRVRLGVKQRMGIGLFL
SCLGMVVAAIVENVRRRKAIRQGLLNNPQTLVGMSAMWLVPQYCLYGLAEAFNAIGQ
TEFYYSEFPKSMSSIAAALFGLGMAVANLLASVILSAVNHLTSRGGKESWVSNNINKGH
YDNYYWLLAIMSAINLLYYLVCSYFYGPCVEQGTKVSDEGKSMEGENELSKLSNGARD
EVESLKDDEKLSKFKDEVEGLKDEEELSKLRQSPS

Vitis vinifera Vitvi_14 GSVIVG01018395001

SLFLSPSSSSLHSSPSSCSLVTSQLYSLILQRIWHQWPASISFKSDGIVGLHDVSFAF
LGRGKTRNEQEECTFDGSVDRHGHPAVRARTGNWVTAILILVNQGLATLAFFGVGVNL
VLFLTRVLGQDNATAANNVSKWTGTVYIFSLLGAFLSDSYWGRYKTCAIFQVIFVIGLV
LLSLSSYIFLLKPNGCGDKEFPCGSHSTFEISFFYLSIYLIALGNGGYQPNIATFGADQFDE
DNPKESHSKVAFFSYFYLALNLGSLFSNTILGYFEDGGRWVLGFWASSASAILALILFLF
GIPRYRHFKPSGNPLSRFCRVVVAATRKWKVEMPPEGEDLYEVDGDDCSGNCRRKMLH
TQGFKFLDKAAVLTAKEREQEDKESRSPWRICTVTQVEEVKCILRLLPIWLCTILYSVVF
TQMASLFVEQGAAMKTTLLGFHIPPASMSSFDIVSVAAFIFIYRRVLDPLVARLKGTKAR
GLTELQRMGIGLIIAIIAMSSLSIFWQIPQYVLIGASEVFMYVGQLEFFNDQAPDGLKSFGS
ALCMTSISLGNYVSSLLVTIVMKFSTRDQMPGWIPSNLNKGHLDRFYFLLAALTMADFG
VYIICAKWYKSIKLEGKYEDSNSKGSDDVMSELNIFNVIVSN

Vitis vinifera Vitvi_15 GSVIVG01020076001

ERNKLRMTLTLGTALIDMYAKCGNMNKAMEVFWGMKEKNVYTWSSAIGGLA
MNGAGEKCLELFSLMKQDSVQPNEITFVSVLRGCSVVGLVEEGRKHFESMIVFYRVYTI
PLGLLCPTLSPPLFKSPTIHQSLLIFSHKRSNRKSKKERVKEMEEGNQQHRWEGYVDWR
GRPALRGRHGGMLAASFVLGVEILENLAFLSNASNLVRYLSDYMHFSPSKSANNVTNF

MGTAFLLALLGGFLSDAFFTPYHIYLISAVIEFLGLIVLTIQARSPSLKPLECKKGTADTSC
QVLSGGKAGMLFVGLYLVALGVGGIKGSLPAHGAEQLDESTPQGRKQRSTFFNYFVFC
LSCGALIAVTLVVWVEDNKGWEWGFGIATISIFASIPVFLGGSATYRNKIPSGSPLTTIFK
VLIAATLNRSPSNAVASMATSPSYPTQNSKEPEEENGKAIPVYKAVECTVQQVEEVKIVI
KILPIFACTIMLNCCLAQLSTFSVQQAATMNTKLGSLKVPPASLPIFPVLFMMTLAPIYDH
FIIPFARKVTKTEMGISHLQRIGIGLVFSIIAMAVAALVEVKRKRVASNLGLIDSTEQLPITF
FWIAFQYLFLGSADLFTLAGLMEFFFTEAPTGMRSLATSLSWASLAMGYYLSSVIVSIVN
NFLGSLNHRPWLSGRKLNHYHLERFYWLMCVLTGLNFLHYLFWACRYKYRSTGATNL
TAPSPKHLGWEFQHGPQTTCNIQAAQWRWKGGDMSSGGPGMGVLGKELIAEGVPTSD
HDDTPIRENLVRSVPPPDGEVLRKLLPVALVVVARRESAS

Vitis vinifera Vitvi_16 GSVIVG01020084001

MSTVDAKHQASPLTSSWSSSPPPKSKPLDNEPEKSKHDAVVSSDVSDEGPRKPGG
WNSMVYILGNETFERLATFGLLANFMVYLLNEFHLDQVYATNVLNIWSGTTNFAPLVG
AFISDACVGRFRTIAFASFASLLGMVTLTLTSWIPQLHPPSCTEDQQQNDQCTGPTSAQM
GILFLGLGFLTIGTGGIRPCSIPFGVDQFDPTTEQGRRGINSFYNWYYTSFTLVLMIALTLV
VYIQDSVSWVLGFGIPTLLMVGSIILFFLGTRVYVYVKPEGSIFSGIARVFVAAYKKRRV
KIPVEGEKEGAYYDPPLTKGSIVAKLPFTKRFRWLNKAAVILEGEKDANGCPSNQWRLC
SIQQVEEVKCLLKIIPVWASGIICFTAISQQGTFTVSQALKMDRHLGPKFQIPAGSLIVISM
LTVGIWVPFYDRILVPALQKITKHEGGITLLQRMGIGIVFSILSMVVSGLVERERRASAIL
QAGPHGIAPMSVMWLAPQLILMGFAEAFNIIGQIEFYNKEFPENMRSIANSLFFCTIAGAS
YLSSLVVVIVHDVTGKAGRSAWLTKNINQGKVDYYYYLLAGMGVLNLIYFLFCARRYR
YKSGHGVTEEEPHLDLELNQLKH

Vitis vinifera Vitvi_17 GSVIVG01021298001

SQKPDGSSSSLSNEKTEDKKGDSSSQTGKLIKIVDLTEMSKGPQDIPGHWLVTGA
KLGVDKGKIVLRINCFISMLVPEQNYLETQLGKSYYYSVFVHTIMDNDVFNVYSRPSIIC
LSKLIYYKIMTTSLESLSKSANSTEATLAFKQQTRAFVPMEKGEELVEGKVDWKGRTAI
KNKHGGQRFSSLILASFALENMATVALAVNLVTYFNGVMHFSIADAANELTNYMGTAY
ILSIVVAFLADAYIGRFYAVLVSAFIELVGLGLLAVQAHYPKLKPPTCVIFDPTADCQQV
HGGNAALLFVALYLVAAGTAGIKAALPTHGADQFDEKDPQEAMQMSSFFNGLLLALCV
GGAVSLTLVVWIQDNKGWDKGFGVPTLAIFLAMIVFAVGLPRYRIHVIQGTSAITEIIQV
LVASFRNRKLPLPDDPAELYEIDKDKEAATEAEFLPHRDIYRFLDKAAIQTTLLGNSDKP
ETPNPWKLCRVTQVENAKIIAGMVPIFCCTIIMTLCLAQLQTFSIEQGLTMDTRVANSFNI
PPASLPILPVIFMIILIPVYDRIFVPYARGITGLRTGITHLQRIGVGLVLSAISMATSAVMEA
LRKRVARDNNMLDAIPVLQPLPISVFWLSFQYFIFGIADLFTYVGLLEFFYSEAPKAIKSIS
TCFLWSSMALGYYFSTVVVNIVNRATKGITRSGGWLAGNNINRNHLNLFYWLLSILSVI
NFFVYLFVAKRYKYRPQALVAPIANEENKNNKASV

Vitis vinifera Vitvi_18 GSVIVG01023146001

METRRQTNKGEEGMGVSTGHEDTATATTVDWRGRPSNPEKHGGMRAASFVLG
LQAFEIMGIAAVGNNLITYVINEMHFPLSTSANIVTNFIGTVFLLALLGGCISDSYLGSFW

TMLIFGFVELSGFILLSVQAHLPQLKPPQCNMVTDGERCVEAKGFKAFIFYLALYLVALG
SGCVKPNMVAHGADQFNRDSPKQSKSLSSYFNAAYFAFSIGELIALTVLVWVQTHSGM
DVGFGVSAAAMAMGLISLVSGTLLYRNKPPQGSILTPIAQVFVAAILKRKQRCPPSPHML
HGSQNNVLVGSVATSKFNKYRFLDKACIKIQDGNNVKESPWRLCTVAQVQQVKILLSVI
PIFACTIVFNTILAQMQTFSVQQGSSMNTQLTKNFHIPPASLQAIPYIILIFLVPLYDAFFVP
FARRFTGNVSGISPLQRIGFGLFVATFSMFLIFGLSEMFTAVGLIEFFYKQSSTGMQAFLT
AITYFSYSFGFYFSSVLVSLVNKITSSSSSDGWLKDDDLNKDRLDLFYWLLAVLSFINFLN
YLFWAGWWYSYKPSSSVPLQSDAHGEEFMGQGFNSSKIVADICMFKEEIEDDALSFFVT
RVPWICERLNRGKAHLQWPSNS

Vitis vinifera Vitvi_19 GSVIVG01024796001

MAEEDNYTKDGTINYQGNPANKKKTGTWTACPYILGNEFCERLAYYGMSSNLV
LYFKYKLHQDSATASKNVLNWSGTCYLTPFIGAFLADAYLGRYWTIASFSIIYVIGMTLL
TVTASVPGLKPNCSPSGVCDPTETQTAVCFLALYLVALGTGGIKPCVSSYGADQFDDTD
EHEKTHKSSFFNWFYLSINVGALIAGSILVWIQENIGWGVGFGIPAAAMAIAVVSFFSGT
RLYRNQKPGGSPLTRMSQVVVASLKKYRVQVPADKSLLYEIADGESGIQGSRKLDHTK
DLSFFDKAAVEIQSDHIKDSPDPWKICTVTQVEELKAIIRLLPVWATGIIFSAVYSQMGSL
FVVQGESMDPHMGRHFEIPSASLSIFDTISVIFWVPIYDRIIVPVARKFTGHSNGITQLQRM
GIGLFISIFAMLSAGILEVVRLGIVKRHNYYDHDRIPLSIFYQVPQYFIIGCAEVFTFIGQLE
FFYEQAPDAMRSFCSALSLATVALGNYLSSLLVTIVTDVSTRGGKLGWIPDNLNRGHLH
YFFFLLAILSVLNLVAFLFVAKWYTYKRAVGTLR

Vitis vinifera Vitvi_20 GSVIVG01025106001

MAAADLQNPDCTAQPSFSGDRESQISDSGSTKGGWITFLFIAGALTGLTLAAGG
WGANLIVYLIEEFSVKRIDAAQISNVVSGSTSLFPIVGAIAADCFFGSFSIIALCSCISLLGV
VFLALTTLDFLRPQQCEHGSTLCKNPSKIQFAVLYSGITLAVIGLGGTRFTLATMGADQF
DKPKHQATFFNWYFFVFYVSSVISNTAIVYVEDNVSWTWGFGLTVVCNLIGLVIFLLGS
RFYRHVKPQGSPFVDLARVFVAALRKRKVLISLNSDDYYYCHKHQGYVKMVTATTPTK
SFRFLNRAALKTEGDIRADGLIAKPWRLCTVQQVEDLKTLIRIFPLWCTSIFLSTPIGIQSS
LTVLQALTMDRHLGPHFKIPAGSILVIAFISAAISLTLIDRILCPLWKKLTNHSPTPLQRIGL
GHILNALSMAVSALVESRRLRIAHAHHLQNQPAGPITPMLSLWFTSTAMISLLIAIAFYLS
TAVIDLIRRTTKWLPDDLNNGRLDNVYWLLTVVGMLNFFGYLVCATMYKYKNTDEGH
GTSNGSDQ

Vitis vinifera Vitvi_21 GSVIVG01025107001

MAAADLQNPDCTAQPSLSGDRESQISDSGSTKGGWITFLFIAGALTGLTLAAGG
WGANLIVYLIEEFNVKRIDAAQISNVVSGSTSLFPIVGAIAADCFFGSFSIIALCSCISLLGV
VLLALTTLDFLRPQQCEHGSTLCKNPSKIQFAVLYSGIALAVIGLGGTRFTLATMGADQF
DKPKHQGTFFNWYFFVFYVSAVISNTAIVYVEDNVSWTWGFGLTVVCNLIGLVIFLLGS
RFYRHVKPQGSPFVDLARVFVAALRKRKVLLSLNSDDYYYCHKHQGSVKMVTGTTPT
KSFRFLNRAALKTEGDNRADGLIAKPWRLCTVQQVVDLKTLIRIFPLWCTSIFLATPIGIQ
SSLTVLQALTMDRHLGPHFKIPAGSIFVIAFISTAISLTLIDRILCPLWKKLTNHSPTPLQRI

GLGQILNALSMAVSALVESRRLRIAHAHHLQNQPAGPITPMLALWFTSTAMISLLIAIAF
YLSTAVIDLIRRTTKWLPDDLNNGRLDNVYWLLTVLGMLNFFGYLVCARMYKYKYTD
EGHGTMLYLIIDS

Vitis vinifera Vitvi_22 GSVIVG01025359001

MGAFQFQGFITGNATGGWKSASLLLANQGLATLAFFGVGVNLVLFLTRVLSQDN
ANAANSVSKWTGTVYLCSLIGAFLSDSYWGRYLTCAIFQVILVLGLLLLSLSSWLFLIEP
KGCGDRTTLCSPSSSVGLGVFYSSIYLVAFGYGGHQPTLATLGADQFDETNPREMNSKT
VFFSYFYFALNLGSLFSNTILVYFEDSGKWTLGFLVSTGSAIIALVIFLCGSSGYRHIKPCG
NPLPRVAQVFVAAFRKWDVVVPENGDGLYELEGSESAIKGSRKILHSNEIEFLDKAATM
IEADMVDPNPWRLCTVTQVEEAKCQGDVMNRKIGNFEIPAASMSAFDIFSVLLCTGIYR
QILVPISGKLTGNPKGMSELQRMGIGLIIGIAAMIAAGLTELGRLRRVSPNEEASSLSIFWQ
TPQYVLVGASEVFMYVGQLEFFNGQAPDGIKSLGSSLCMASISLGNYVSSLLVNIVMGV
TTRGDNPGWIPEDLNTGHLDRFYFLIAVLTVIDFVIYVFCAKWYKSINLESFEKKKDQED
GHAELRCIDRHDFIV

Vitis vinifera Vitvi_23 GSVIVG01025795001

MAEDGVEENRENTKKKELGGLRTMPFILANEICDRFASSGFHANMITYLTEVLN
MPLVPASNTLTNFSGTASFTPLIGALIADSFAGRFWTIIVGSIIYELGLVSITISAVLPSLRPP
PCPTKENCKEASTLQLCILYISLLLTSLGTGGIRPCVVTFAADQFDMSKSKVASRSWNFF
NWYYFSMGLATLSALTIVVYIQDNVGWGWGLGLPTIAMALSIIAFLVGSPLYKKLKPGG
SPLVRLAQVIVAATKKRKAVAPADPSLLYENKELDATISVNGRLLHTNQFKWFDKAAIV
TDAEATSLNPPNLWRLATVHRVEELKSIVRMLPIWAAGILHVTSSSHQHSFTIQQARTMD
RHLSPSFQIPPASLSIFSVLTVLIGIVLYERFFVPLARRFTRNPSGITSLQRMGIGFMVNILA
TIVASFVEIKRKAIAANHNLLDKPRAIIPISVFWLVPQFALHGVAEVFMSVGHLEFLYDQS
PESMRSTAAALYWIAIAIGNYLGTLLVTLVHKYTGHSRNWLPDRNLNRGRLEYYYWLV
SGIQVVNLIYYVTCAWLYTHKPSRLSDERD

Vitis vinifera Vitvi_24 GSVIVG01026058001

MAHSGILPHAHTPLLDDTLDSAVDYKGRPARRCSSGRWRSACFIIGVEVAERFAY
YGIESNLINYLTGRLGQSMATAAQNVNTWSGTASMLPLLGAFVADSYVGRYPTIVIASL
LYILGLGLLTVSAVLPSFNPSHCQTDKEISSCSPPMLQVILFFFALYLVAVGQGGHKPCVQ
AFGADQFDGKNPEESKAKSSFFNWWYFCMSGGILINSSILNYIQDNLNWGLGFGIPCTT
MVAALFVFLLGTKTYRYSVKGDEKNPFLKIGWVFVAAIKNWHTTDSSLTDEEVAHGTW
PHQCSHKFKFLNKALLAPDGSKEDGKVCSVSDVEEAKSVLRLFPIWASCLAFAIVFAQPP
TFFTKQGVTMDRSIGSGFKVPAASLQCFISLSILLFVPIYDRILVPTARVLTRKPSGITMLQ
RIGTGMLLSVIAMVFAALVEVQRLKTAEQYGLVDIPYATVPMAVWWLIPQYVIFGVAQ
VFTMVGLQEFFYDEVPNELRSVGLSLYLSIFGVGSFLSSFLISVINKTTGGDGQTSWFND
NLNQAHLDYFYWLLAGLSTVGLSTYLYSARSYIYNSTSTT

Vitis vinifera Vitvi_25 GSVIVG01026059001

KTTLPMKIPSELRSVGVSLQLSIVGLGRLLSTSLISVIGKITSGDGRDSWFSDNLNR

AHLDYFYWLLAGVTAIGLATPFLEDAVEGVVDYRGVPAKRSRSGGWRSASFIIGVELAE
RIAYYGISFNLISYLTGPLGQSMAVAAQNVNTFSGAGCLLPLLGAFVADSFLGRYRTIVI
ASLLYILGLGLLTLSAMLPSLIPSFCQNIDNPPQFQVVLFFFSLYLVTIGQSGHKPCTQAFG
ADQFDGQHPEECKAKSSFFNWWYFALCSGISVAFLILSYIQENLNWVLGFGIPCIVMVA
ALLLFLLGTKTYRYSINTNEENPFVRIGKVFVEATRNWRTMPSLKTAEEVAGETLPHHGS
HQFKFLSKALLTLDCSKEDGKACSFSDVEEAKAVLKLFPIWITSLVFGILPAQLSTFFTKQ
GITMDRSTGLGFDIPAASLQSLNTTTIVIFIPIYDRILVPIARHLTRKPSGLSMLQRIGTGMF
LYIISMVIAALIEVKRLKKAEEHGLVDTPNVTIPMSVWWLVPQYVLSGVGDALAMVGF
QEFFYDQAPNELRSVGIALNLSIFGLGSFLSSFLISATDKVTGGDGHDSWFNDNLNKAHL
DYFYWLLVGLGLLGLAGYLYFAKSYIYNKRGIV

Vitis vinifera Vitvi_26 GSVIVG01026064001

MAISDISLDSETPFLEDAVEGVVDYRGVPAKRSRSGGWRSASFIIGVELAERIAYY
GISFNLISYLTGPLGQSMAVAAQNVNTFSGAGCLLPLLGAFVADSFLGRYRTIVIASLLYI
LGLGLLTLSAMLPSLFPSFCQNIDNPPQFQVVLFFFSLYLVTVGQSGHKPCTQAFGADQF
DGQHPEECKAKSSFFNWWYFALCSGISVAFLILSYIQENLNWVLGFGIPCIVMVAALLLF
LLGTKTYRYSINTNEENPFVRIGKVFVEATRNWRTMPSLKTAEEVAGETLPHHGSHQFK
FLSKALLTLDCSKEDGKACSFSDVEEAKAVLKLFPIWITSLVFGILPAQLSTFFTKQGITM
DRSTGLGFDIPAASLQSLNTTTIVIFIPIYDRILVPIARHLTRKPSGISMLQRIGTGMFLYIIS
MVIAALIEVKRLKKAEEQGLVDTPNVTIPMSVWWLVPQYVFFLSSFLISAIDKVTGGDG
HDSWFNDNLNKAHLDYFYWLLVGLGLLGLAGYVVYFAKSYIYNKRGIA

Vitis vinifera Vitvi_27 GSVIVG01026065001

MANMLQSLESPLLEDTVDGSVDHQGYPSKRSISGGWRSAIFIIGVEVAERFAYCG
IGSNLINYLTGPLGQSTAMAAANVNTWAGTATLLPLLGAFVADSYLGRYRTIVLASLLYI
LGLSLLTLSAMLPSLIAFQSQNVDYFTLYSPPQLQIVLFFFSLYLVAVGQQGGHKPCTQAF
GADQFDGQNLEECKAKSSFFNWWLFGVSTGTSVTYVIVSYIEENFNWGLGFGIPCIVMV
AALLVFLLGTRTYRFTIKRNGKSPFVRIGKVFVEAARNWRTTPSLKAIQERTQENLPHHG
SHNFKFLNKALLVPACLKGDGKACSITDVEEAKAVLSLFPIWATSLVYGIVTAQSSTFFT
KQGITMDRSIGSGFRIPAASLLSFIPITIILFIPIYDCIFVRIARALTGKPSGITMLQRSGIGFLL
CVVSMVTAAIVEMKRLKTAKEYGLVDMPNVTVPMRVWWLIPQYILLGIADVFAMVGL
QEFFYDQIPNELRSVGLSLYLSIYGVGSFLSGFLISIIEETTGGDGKTSWFNNNLNRAHIDN
FYWLLAGLSAVELAAFLYFAKSYVYNRNQEKILLKKQSLDLQFFTLIFGSPIVLSHSNNL
NLCSQCF

Vitis vinifera Vitvi_28 GSVIVG01026066001

MAMADILGGSETLLVEDSVDGTIDHKGCPAKRSSSGGWRSAYFIIGAEVLERFAY
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YILGLGLLTLSAVLPFQSTFDCQNTHQSTSCSPPELRIIFFFISLYLVAVAQGGYKPCTQAL
GADQFDGQNREENKAKSSFFNWWLFCLSACTSVSYVILSYIQDNLSWGLGFGIPCTVMI
ASLLIFLLGTKTYRYILKGDEKSPLLRIGKVFVEAARNWRTSPSLKATEEVTQGTLPHQG
SHQFKFLNKALPMQDYLEEGGDACTVKDVEEAKAVLRLFPIWSTCLVYGIVHAQSSTLF

TKQGNTMDRSIGSGFDIPAASLQSIVPITIVLSIPIYDCIFVPIARALTRKPSGITMLQRIGTG
GFLYAISMVIAAIVEIKRLKTAQEHGLLDMPNVAVPMKVWWLVPQYAMFGVADVFAV
GGLQEFFYDQVPSELRSVGLSLYLSLFGVGSFLSGFLISAIEKATGGDGRSSWFNSNLNR
AHLDYFYWLLAGLTAVGLAAFSHFAKSYIYNRRVIF

Vitis vinifera Vitvi_29 GSVIVG01026067001

IADVFTMVGLQEFFYDQVPNELRSVGLSLYLSIFGVGSFLSSLLIAVIEKATGGDG
QDSWFTDNLNRAHLDYFYWLLAGLSTVELAAYLYFAKSYIYDRKLSSLLAFASNMAM
NGLLEGPQSPLLEDTVVGAIDNKGRPARRSTSGRWRAACFIVGAAVAERFAYFGIEANLI
NYLTGQLGQSTAAAAKNVNTWFGVSALLPLVGAFVADCYVGRYRTIVAASLLYVLGL
GLLTLSAVYSSQSLSDCQNTEKIMSCSPSRPQVLFFFFSLYLVAVAGGGHKTCNQAFGA
DQFDGQDPEECKAKSSFFNWCSFCLCIGLSVSMLTLSYIQDNLNWVLGFGIPRIAMVVA
LLLFLLGTDTYRYSIKRDEKSPVMRICKVFVEAARNWRITPSSEKFIEEGAPGTLSHQGSQ
EFKFLNKALLVQTCFEEDGKACSVSEVEEAKSVLRLFPIWSTCLVYAIVLAQSSTFFTKQ
GMTMDRSVWSGFDIPAASLLAFISLSIVLFVPIYDRILVPIAGDFTRKPSGITMLQRIGIGIF
LSSISLVIAALVEMKRLKTAQEHGLIDMPNATVPMRVWWLVPQYVLFGLSEVFALVGL
QEFFYDQVPNELRSVGVSLYLSIFGVGSFLSSFLISAIEKATGEDGQDGWFNDNLNRAHL
SYFYWLLSGLSMVGLATYLHFAKYYTYNKGGVS

Vitis vinifera Vitvi_30 GSVIVG01026068001

MVDGPESPLLEDTVAGAVDHTGLPAKRSTSGGWSSSYFIIGTEVAERSAYFGIEA
NLVNYLTGPLRQSTAMAAKNVNTWFGITTLLPLVGAFVADSYMGRYRTIVIASLLYILG
LGLLTMSAVLSSHNPSECQNTRKIMSCPPPQCQVIFLFLSLYLVAVAEGGHKPCTQAFGA
DQFDGRDSEEGKAKSSYFNWLNFCVGISLSVSMLTLSYIQDKLSWVLGFGIPCILMVVA
LLLFLLGTNTYRYSVKRADKNPFVRISKVFVEAARNWRLNPSSEKAIEEGAQGTLSHQC
SPEFNFLNKALLGTKFSEEDGKACIVNEVEEAKAVLRLFPIWSTCLIYAMVLAQSSTFFTE
QGMTMDRSIGSGFDIPSSSLKSFLTITVVLFIPIYDLVFVPIATVFTRKPSGITMLQRIGIGM
FLSTISIAIAALVEMKRLKIAQEHGLVDMPNATVPMRVWWLVPQYVLFGLCNVFTTIGL
QEFFYDQVPNELRSIGVSLYLSIIAVDHRGLPAKRSTSGGWRSTYFIIGTEVAKRSAYFGI
EANLVNYLTRPLGQSTAMAAKNVNTWFGIATLLPLVGAFVADSYIGRSRTTVILSLLYIL
VCDLLSFY

Vitis vinifera Vitvi_31 GSVIVG01026070001

MTIAGTPGGPESPLLEDIVDGYTDHKGRPARRSTSGCWRSAYFIIGVEVAERFAY
SGIQANLINYLTGRLGLSMATAAENVNTWSGTGGLLPLVGAFVADSYLGRYRTIIIASFL
YILGLGLLTLSAVLPSPSPSDCQKSNQITSCSPPQLQIILFFFSLYLVAVGQGGHKPCNQAF
GADQFDGRNPEECKAKSSFFNWWYFGLCFGTVINYSVLSYIQENLNWGLGFGIPCVVMI
AALLLFLLGTRTYRYSVKTDEKSPFVRIGKVFIAAAKNWRTMPSLVATEELAREAPHHQ
VSQQFKCLNKALLAPDGSKGNGRQCTIDNVEEAKAVLRLFPIWTTCLVYAIAFAQSSTFF
TKQGITMDRSIGWGIDIPASSLQGFIGLSIVLIVPIYDRILVPIARTLTRKPSGITMLQRIGTG
MFLSAISMVVAALVEMKRLKTAQEHGLVDMPNVTLPMSVWWLLPQYILFGVSDVVTIV
GLQEFFYDQVPTELRSVGIALYLSILGVGNFLSSFLISAIEKATGGDGQHSWFNDNLNRA

HLDNYYWVLAGLSAVGLSLYLYFAKSYIYNRGKNILPGVFCGWNSQRPPISAAGRHSR
WLHRLQGPSSQETHFRRLEIRIFHHGAEVAERFAYFGIQSNLINFFTDRLGQSNPTAGESV
NIWTGTGSLMP

Vitis vinifera Vitvi_32 GSVIVG01026071001

MVIAARTWLGPESPLLEDTVDGYTDHKGRPARRSTSGGWRSAYFIIGVEVAERF
AYYGIQANLINYLTGRLGQSIASAAENVNTWTGTGSLLPLVGAFVADSYLGRYRTIIIAS
LLYILGLGLLTLSAVLPSPSPSDCKESNQITSCSPPQLQIILFFFSLYLVAVGQGGHKPCTQ
AFGADQFDGRNPEECKAKSSFFNWWYFGLCFGTVITYSVLTYIQENLNWGLGFGIPCVV
MIAALLLFLLGTRTYRYSVKKDERSPFVRIGKVFIAAAKNWRTMPSLVATEELAREAPH
HQLSQQFKCLNKALLAPDGSKGNGRQCTIDDVEEAKAVLRLFPIWATCLVYAIVFAQSS
TFFTKQGITMDRSIGWGIDIPASSLQAFISLSIVLIVPIYDRILVPIARTLTRKPSGITMLQRI
GTGMFLSAISMVVAALVEMKRLKTAQEHGLVDMPNVTLPMSVWWLLPQYILFGVSDV
FTMVGLQEFFYDQVPIELRSVGIALYLSILGVGSFLSSFLISAIEKATVFYLFIVNPLHIKFV
RVESCNNL

Vitis vinifera Vitvi_33 GSVIVG01026072001

MAGTPGGPRSPLLEDTVDGSIDHKGRPAKRPTSGGWRSAYFIMGAEVAGRFAYF
GIQSNLINFLTDRLGQSVPSAAESVNTWTGTGSLMPLVGAFVADSYIGRYATIIIASLLYIL
GLGLLTLSAVLPVPSHSDCQKSNKTIPCSPPQLQMIFFFFSLYLVAVGLGGHKPCIQAFGA
DQFDGRNPVECIAKSSFFNWWIFGVFSVTIVTQSVLSYIQDNLNWGLGFGIPCIGMILGLL
LFLLGTRTYRYSVKGHERGPFMRIGQVFIAAAKNWLATPSSIATEDLAGGTLQQQDSQH
FKFLNKALLAQDDSKGNGRQCTIDDFEEAKAVLRLFPIGATCLAYAIVYAIVYAQSSTFF
TKQGFTMDRSIGSGFDIPAASLQAFIGLSIVLIIPIYDRIFVPIARTLTRKPSGITMLQRIGTG
MFLSGISMVIAALVEMKRLKTAQEHSLVDVPNATLPMKVWWLLPQYILFGITDVFTVV
GLQEFFYDQVPTELRSVGLALCHCIFGVGSFLSSFLISGIEKATGGDGQHSWFNNNVNRA
HLDYYYWVLAGLSAVGLSLYLYFARSYIYNRGRAL

Vitis vinifera Vitvi_34 GSVIVG01027876001

MGVENGVDDYTQDGTVDLKGNPVRRSKRGGWTACSFVVVYEVFERMAYYGIS
TNLVIYLTKKLHQGTVTSSNNVTNWVGTVWMTPVLGAYIADAYLGRYLTFVIASAIYL
AGMSLLTVAVSVPGLKPPRCVATDMADCKKASTLQLAVFFGALYTLAVGTGGTKPNIS
TIGADQFDDFDPKEKGHKLSFFNWWMFSIFFGTLFANTILVYIQDNVGWTLGYGLPTAG
LAISIVIFLAGTPFYRHRVPSGSPFTRMAKVIIAALRKWKTPVPTDPKELYELDLEEYAKK
GKFRIDSTPTLRFLNKACVKTGSKDPWMLCSVTQVEETKQMLRMIPILIATFVPSTMIAQI
NTLFVKQGTTLDRGIGSFNIPPASLTGFVTLSMLVSVVLYDRFFVTITRRLTKNPRGITLL
QRMGIGLVFHIFIMMVASLVERRRLSVAKDHGVVESGGQVPLSILILLPQFILMGTADAF
LEVAKIEFFYDQAPESMKSLGTSYSMTSLGIGNFLSSFLLTTVSHITKKHGHHGWILNNL
NASHLDYYYAFFAILNFLNFIFFIVVTKYYVYKAEVTDSMEVLEGQLRGLTPAVTNQEES
RT

Vitis vinifera Vitvi_35 GSVIVG01028391001

MEVAEERGGADGREEYTKDGTVDLKGRPILRSKTGRWRACSFIVGYEMCERMS
YYGIASNLVLYLTRELHEGTLKSANNVTNWAGFVWMAPILGAYIADAHLGRYRTFVIA
SGIYLLGMSLLTLAVSVPALKPPSCGHGVKDEDCEKHASTFQVGIFYFALYIIAIGTGGTK
PNISTMGADQFDDFDPKERTQKLSFFNFWMLGIVFGTLFSYTFLVYIQDNVGWSLGYGL
PTLGLALSILVFLVGTPLYRHRLPSGSPLTRMSMVLVAAVRKWKVPVPKDPKELHELSL
RDYSNLGNFRIDRTPTLRVLDKAAVKSGPTSPWMLCPVSQVEETKQMIKMIPVLIATLIP
STITAQVGTLFIKQGTTLNRSLGPHFDIPPACLTSFVVIFMFISLVIYERHFVPAIRKYTGDP
RGISLLQRLGIGLVLHIIIMVTACFAERTRLSVARENGILGKNQTVPLTIFILLPQFALMGIA
DAFVDVSKLEFFYDQAPQGMKSLGTSYFTTSVGIGNFLSSFLLTTVSHITKKHGHRGWIQ
NNLNTSRLDYFYAFYAILSFLNLLFFLLVAKFYVYNEEVDVIESKRELQKIIYHSVQCSQF
KAFNVILYFSQDL

Vitis vinifera Vitvi_36 GSVIVG01028392001

MSTTVAEERGGGDGREEYTEDGTVDLKGRPILRSKTGRWRACSFIVGYEVFERM
AYYGIASNLVLYLKRELHEGTVKSANNVTNWVGTVWMAPILGAYIADAHLGRYWTFV
IASGIYLLGMGLLTLAVSLPALKPPSCGHGVKDEDCDKRASTFQVAIFYLALYIIAAGTG
GTKPNISTMGADQFDDFQPKERIQKLSFFNWWMFSIFFGTLFSNTFLVYIQDTVGWSLGY
GLPTLGLAISVSVFLVGTPFYRHKVPSGSPFTRMFMVLVAAVKKRKVDVPNDPKELHEL
NLDEYAKSRTFRIDHTPSLRLLDKAAVKSGPTSPWMLCPVTQVEETKQMIKMIPILVSTF
LPSTMLVQVSTLFIKQGDTLDRNMGPNFVIPPACLTAFVTIFMLISIVIYDRWFVPLVRKY
TGNPRGITMLQRIGIGIVLQIIVMVTACLAEMRRLRVARENGIFGKTQTVPLTIFILLPQFA
LMGIADTFVEVAKIEFFYDQAPQGMKSLASWNGRVVNCIHGLSPKERYLVHSWVGTQV
LHRVMTIYVEHCESFGHDKHAFLVTVTVYLHFLSFSIPTSLLCLSGNH

Vitis vinifera Vitvi_37 GSVIVG01030494001

RGNYVQTEACTYNTAPLIGVFGKLLQLEENEDGQTQNLGCRHHGHRMISPKCMT
WYKLYNHSNPNFCATTRCGRHEMPTNIRLLSYFLPQSFTSVYINYNPSLVNSTTNHPISA
LLSLSLSLSLSPSPSAKMVLVDAHAGKDGTDDGALDFRGNPVDKTRTGGWLGAGLILG
TEFAERVCVMGISMNLVTYLVQNLHISAAKSATIVTNFMGTLNLCGLLAGFLADAKLGR
YLTVAIFGSITALGVILLTVATTIPSMRPPPCSDYMRQHHQCIEANGSQLAMLYAALYTIA
LGGGGIKSNVSGFGSDQFDNSDPKEEKAMIFFFNRFYFCVSIGSLFAVTVLVYIQDNVGR
GWGYGISAVTMVIAVTILLGGTPFYRFKMPRGSPLTVIWRVIFLAWRKRNLPYPSHPSLL
NEYHNAKVSHTQRFRCLDKAAILEDYYSASGNKDNPWIVSTVNQVEEVKMVIKLLPIW
STCILFWTVYSQMTTFTIEQATFMNRKLGSFVVPSGSFSVFLFISILLFTSLNERIFVPCAR
KLTHNVQGVTSLQRVGIGLIFSMVAMVTAAIVEKQRREAAVQHKTNISAFWLVPQFFLV
GAGEAFAYVGQLEFFIREAPDRMKSMSTGLFLSTLAMGFFVSSLLVSLVDKVTNMRWL
RSNLNRGKLDNFYWMLAVLGVLNFLAFLVFAMRHQYKTLQYKSPDVYGENELKKGW
NEGITSEMEKKERVEGKEEP

Vitis vinifera Vitvi_38 GSVIVG01031343001

MLKSHVCVSGGQEATKAGYKSLFEKANNGKGGFRASMFIYILTSLENMGFVAN

MVSLFSYFYGLMHFDLSGAANTLTNFMGATFLLSLVGGFVSDTLLSRLNTCLIFGTIELL
GLMLMTIQAYSNKLHPADCGKPSCVEGGTAVMFYVSLCLYALGSGGVRGALPALGAD
QFNQKDPNEAEALASFFNWVILSATVGASVGVTVIVWVSSTVTWYWGFFISLVTAFIGFI
VLALGRRFYRIQPHGQSPIIRTVQVIVVAIKNRSLSPPESPGELYEINDQVTDFTDPKLAHT
DQFRCLDKAAILGKDSEPRPWEVCTVTQVEEVKILTRMLPILFSTIIMNTCLAQLQTFSVH
QGNEMDRFLGSFEVPASSIPIIPLVFMSILIPIYEFVFVPFARKITGHPAGITQLQRVGIGLV
LSAISMAVAGLVEVKRRNEALEIPPRKISLFWLSFQYGIFGIADMFTLVGLLEFFYKEAPK
GMRSLSTSFTWVSLSFGYFLSTIFVDIINSVTKRIAPSKQGWLHGSYINKNNLNLFYYFLA
ILSCINFVNYLYWASWYKYKAEDRPDTELKLKALSAPPVFRKESTQDNIGAITNGAASA
EHTEDAKEDGGKLLNPASESRKSDAHTGC

Vitis vinifera Vitvi_39 GSVIVG01032550001

MAGGQRSRGLNKPCILLIVVAGMERFAFKGVVSNLVTYLTDVVKMSNSTAAKT
VNSWCGLTSMLALLVAPLADSYWYRYSTILASSFLYIIGLLALTSTALVGTWIPEDRTSG
SSFLFWSLYLISLGLGGYNPSLQAFGADQLETEEDLPCTKDEKNPDSKSLFFQWWYFGIC
SGSLLGVTVMSYIQDTSGWGIGFAIPTIVMIASIAFFSCGTRFYTYRQDRDVNWKTLETIV
QAIKAITSKMMNCGINLPANKSSHVIELELQEKPLCRDTKDLAENHKSGIYLPESIKVVLR
LFPIWTMLLMFAVIFQQPATFFTKQGMTMKRNIGRNLLIPPAMLQSAITVSIIVLMPLYD
KVLIPFTRLITRKEKGINVMQRMGIGMVLSIIAMVIAALVEKKRLSISSKLESQSETVPLSI
FWLLPQYIILGIADIFTVVGMQEFFYGEVPIRMRTMGIALYSSVFGVGSFMSAFLIWLIEIF
TSSGGRQGWFSDDMREARLDKYYWLLALSSTFSLLLYMLLCKYYKSRSELDTKMTGFP
NALVFPSFTRVV

Vitis vinifera Vitvi_40 GSVIVG01032603001

MEKEEKAILSDESPEVINYRGVKAMPFIIGNETFEKLGTIGTSSNLMVYLTSVFNIK
SVTAATLINIFNGTTNMAPLLGAFLSDSYFGRFKTLALASICSLSGMTVIMLTAAISKLHP
PHCGTKETELCRGPTTSQLAFLLTGFGLLIIGAGGIRPCNLAFGADQFNPATESGKRGINS
FFNWYYFTFTFAVMISGTFIVYVQSNVSWALGLGIPSCLMFVSCVLFFAGSRIYVKVKPR
GSPLTGVAQVLVAASKKRYFKLPDHPELSLFSHVPTNYMNSKLPHTDQFRFLDKSAIITM
EDQINTDGSASNPWRLCSMQQVEEVKCLMRVIPIWASSIIYHVAIVQQHTYAVLQALQS
DRHLGSFEVPAASYSIFSMLSLTIWIPIYDRIVIPFLHKLTGKEDGITLLQRMGTGIVLSVA
TMLVSAVIEEQRRTFARTRPTIGTAPKGGAISSMSASWLIPQLILAGLSEAFNSIGQIEFYY
KQFPENMRSIAGSFFFCGIAGSNYLSGFLVSVVHQITLNGARGGDWLPEDLNKGKLDCF
YYMIAALGAVNFAYFLVCSKWYRYKGGDRVEVAMETKGSRKHVV

Vitis vinifera Vitvi_41 GSVIVG01032716001

MEAKGYTQDGTVDLQGRPVIASKTGKWRACAFLVGYEAFERMAFYGVASNLV
VYLTTQLHEDNVSSVRNVNNWSGSVWMTPILGAYIADSYLGRFWTFTVSSLIYVLGMV
LLTMAVSLKFLKPTCANGVCNKASTSQIAFFYSALYIIAVGSGGTKPNISTFGADQFDDF
NAKEKELKVSFFNWWMFSSFLGALFATLGLVYIQENLGWGLGYGIPTVGLLLSLFIFYIG
TPIYRHKVRKSKSPARDLIRVLIAAFKNRKLTLPTQPSELHELELQHYSSSGKRQVHHTPT
FSFLDKAAIKEGNMGTTRPPCTVTQVEGTKLVFGMIMIWLVTLIPSTIWAQINTLFVKQG

TTLDRHLGSSFRIPAASLGSFVTLSMLLSVPMYDRYFVPLMRRKTGNPRGITLLQRIGIGF
MLQVIAVAIAYGVELRRMHVIRIHQVVGPKEVVPMSIFWLLPQYVLIGIGDVFNAIGLLE
FFYDQSPEDMQSLGTTFFTSGIGVGNFLNSFLVTVVDKITRRGGGKSWIGKNLNDTHLD
YYYGFLLVISALNLGAFLWASGKYIYKRENIEVYVDGVQVESKALDTSPLAIQV

Vitis vinifera Vitvi_42 GSVIVG01034004001

MAEEDIYTKDGTIDFRSNPAVKKETGTWKACPYILGNECCERLAYYGINTNLVN
YLKFQLNQRNVVAINNVTNWSGTCYVTPLLGAFLADAYLGRYWTIAGFSIIYVFGMTLL
TLSASAHGLKPLCDGQNVCYPTGLQTAVFFVGLYLIALGTGGIKPCVSSFGADQFDDSD
ETERKSKSSFFNWFYFSINIGALLASSVLVWVQTNVGWGWGFGIPAVAMGIAVMSFFSG
TRLYRNQKPGGSPLTRICQVIVASLRKFQVEVPADKCLLYETADSESAVTGSRKLDHTK
HLSFFDKAAVETHIDAIKGSVDSWRLCTVTQVEELKSIIRLLPIWATGIVFSAVYSQMGTL
FVLQGNTMDLHITGSFQIPSASLSLFDTISVIFWVPIYDRLIVPFARKFTGHKSGFTQLQRI
AIGLVISIFAMLVAGTLELLRLRMVREHNYYELKHIPMSIFWQVPQYFIIGCAEVFTFIGQ
LEFFYEQAPDAMRSLCSALSLTTAALGNYLSTLLVNVVTDVSTRGGKPGWIPDNLNYG
HLHYFFWLLAALSVFNLGVYLQNIAQIQGYHCKKMKIYAFYLEYLALQATDGQRCDIFP
YLAGDWKANRARSPGFSRIPSAPKPYPLTETCLLLSDFHSRYVSSLSPL

Vitis vinifera Vitvi_43 GSVIVG01035643001

ANEQGLDEQPAATLNMSAMWLLPQFILFGFAEAFSAIGQIEFYYSQFSKSMSSIA
VALFTVGIAGSNLVGSLLVNVVNSVTSKGGKESWLSSNLNKGHLDYYYWLITILCLINII
YFLVCCWSYGPFEDEKPGISDEGEANIDKLQILTVMEQIIAEDQMGFAPNPNRSRYPPPK
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DAPVAADGRLLHTDQLRQVLLTSCLLLQTLVSCALQRFLDRAAVLTTGDLSDSGEPNL
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MIIFTTLTMLVSLALYDRVFVPVARRYTGRRSGGITYFQRMGAGFAVSVLGVLAGALVE
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SSAAALFWVAGSLGNYLGTVLVTVVQSATRGVWLQDNINKGRLDYYYWLVTFLLVLN
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Zea mays Zeama_43 GRMZM2G361652

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PAPCKPGGAVACQEAAPWQLAVLYVSLLLNAVGAGGYRPCIVAFGADQFDESRAAER
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YPMYRRLEPAGSPFTRLAQVVVAAVKKRRLPAADVDPALLYEDDELDAPISMYGKLVH
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AAGILVITGSSTQNTFSLQQASTMDRRLAPGLSTFEIPAGSMTVFGLLAMLFTLFVYDRA
LIRVARRFTGLDRGISFLHRMGVGFAISVLATLVAGFVERHRRDAAAAAGATDAGTSPL
SAYWLVPQYALHGVAEAFTSVGHLEFMYDQAPESMRSTATALFWLSISLGSYASTLLV
DAVHRWSAGPGGANWLPDNINHGKLDYFYWVVTVLQVMNLVYYAICAKRFTFKPVQ
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Zea mays Zeama_44 GRMZM2G375113

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CGFSFGGDGEPSQLQRMGAGRLLMALAMAVAALVEMKRLGSAARGEEITIAWQIPQYF
FLAGAEVLCYIAQLEFFYEEAPETMKSTCTSLALLTIALGSYLSSFIYAIVAAFTATADSP
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Zea mays Zeama_45 GRMZM2G378604

MPSRSDSDSLLVRAEGMRDAALDYHGRPADRGATGGWRSALFIIAVEIAERFTF
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AVMAAALAVFLLGTRTYRYYVTAGQGLFARAGEAFAEWRSRRKAGQLVQDSQELDPP
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FLSLLSMVIAALVEKHRLRVAGDAGLVDKPKVPVPMSLWWMVPQYVLFGAADVFTM
VGLQEFFYDQVPDKLRSLGLALYLSIFGVGSFISSALVSVIDRVTTDRGGSWFSNNLNRG
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Zea mays Zeama_46 GRMZM2G400602

MDANTLLLPCSDGAVAGAVDFRGRPASRSGTGRWSAAMFVLGVEIAERFAYHG
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FVVSMGMLTVSALPAFHHDGCSSYASASRPLACSPPPVQVGVFYVSLYLVALAEAGHK
PCAQAFGADQFDQNDPKESASRSSFFNWWYFGMCSGTAVTTMVSSYIQDNVGWGLGF
GVPCLVMLFALLMFLLGTRNYRYYTYTESSPFARLATAFVALIKGSKSRQHDGTLASDD
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VTIMAFIPVYDRAFVPLARRLTRLSSGITMLQRIGTGLVLALVAMVVAALVEMRRLAVA
RDAGLVDQPKAALPMSLWWMVPQYVLFGLSDVFAMIGLQEFFYDQVPDALRSLGLAF

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Zea mays Zeama_47 GRMZM2G419328

MASLALKPSGCGLCTACTRTCIHGGDGGTRPDITPASNCFQFIAYFAVSTNLVNY
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DKSRPASAWRLCTVTQVEELKCVLRLLPVWASGIVFAAAYTQMTTTFVLQGDTLDPYV
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Zea mays Zeama_48 GRMZM2G472167

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LYIVALGNGGTKPNISTIGADQFDEFDPRERTHKLSFFNWWMFTIFLGILFSSTVLVYLQD
NVSWSVGYGIPTLGLMVSISVFLAGTRLYRHRVPQGSPFTSMGRVLAAALWKWSVPVP
ADAKELHELDVEEYARKRRFRMDSTDAMAFLNKAAAVAVPSGGPASTPAWSLCTVTQ
VEETKQILRLVPLLVAMIVPCTLIAQTNTLFVKQGTTMDRHMGPRFEIPAASLGAFVTLT
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RSHGLDATGGQLGLTIFALLPQFVLMGLADAFLVVGKIEFFYDQAPESMKSLGTAMSLT
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SARYRYKAQSTDRIDAAVGLGTEKAKLQAEPLG

Zea mays Zeama_49 GRMZM2G476069

MDGKKVQERAAWCVSDGGGNLVQDAVDYRGCRADKSSTGGWASAALAVGIE
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TIAIFAVVQAIGTGLLAVSTEVRQLRPPPCGPGAAGPCEQATGLQMGVLYVCLYLIALGT
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CAYGICAGAMLVAVAVFLSGTRRYRYKRSSGSPIVHILQVLVAATRKRNIVMQPLTAAA
LYEDHPEHARIPHTAQFPCLDRAAVMAGDDDNEVGHDGRPTMNPWKLRSVSRVEEVK
MVARLMPVWATTILFWTMYAQMITFSVEQATTMDRRMGGFEIPAASLTVFFVGAIMLT
LAFYDRVFVPLCRSLMTGRQGFTNLEKIGIGLVLSTFGMAAAAICEKKRLAVAATSVAV
GHGSLPISVFMLTPQFLLVGSGEAFIYTGQLDFFIMRSPKSMKTMSTGLFLTTLSLGFFLS
SALVSLVKSCTRWLGDTINHSRLDYFYWLLAVLGVVNLVAYIVYAMWAAAPASSQAE
QPQHAMAADEKC

Zea mays Zeama_50 GRMZM5G811593

MDAQDGDERPLIIHRLPLLQDESTSEFTSDGTVDLRNQPARKQRTGKWKACFFIL
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RYWTILAFLSVYVTGMTVLTASALLPLLMGASYSRSAHRLFAYLGLYLAALGTGGIKPC
VCALGADQFDASDPVERRAKGSFFNWYYFSINIGSLLSATVVVWVQDNVGWGVGFAIP
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APPGTTEGNDSTMQHTSQFRFLDKAAIVAPSSGEKGATASPWRLCTVSQVEELKTVLRM
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LVPLARRATGKERGLSQLQRLGVGLALSVAGMVYAALLEARRLSLARAAADGRPPMSI
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SS

Zea mays Zeama_51 GRMZM5G827496

MGTATAAMDRNADGEQGKRKKKGGFRTMPLILASEVCDRFATAGFGANLITYL
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CDKDCELSSLQKNGSGAALV

Zea mays Zeama_52 GRMZM5G867390

MAGAERAEAVALEQGLLDPEESNQVVYTGDGSVDFSGNPVVKERTGRWKACPF
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LGFGIPTVFMGLAIISFFSGTSLYRFQKPGGSPITRVCQVIVASLRKWNVPVPEDSSLLYEL
PNGVSTIEGSRQIEHTDELRCLDKAATVTEVDVKTADFNNPWRICTVTQVEELKILVRMF
PVWATTIVFSAVYAQMSTMFVEQGMVLDPSLGSFKIPPASLSTFDTLSVIICVPMYDYIV
VPIARRFTGNERGFTELQRMGIGLVISIMAMSVAAVLEIKRLAVAREAHLVDQNVPVPLS
IFWQIPQYFLIGLAEIFTFIGALEFFYDQSPDAMRSLCSALNLLTTAFGNYLSTFILTMVAY
FTTRGGNPGWIPDNLNEGHLDYFFLLIAGISFLNLIVYVLCAGKYKSKKAA

NRT2:

Organism Name in Phylogeny Accession Number Sequence

Aquilegia coerulea AcNRT2-A AcoGoldSmith_v1.015105m

MANTDIEGAPGSSMHGVTGREQSFAFSVASPMVPTDTTAKFDLPVDSEHKSKVF
KLFSLANPHMRTFHLSWISFFTCFVSTFAAAPLVPIIRDNLNLVKGDIGNAGIASVSGSIFS
RLCMGAVCDLLGPRYGCAFLMMLSAPTVFSMSLVSSPGGYVAVRFMIGFSLATFVSCQ
YWMSTMFNGKIIGLVNGTAAGWGNMGGGATQLIMPMLFELIRKLGSTPFTAWRIAFFIP
GCMHIFTGILVLTLGQDLPDGNLSSLQKKGDVAKDKFSKVLWYAVTNYRTWIFVLLYG
YSMGVELTTDNVIAEYMFDRFDLKLHTAGIIAASFGMANIVARPFGGWMSDYGARRFG
MRARLWNLWILQTLGGVFCIWLGRATSLPISVFAMILFSLCAQAACGATFGVIPFISRRSL
GIISGLAGAGGNFGSGLTQLLFFTSTAYSTATGISLMGIMIVACTVPVAFVHFPQWGSMF
LPASQDVKRNEESYYVSEWTEEERQKGLHQNSIKFAENSRSERGRRVASAPTPPNATPIR
V

Aquilegia coerulea AcNRT2-B AcoGoldSmith_v1.019656m

MADSDIEGAPGSSMHGVTGKEQSFAFSVASPMVPTDTTAKFDLPVDSEHKSKVF
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RLCMGAVCDLLGPRYGCAFLMMLSAPTVFSMSLVSSPGGYVAVRFMIGFSLATFVSCQ
YWMSTMFNGKIVGLVNGTAAGWGNMGGGATQLIMPMLFELIRKLGSTPFTAWRIAFFI
PGCMHIFTGILVLTLGQDLPDGNLSSLQKKGDVAKDKFSKVLWYAVTNYRTWIFVLLY
GYSMGVELTTDNVIAEYMFDRFDLKLHTAGIIAACFGMANIVTRPFGGWMSDYGARRF
GMRARLWNLWILQTLGGVFCIWLGRATSLPISVFAMILFSICAQAACGATFGVIPFISRRS
LGIISGLAGAGGNFGSGLTQLLFFTSTAYSTATGISLMGIMTVACTIPVAFVHFPQWGSM
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HV

Arabidopsis lyrata AlNRT2-A 334098

MGDSTGEPGSSMHGVTGREQSFAFSVQSPIVHTDKTAKFDLPVDTEHKATVFKL
FSFAKPHMRTFHLSWISFSTCFVSTFAAAPLVPIIRENLNLTKQDIGNAGVASVSGSIFSRL
VMGAVCDLLGPRYGCAFLVMLSAPTVFSMSFVSGAAGFITVRFMIGFCLATFVSCQYW
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HIIMGILVLTLGQDLPDGNRAALEKSGEVAKDKFGKIMWYAVTNYRTWIFVLLYGYSM
GVELSTDNVIAEYFFDRFHLKLHTAGLIAACFGMANFFARPAGGYASDFAAKYFGMRG
RLWTLWIIQTAGGLFCVWLGRANTLVTAVVAMVLFSLGAQAACGATFAIVPFVSRRAL
GIISGLTGAGGNFGSGLTQLIFFSTSHFTTEQGLTWMGVMIVACTLPVTLIHFPQWGSMF
LPPSKDPVKGTEEHYYGSEWNEQEKERNMHQGSLRFAENAKSEGGRRIRSAATPPENTP
NNA

Arabidopsis lyrata AlNRT2-B 917822

MADGFGEPGSSMHGVTGREQSYAFSVESPVVPSDTSAKFSLPVDTEHKAKVFKL
LSFEAPHMRTFHLAWISFFTCFISTFAAAPLVPIIRDNLNLTRQDVGNAGVASVSGSIFSRL
VMGAVCDLLGPRYGCAFLVMLSAPTVFSMSFVANAGGYITVRFMIGFCLATFVSCQYW
MSTMFNGQIIGLVNGTAAGWGNMGGGVTQLLMPMVYEIIRRLGSTSFTAWRMAFFVP
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YSMGVELTTDNVIAEYFFDRFHLKLHTAGIIAASFGMANFFARPIGGWASDIAARRFGM
RGRLWTLWIIQTLGGFFCLWLGRATTLPTAVVFMILFSLGAQAACGATFAIIPFISRRSLGI
ISGLTGAGGNFGSGLTQLVFFSTSTFSTEQGLTWMGVMIMACTLPVTLVHFPQWGSMFL
PSTEDEVKSTEEYYYMKEWTEPEKQKGMHEGSLKFAVNSRSERGRRVASAPSPPSATPE
HV

Arabidopsis lyrata AlNRT2-C 470866

MGDSNGEPGSSMHGVTGREQSYAFSVDTPTVPTNTKKKYNLPVDAEDKATVFK
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VMGAVCDLLGPRYGCAFLVMLSAPTVFSMSFVSGAAGFITVRFMIGFCLATFVSCQYW
MSTMFTSQIIGLVNGTAAGWGNMGGGITQLLMPIVYEIIRRCGSTAFTAWRIAFFVPGWL
HIIMGILVLTLGQDLPGGNRAAMEKSGEVAKDKFGKILWYAVTNYRTWIFVLLYGYSM
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LWTLWIIQTAGGLFCVWLGRANTLVTAVVSMVLFSLGAQAACGATFAIVPFVSRRALGI
ISGLTGAGGNFGSGLTQLVFFSTSRFTTEEGLTWMGVMIVACTLPVTLIHFPQWGSMFLP
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Arabidopsis lyrata AlNRT2-D 937163

MAYQNDDEGSIGTSMHGVTAREQVFSFSVDGNASHLIQVVRSDDPTAKFSLPVD
SEHRAKVFKPFSFAKPHMRAFHLGWISFFTCFISTFAAAPLVPIIRDNLDLTKNDIGNAGV
ASVSGAIFSRLAMGAVCDLLGARYGTAFLLMLSAPTVFSMSFVANAGGYLAVRFMIGF
CLATFVSCQYWTSVMFNGKIIGLVNGCAGGWGDMGGGVTQLLMPMVFHVIKLAGASP
FVAWRIAFFVPGFLQVIMGILVLTLGQDLPDGNLSTLQKKGDVSKDKFSKVFWYAVMN
YRTYVLFLLYGFSMGIEMTINNVISEYFFDRFQLQLHTAGMIAASFGMANFFARPLGGY
ASDMSARFFGMRGRLWTLWILQTSGGLFCVWLGRATSLPIAILAMMLFSVGVQAACGA
IFGIVPFVSRRSLGLISGLTGAGGNFGSGLTQLIFFSSSRFHTADGLSMMGIMAMVFTLLV
AFIHFPQWGSMFFGPTSDEKKVLEEHYYAAEWTEEEKRQGLHEGSLKFAENSRSERGRK
AAVDGASTPENRTPAHV

Arabidopsis lyrata AlNRT2-E 332328

MAHNHSNEEGSIGTSLHGVTAREQVFSFSVDASSQTVQSDDPTAKFALPVDSEHR
AKVFNPLSFAKPHMRAFHLGWLSFFTCFISTFAAAPLVPIIRDNLDLTKTDIGNAGVASVS
GAIFSRLAMGAVCDLLGARYGTAFSLMLTAPIVFSMSFVGGPSGYLGVRFMIGFCLATF
VSCQYWTSVMFNGKIIGLVNGCAGGWGDMGGGVTQLLMPMVFHIIKLAGATPFMAWR
ISFFAPGFLQVVMGILVLSLGQDLPDGNLSILQKRGQVSKDKFSKVFWFAVKNYRTWILF
VLYGSSMGIELTINNVISGYFYDRFNLKLQTAGIVAASFGMANFIARPFGGYASDVAARI
FGMRGRLWTLWIFQTVGALFCIWLGRASTLPIAILAMVLFSIGTQAACGALFGVAPFVSR
RSLGLISGLTGAGGNFGSGLTQLLFFSSSRFSTAEGLSLMGVMAVLCTIPVAFIHFPQWGS
MFLRPSSDGERSQEEYYYSSEWTENEKQQGLHEGSIKFAENSRSERGRKVALTDIPTPAN
ATPSHV

Arabidopsis lyrata AlNRT2-F 484901

MAHNHSNEDGSIGTSLHGVTAREQVFSFSVQEDGPSSQAVRSDDPTVKFALPVD
SEHRAKVFKPLSFAKPHMRAFHLGWISFFTCFISTFAAAPLVPVIRDNLNLTKTDIGNAG
VASVSGAIFSRLAMGAVCDLLGARYGTAFSLMLTAPAVFSMSFVADAGSYLAVRFMIG
FCLATFVSCQYWTSVMFSGKIIGLVNGCAGGWGDMGGGVTQLLMPMVFHVIKLTGAT
AFTAWRFAFFIPGILQIIMGILVLTLGQDLPDGNLSTLQKSGQVSKDKFSKVFWFAVKNY
RTWVLFMLYGFSMGVELTINNVISGYFYDRFNLTLHTAGIIAASFGMANFFARPFGGYA
SDVAARLFGMRGRLWILWILQTVGALFGIWLGRASSLPIAILAMMLFSIGTQAACGALF
GVAPFVSRRSLGLISGLTGAGGNFGSGVTQLLFFSSSRFSTAEGLSLMGVMAVVCSLPVA
FIHFPQWGSMFLRPSQDGEISKEEHYYGAEWTEEEKSLGLHEGSIKFAENSRSERGRKA
MLADIPTPETGSPTHV

Arabidopsis thaliana AtNRT2-1 AT1G08090

MGDSTGEPGSSMHGVTGREQSFAFSVQSPIVHTDKTAKFDLPVDTEHKATVFKL
FSFAKPHMRTFHLSWISFSTCFVSTFAAAPLVPIIRENLNLTKQDIGNAGVASVSGSIFSRL
VMGAVCDLLGPRYGCAFLVMLSAPTVFSMSFVSDAAGFITVRFMIGFCLATFVSCQYW
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LGIISGLTGAGGNFGSGLTQLLFFSTSHFTTEQGLTWMGVMIVACTLPVTLVHFPQWGS
MFLPPSTDPVKGTEAHYYGSEWNEQEKQKNMHQGSLRFAENAKSEGGRRVRSAATPPE
NTPNNV

Arabidopsis thaliana AtNRT2-2 AT1G08100

MGSTDEPGSSMHGVTGREQSYAFSVDGSEPTNTKKKYNLPVDAEDKATVFKLFS
FAKPHMRTFHLSWISFSTCFVSTFAAAPLIPIIRENLNLTKHDIGNAGVASVSGSIFSRLVM
GAVCDLLGPRYGCAFLVMLSAPTVFSMSFVSDAAGFITVRFMIGFCLATFVSCQYWMST
MFNSQIIGLVNGTAAGWGNMGGGITQLLMPIVYEIIRRCGSTAFTAWRIAFFVPGWLHII
MGILVLTLGQDLPGGNRAAMEKAGEVAKDKFGKILWYAVTNYRTWIFVLLYGYSMGV
ELSTDNVIAEYFFDRFHLKLHTAGIIAACFGMANFFARPAGGWASDIAAKRFGMRGRLW
TLWIIQTSGGLFCVWLGRANTLVTAVVSMVLFSLGAQAACGATFAIVPFVSRRALGIISG
LTGAGGNFGSGLTQLVFFSTSRFTTEEGLTWMGVMIVACTLPVTLIHFPQWGSMFFPPSN
DSVDATEHYYVGEYSKEEQQIGMHLKSKLFADGAKTEGGSSVHKGNATNNA

Arabidopsis thaliana AtNRT2-3 AT5G60780

MTHNHSNEEGSIGTSLHGVTAREQVFSFSVDASSQTVQSDDPTAKFALPVDSEHR
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GAIFSRLAMGAVCDLLGARYGTAFSLMLTAPTVFSMSFVGGPSGYLGVRFMIGFCLATF
VSCQYWTSVMFNGKIIGLVNGCAGGWGDMGGGVTQLLMPMVFHVIKLAGATPFMAW
RIAFFVPGFLQVVMGILVLSLGQDLPDGNLSTLQKSGQVSKDKFSKVFWFAVKNYRTWI
LFVLYGSSMGIELTINNVISGYFYDRFNLKLQTAGIVAASFGMANFIARPFGGYASDVAA

RVFGMRGRLWTLWIFQTVGALFCIWLGRASSLPIAILAMMLFSIGTQAACGALFGVAPF
VSRRSLGLISGLTGAGGNFGSGLTQLLFFSSARFSTAEGLSLMGVMAVLCTLPVAFIHFP
QWGSMFLRPSTDGERSQEEYYYGSEWTENEKQQGLHEGSIKFAENSRSERGRKVALANI
PTPENGTPSHV

Arabidopsis thaliana AtNRT2-4 AT5G60770

MADGFGEPGSSMHGVTGREQSYAFSVESPAVPSDSSAKFSLPVDTEHKAKVFKL
LSFEAPHMRTFHLAWISFFTCFISTFAAAPLVPIIRDNLNLTRQDVGNAGVASVSGSIFSRL
VMGAVCDLLGPRYGCAFLVMLSAPTVFSMSFVGGAGGYITVRFMIGFCLATFVSCQYW
MSTMFNGQIIGLVNGTAAGWGNMGGGVTQLLMPMVYEIIRRLGSTSFTAWRMAFFVP
GWMHIIMGILVLTLGQDLPDGNRSTLEKKGAVTKDKFSKVLWYAITNYRTWVFVLLYG
YSMGVELTTDNVIAEYFFDRFHLKLHTAGIIAASFGMANFFARPIGGWASDIAARRFGM
RGRLWTLWIIQTLGGFFCLWLGRATTLPTAVVFMILFSLGAQAACGATFAIIPFISRRSLGI
ISGLTGAGGNFGSGLTQLVFFSTSTFSTEQGLTWMGVMIMACTLPVTLVHFPQWGSMFL
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Arabidopsis thaliana AtNRT2-5 AT1G12940

MEVEGKGGEAGTTTTTAPRRFALPVDAENKATTFRLFSVAKPHMRAFHLSWFQF
FCCFVSTFAAPPLLPVIRENLNLTATDIGNAGIASVSGAVFARIVMGTACDLFGPRLASAA
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Arabidopsis thaliana AtNRT2-6 AT3G45060

MAHNHSNEDGSIGTSLHGVTAREQVFSFSVQEDVPSSQAVRTNDPTAKFALPVD
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Arabidopsis thaliana AtNRT2-7 AT5G14570

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Brachypodium distachyon BdNRT2-A Bradi3g01270.1

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Brachypodium distachyon BdNRT2-B Bradi3g01250.1

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Brachypodium distachyon BdNRT2-C Bradi3g01290.1

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Brachypodium distachyon BdNRT2-D Bradi3g01280.1

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Brachypodium distachyon BdNRT2-E Bradi2g47640.1

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Brachypodium distachyon BdNRT2-F Bradi2g26210.1

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Cucumis sativus CcNRT2-A Cucsa.268720.1

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Cucumis sativus CcNRT2-B Cucsa.286270.1

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Carica papaya CpNRT2-A evm.model.supercontig_65.29

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HMV

Carica papaya CpNRT2-B evm.model.supercontig_56.19

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PHV

Carica papaya CpNRT2-C evm.model.supercontig_65.30

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Chlamydomonas rinhardtii CrNRT2-A Cre09.g396000

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Chlamydomonas rinhardtii CrNRT2-B Cre09.g410800

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Chlamydomonas rinhardtii CrNRT2-C Cre09.g410850

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Glycine max GmNRT2-A Glyma11g20090.1

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A

Glycine max GmNRT2-B Glyma13g39850.1

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Glycine max GmNRT2-C Glyma12g30050.1

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Manihot esculenta MeNRT2-A cassava4.1_030050m

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Manihot esculenta MeNRT2-B cassava4.1_031095m

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Manihot esculenta MeNRT2-C cassava4.1_031702m

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Mimulus guttatus MgNRT2-A mgv1a025664m

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Mimulus guttatus MgNRT2-C mgv1a004568m

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Mimulus guttatus MgNRT2-D mgv1a025562m

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Mimulus guttatus MgNRT2-E mgv1a004332m

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TPNHV

Mimulus guttatus MgNRT2-F mgv1a005457m

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Mimulus guttatus MgNRT2-G mgv1a022931m

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Mimulus guttatus MgNRT2-H mgv1a004788m

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Medicago truncatula MtNRT2-A AC233663_16.1

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Oryza sativa OsNRT2-1 LOC_Os01g50820

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Oryza sativa OsNRT2-2 LOC_Os02g02190

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NSPEHA

Oryza sativa OsNRT2-3 LOC_Os02g02170

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Oryza sativa OsNRT2-4 LOC_Os01g36720

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Physcomitrella patens PpNRT2-A Pp1s12_58V6

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Physcomitrella patens PpNRT2-B Pp1s12_378V6

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Physcomitrella patens PpNRT2-C Pp1s75_75V6

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ARRFGMKGRLCTLWICHSLGAVFCIVLGRMDSLTAAIAVLIVFAVFIQASSGAVFGIIPFIS
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Physcomitrella patens PpNRT2-D Pp1s100_222V6

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Physcomitrella patens PpNRT2-E Pp1s100_228V6

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Physcomitrella patens PpNRT2-F Pp1s106_166V6

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Physcomitrella patens PpNRT2-G Pp1s254_65V6

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Physcomitrella patens PpNRT2-H Pp1s449_20V6

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Prunus persica PrpNRT2-A ppa004104m

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SHV

Prunus persica PrpNRT2-B ppa021664m

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Populus trichocarpa PtNRT2-6 POPTR_0009s01420

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RV*

Populus trichocarpa PtNRT2-7 POPTR_0143s00200

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TPNRV

Populus trichocarpa PtNRT2-A POPTR_0009s01410

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Populus trichocarpa PtNRT2-B POPTR_0012s08950

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PAVYFTSIASSPTSFLLVRFFTGFSLATFVSTQFWMSSMFSARVVGTANGVAAGWGNLG
GGATQLIMPLVFGLIRDIGVLKFTAWRIAFFIPALFQTLSAFAVLIFGKDLPDGNFRPLQK
AGAKPKDKLSNVFYHGITNYRGWILALTYGYCFGVELTVDNIIAEYFYDRFDLKLHTAG
IIAASFGLANIVSRPAGGLISDAVAKRFGMRGRLWALWIVQTLGGVFCILLGRVESLGASI
LVMIVFSFFCQAACGLTFGVVPFVSRR

Populus trichocarpa PtNRT2-C POPTR_0001s35030

MRAFHLAWLSLFSCFFSTFSIPPLLPIIRDDLKLTETDIGNAGIASFVGSIFSRLAMG
PACDLMGPRLASATLSLATAPIIMSASLVTSPTCFILIRFGVGFSLANFVASQFWMTSMFS
PSVVGLANGVSAGWANMGAGVAQLVMPQIYYLLISLLDLPLSTAWRVSFLIPGLFQAV
TAIMVLAYGQDLPSGSYKDFRKAIKTPKDNFSEMLYNGLTNYRGWILALTYGYCFGSEL
TTDNIIAHYFYDRFGVNLQVAGMIAASVGLANLFSRPMGGALSDKMGRSFGMRGRLW
GLWLVQTVAGLLCVLLGRVTSLWGSIAVLCIFSVFVQAASGLTFGVVPFVSKRYV

Populus trichocarpa PtNRT2-X POPTR_0015s09290

MEIEGQATVKESQPPKFALPVDSEHKATEFRLFSVAAPHMRAFHLSWVSFFACFV
STFAAPPLLPIIRDNLNLTASDIGNAGIASVSGAVFARVAMGTACDLFGPRLASASLILITA

PAVYFTSIASSSTSFLLVRFFTGFSLATFVSTQFWMSSMFSAPVVGTANGVAGGWGNLG
GGATQLIMPLVFGLIRDIGAIKFTAWRIAFFIPALFQTLSAFAVLIFGKDLPDGNFGRLQK
AGDKTKDKFSNVFYHGIKNYRGWILALSYGYCFGVELTIDNIVAEYFYDRFDLKLHTAG
MIAASFGLANIVSRPGGGMISDAVGKRFGMRGRLWALWIAQTLGGVFCIILGRVGSLGA
SIVVMIVFSLFCQAACGLTFGVVPFVSRRSLGLISGMTGGGGNVGAVLTQLIFFRGSKYS
KDRGIMLMGVMIICCTLPICLIYFPQWGGIFCGPSSTKIATEEDYYLSEWTSEEKEKGLHL
SSLKFADNSRRERGRKEDSETRPVDESPSTQV

Populus trichocarpa PtNRT2-Z POPTR_0015s09310

MEIEGQATVKESQPPKFALPVDSEHKATEFRLFSVAAPHMQAFHLSWVSFFACF
VSTFAAPPLLPIIRDNLNLTASDIGNAGIASVSGAVFARVAMGTACDLFGPRLASASLILL
TAPAVYFTSIASSSTSFLLVRFFTGFSLSTFVSTQFWMSSMFSAPVVGTANGVAGGWGNL
GGGATQLIMPLVFGLIRDIGAIKFTAWRIAFFIPALFQTLSAFAVLIFGKDLPDGNFRRLQ
KAGDKTKDKFTNVFYHGITNYRGWILALSYGYCFGVELTIDNIVAEYFYDRFDLKLHTA
GMIAASFGLANIVSRPGGGMISDAVAKRFGMRGRLWALWIVQTLGGVFCIILGRVGSLG
ASVVVMIVFSLFCQAACGLTFGVVPFVSRRSLGLISGMTGGGGNVGAVLTQLIFFKGSK
YSKERGIMLMGVMIICCTLPICFIHFPQWGGMFCGPSSAKTATEEDYYLSEWTSEEKEKG
LHLSSLKFADNSRRERGRKEGSETRPVDESPSTKV

Pyropia yezoensis PyNRT BAG70346

MSSRESSDAAEPAAAPAPARQFHLPVDEKNRATKLVIYQFSRPHMRSFHFAWLS
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TTLLTVFSIPVFLVGTARSFATFALARFFIGFIGAAFVVTQAWTTIMFAPIIVGTANATSAG
WGNLGGGVTNAIMPLLFKGIDAGLNNPDRSWRVVQVIPGIALVLCGVSLFFLSDDCPEG
NYKDLIKAGTRTKTNPWLAFFRASKNYRSWVLFVLYAMCFGVELIMNGNLASYFKQEF
ALSQSVAGIIAGLFGLMNLFARSIGGIVSDVAAKKYGMRGRLWAFFVILFCESLALIGFS
RIGKIGIAIPVLIVFSSFVQMAEGATFGIVPFVDPEATGAVSGIVGAGGNVGAVTLSFLLKI
SSKPDGFLYLGFVVMGASFLVHLIYWPQYGSTFRPATAPPVKVVEDDADMADEYAAGP
APIAT

Ricinus communis RcNRT2-A 29589.m001223

MGDIEGSPGSSMHGVTGREQTFAFSVASPIVPTDTTAKFDLPVDSEHKAKVFKLF
SFANPHMRTFHLSWISFCTCFVSTFAAAPLVPIIRDNLNLVKSDIGNAGVASVSGSIFSRL
VMGAICDLLGPRYGCAFLIMLSAPTVFCMSFVSSAGGYIAVRFMIGFSLATFVSCQYWM
STMFNGKIIGLVNGTAAGWGNMGGGATQLIMPLVYDLIQRVGATPFTAWRIAFFVPGLL
HVIMGILVLTLGQDLPDGNLGALQKKGDVAKDKFSKVMWYAITNYRTWIFVLLYGYS
MGVELSTDNVIAEYFYDRFNLKLQTAGIIAATFGMANLVARPFGGFASDYAARYFGMR
GRLWVLWILQTLGGAFCIWLGRANSLPIAVLAMILFSVGAQAACGATFGVIPFISRRSLGI
ISGLTGAGGNFGSGLTQLIFFSTTRFSTETGLSLMGVMIVACTLPVTLVYFPQWGGMFLP
PSKDAMKSTEEFYYASEWNEEEKQKGLHQQSLKFAENSRSERGNRIASAPTPPNTTPNR
V

Ricinus communis RcNRT2-B 29589.m001224

MANIEGSPGSSMHGVTGREQTFALSVASPMVPTDTTAHFDLPVDSEHKAKVFKL
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VMGAVCDLLGPRYGCAFLIMLSAPTVFCMSLVSSAGGYIAVRFMIGFSLATFVSCQYW
MSTMFNGKIIGLVNGTAAGWGNMGGGATQLIMPLVYDLIQRVGATPFTAWRIAFFVPGI
LHVIMGILVLTLGQDLPDGNLGALQKKGDVARDKFSKVMWYAITNYRTWIFVLLYGYS
MGVELTTDNVIAEYFFDRFNLKLHTAGIIAATFGMANLVARPFGGYASDVAARHFGMR
GRLWVLWTLQTLGGAFCIWLGRANSLPLAIFTMIAFSIGAQAACGATFGVIPFISRRSLGII
SGLTGAGGNFGSGLTQLIFFSTTKFSTQAGLSLMGVMIVACTLPVTLIYFPQWGGMFFPA
SKDVTRSTEEHYYEAEWNEEEKQKGMHQGSLKFAENSRSERGRKVASAPTPPYNTPSH
V

Ricinus communis RcNRT2-C 30078.m002302

MASTEEMSPGSSMHGVSGKEQTFAFSVTNDPEIPTDTTAKFSLPVDSEHKAKVFN
LLSLANPHMTTFHLSWLSFFTCFVSTFAAAPLVPIIRDNLNLTKKDIGNAGIASVSGSIFSR
LVMGAACDLLGPRYACAFLIMLSAPTVFCMTFVSSAGGYVAVRFMIGFSLATFVSCQF
WMSTMFNGKIIGVVNGTAAGWGNMGGGATQLLMPLLYELIKRAGATPFTAWRIAFFIP
GWLHVIMGILVLSLGQDLPDGNLSTLQKKGDVPKDKFSKVLWYAITNYRTWVFFLLYG
MSLGVELTTDNVIAEYFFDRFDLKLRTAGTIAAIFGMANIFARPMGGLMSDIAARRFGM
RGRLWNLYILQTLGGIFCICLGRVSSLPLSVLFMILFSLGAQAACGATFGIIPFISRRSLGIIS
GLTGAGGNFGSGLTQLLFFTSSTYTTATGLSLMGIMIVACTLPVTLVHFPQWGSMFLPAT
KNVEKCSEEYYYASEWNQEEKEKGLHQGSLKFAENSRSERGRRVASAATPPSSTAANL

Ricinus communis RcNRT2-D 29589.m001225

MAQDGALGTSMHGVTGREQTFAFSVQSTENDTTHKFELPVDSEHRAKVFKPFSL
ANPHMRAFHLAWTSFFTSFISTFAAAPLVPIIRDNLNLTKSDVGNAGVASVSGSILSRLV
MGAVCDLIGPRYGTAFLLMLSAPTVFCMSFVSDAQGYLIVRFMIGFCLATFVSCQYWTT
MMFNGKIIGLVNGCAGGWGDMGGGVTQLLMPLVFHIIKLAGATPFTAWRIAFFVPGCF
HVIIGILVLTLGQDLPDGNLSTLQKKGDVAKDKFSKVLKYAITNYRTWIFFLLYGFSMGI
QLTTNNIITEYFYDRFNLKLHTAGVIAASFGMTNIFARPFGGYASDLTARRFGTRGRLWT
LWILQTLGAVFCIWLGRANSLPIAILAMILSSMGIQAACGATYGIVPFVSRRSLGILSGLT
GAGGNFGSGLNQLVFFSSSRFSTATGLSLMGILALVCTLSVALIHFPQWGSMFLPPSKDP
AKCSEEYYYTAEWTEEEMQKGMHEGSVKFAENSRSERGRRNALASAATPPNATPLNN
V

Sorghum bicolor SbNRT2-A Sb04g001000.1

MEAAGAPGSSLHGMTGREPAFAFSTAAPEHDGDDAAASKFDLPVDSEHKAKSIR
LFSFANPHMRTFHLSWISFFTCFVSTFAAAPLVPIIRDNLNLTKADIGNAGVASVSGSIFSR
LTMGAVCDLLGPRYGCAFLIMLSAPTVFCMALIDDAAGYIVVRFLIGFSLATFVSCQYW
MSTMFNSKIIGTVNGLAAGWGNMGGGATQLIMPLVYDVIRKCGATPFTAWRVAYFVP
GLMHVVMGVLVLTLGQDLPDGNLRTLQKKGNVNKDKFSKVMWYALINYRTWIFVLL
YGYSMGVELTTDNVIAEYMYDRFDLDLRVAGTIAACFGMANLVARPMGGVLSDVGAR

YWGMRARLWNIWILQTAGGAFCLWLGRASTLPVSIVAMVLFSFCAQAACGAIFGVIPF
VSRRSLGIISGMTGAGGNFGAGLTQLLFFTSSTYSTARGLEYMGIMIMACTLPVVFVHFP
QWGSMFFPASATADEETYYASEWNDDEKSKGLHSASLKFAENSRSERGKRNVIQADAG
ATPEHV

Sorghum bicolor SbNRT2-B Sb04g000990.1

METIGAPGSSLHGMTGREPAFAFSTAAPEHDGDDAAASKFDLPVDSEHKAKSIRL
FSFANPHMRTFHLSWISFFTCFVSTFAAAPLVPIIRDNLNLTKADIGNAGVASVSGSIFSRL
TMGAVCDLLGPRYGCAFLIMLSAPTVFCMALIDDAAGYIVVRFLIGFSLATFVSCQYWM
STMFNSKIIGTVNGLAAGWGNMGGGATQLIMPLVYDVIRKCGATPFTAWRVAYFVPGL
MHVVMGVLVLTLGQDLPDGNLRTLQKKGNVNKDKFSKVMWYALINYRTWIFVLLYG
YSMGVELTTDNVIAEYMYDRFDLDLRVAGTIAACFGMANLVARPMGGVLSDVGARY
WGMRARLWNIWILQTAGGAFCLWLGRASTLPVSIVAMVLFSFCAQAACGAIFGVIPFVS
RRSLGIISGMTGAGGNFGAGLTQLLFFTSSTYSTARGLEYMGIMIMACTLPVVFVHFPQ
WGSMFFPASATADEEGYYASEWNDDEKSKGLHAASLKFAENSRSERGKRNVIQADAG
ATPEHV

Sorghum bicolor SbNRT2-C Sb04g000970.1

MASEAPAGSSLHGVTAREPSFPFAFSTEETPAAAAGKSFDLPVDSEHKAKSIRLLS
FANPHMRTFHLSWMSFFTCVVSTFAAAPLIPIIRENLGLTKADIGNAGVASVSGAIFSRLA
MGAVCDLLGPRYGCAFVVMLAAPAVFCMAIIDSAAGYVVCRFLIGFSLATFVSCQYWT
STMFNIKIIGTVNALASGWGDMGGGATQLIMPFVYEGILRCGATPFAAWRIAYFVPGLM
HIAVGILVLTAGQDLPDGNLRTLQKQGGDSCRRDNFSRVLWHAVANYRTWVFVFVYG
YCMGVQLTTNNIIAEFFYDQFDLDIRVAGIIAASFGMANLVSRPLGGVLSDVGARYWGM
RARLWNIWILQTAGGAFCLWLGRASWLPASVTAMVLFSLCAQAACGATFGVIPFVSRR
SLGVISGLTGAGGNVGAGLTQLLFFTTSSYSTGKGIENMGIMTMACTLPLVLVHFPQWG
SMLLPPSADADEESYYAAEWSEEEKSVGRHSTSLKFAENCRSERGRRNSAVAVLAAAA
TPPDNTPEHV

Sorghum bicolor SbNRT2-D Sb03g032310.1

MAEAELKPSAMQVEAAEAASKPRFRMPVDSDNKATEFWLFSLARPHMSAFHLS
WFSFFCCFLSTFAAPPLLPLIRDTLGLTATDIGNAGIASVSGAVFARVAMGTACDLVGPR
LASAAIILLTTPAVYCSAIIDSPSSFLLVRFFTGFSLASFVSTQFWMSSMFSPPKVGLANGV
AGGWGNLGGGAVQLIMPLVYEAIRKIGSTPFTAWRVAFFIPGLLQTLSAIAVLAFGQDM
PDGNYRKLHKSGDMHKDSFGNVLRHAVTNYRAWVLALTYGYCFGVELAVDNIIAQYF
YDRFGVKLSTAGFIAASFGMANIISRPGGGLMSDWLSTRFGMRGRLWGLWVVQTIGGV
LCVVLGAVDYSFAASVAVMILFSLFVQAACGLTFGIVPFVSRRSLGLISGMTGGGGNVG
AVLTQLIFFHGSKYKTETGIKYMGLMIIACTLPIALIYFPQWGGMFVGPQPGATAEDYYN
REWTAHEREKGFNAGSVRFAENSVREGGRSGSQSKHTVPVESSPADV

Saccharomyces cerevisiae S288C ScNRT YKR093W

MLNHPSQGSDDAQDEKQGDFPVIEEEKTQAVTLKDSYVSDDVANSTERYNLSPS

PEDEDFEGPTEEEMQTLRHVGGKIPMRCWLIAIVELSERFSYYGLSAPFQNYMEYGPND
SPKGVLSLNSQGATGLSYFFQFWCYVTPVFGGYVADTFWGKYNTICCGTAIYIAGIFILFI
TSIPSVGNRDSAIGGFIAAIILIGIATGMIKANLSVLIADQLPKRKPSIKVLKSGERVIVDSNI
TLQNVFMFFYFMINVGSLSLMATTELEYHKGFWAAYLLPFCFFWIAVVTLIFGKKQYIQ
RPIGDKVIAKSFKVCWILTKNKFDFNAAKPSVHPEKNYPWNDKFVDEIKRALAACKVFI
FYPIYWTQYGTMISSFITQASMMELHGIPNDFLQAFDSIALIIFIPIFEKFVYPFIRRYTPLKP
ITKIFFGFMFGSFAMTWAAVLQSFVYKAGPWYNEPLGHNTPNHVHVCWQIPAYVLISFS
EIFASITGLEYAYSKAPASMKSFIMSIFLLTNAFGSAIGCALSPVTVDPKFTWLFTGLAVA
CFISGCLFWLCFRKYNDTEEEMNAMDYEEEDEFDLNPISAPKANDIEILEPMESLRSTTK
Y

Setaria italica SiNRT2-A SiPROV006723m

MDMERGAPGSSLHGMTGREPTFAFSTEDATAASKFDLPVDSEHKAKTIRLFSFA
NPHMRTFHLSWISFFTCFVSTFAAAPLVPIIRDNLNLTKADIGNAGVASVSGSIFSRLAMG
AVCDLLGPRYGCAFLIMLAAPTVFCMAIIDDAAGYIVVRFLIGFSLATFVSCQYWMSTM
FNSKIIGTVNGLAAGWGNMGGGATQLIMPLVYDIIRKCGATPFTAWRLAYFVPGSLHIV
MGILVLTMGQDLPDGNLRSLQKKGDANKDKFSKVMWYAITNYRTWIFVLLYGYCMGV
ELTTDNVIAEYYFDHFNLDLRVAGIIAACFGMANIVARPLGGILSDVGARYWGMRARL
WNIWILQTAGGAFCLWLGRATTLPASITAMVLFSFCAQAACGAIFGVTPFISRRSLGIISG
MTGAGGNFGAGLTQLLFFTSSKYSTGMGLEYMGIMIMACTLPVVFVHFPQWGSMLFPA
NAGAVEEHYYSSEWNEEEKSKGLHSASLKFAENCRSERGKRNVIQATSSTQPNNTPEHV

Setaria italica SiNRT2-B SiPROV027691m

MADGERGAPGSSLHGMTGREPTFAFSTEDATAASKFDLPVDSEHKAKTIRLFSFA
NPHMRTFHLSWISFFTCFVSTFAAAPLVPIIRDNLNLTKADIGNAGVASVSGSIFSRLAMG
AVCDLLGPRYGCAFLIMLAAPTVFCMAIIDDAAGYIVVRFLIGFSLATFVSCQYWMSTM
FNSKIIGTVNGLAAGWGNMGGGATQLIMPLVYDIIRKCGATPFTAWRLAYFVPGSLHIV
MGILVLTMGQDLPDGNLRSLQKKGDANKDKFSKVMWYAITNYRTWIFVLLYGYCMGV
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WNIWILQTAGGAFCLWLGRATTLPASITAMVLFSFCAQAACGAIFGVTPFISRRSLGIISG
MTGAGGNFGAGLTQLLFFTSSKYSTGMGLEYMGIMIMACTLPVVFVHFPQWGSMLFPA
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Setaria italica SiNRT2-C SiPROV035072m

MRERGAPGSSLHGMTGREPTFAFSTEDATAASKFDLPVDSEHKAKTIRLFSFANP
HMRTFHLSWISFFTCFVSTFAAAPLVPIIRDNLNLTKADIGNAGVASVSGSIFSRLAMGAV
CDLLGPRYGCAFLIMLAAPTVFCMAIIDDAAGYIVVRFLIGFSLATFVSCQYWMSTMFNS
KIIGTVNGLAAGWGNMGGGATQLIMPLVYDIIRKCGATPFTAWRLAYFVPGSLHIVMGI
LVLTMGQDLPDGNLRSLQKKGDANKDKFSKVMWYAITNYRTWVFVLLYGYCMGVEL
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WILQTAGGAFCLWLGRATTLPASITAMVLFSFCAQAACGAIFGVTPFISRRSLGIISGMTG

AGGNFGAGLTQLLFFTSSKYSTGMGLEYMGIMIMACTLPVVFVHFPQWGSMLFPANAG
AVEEHYYSSEWNEEEKSKGLHSASLKFAENCRSERGRRNVIQATSNTQPNNTPENV

Setaria italica SiNRT2-D SiPROV038225m

MDMERGAPGSSLHGMTGREPTFAFSTEDATAASKFDLPVDSEHKAKTIRLFSFA
NPHMRTFHLSWISFFTCFVSTFAAAPLVPIIRDNLNLTKADIGNAGVASVSGSIFSRLAMG
AVCDLLGPRYGCAFLIMLAAPTVFCMAIIDDAAGYIVVRFLIGFSLATFVSCQYWMSTM
FNSKIIGTVNGLAAGWGNMGGGATQLIMPLVYDIIRKCGATPFTAWRLAYFVPGSLHIV
MGILVLTMGQDLPDGNLRSLQKKGDANKDKFSKVMWYAITNYRTWIFVLLYGYCMGV
ELTTDNVIAEYYFDHFNLDLRVAGIIAACFGMANIVARPLGGILSDVGARYWGIPQAAFC
LWLGRATTLPASITAMVLFSFCAQAACGAIFGVTPFISRRSLGIISGMTGAGGNFGAGLT
QLLFFTSSKYSTGMGLEYMGIMIMACTLPVVFVHFPQWGSMLFPANAGAVEEHYYSSE
WNEEEKSKGLHSASLKFAENCRSERGKRNVIQATSSTQPNNTPEHV

Setaria italica SiNRT2-E SiPROV006793m

MASVHGVTGREPTFSFSTEDGRPDAEDAAPAKFDLPVDSEHKAKSIRILSMANPH
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CDLLGPRYGCAFVMMLAAPPVFCMAVIDSAAGYITIRFLIGVSLATFVSCQYWTSTMFNI
KIIGTVNALASGWGDMGGGATQLIMPFVYEGILKCGVSPFEAWRIAYFVPGLMHVVMG
ILVLTTGQDLPDGNLRNLQKQGDANKDNFSKVFMHAVTNYRTWVFVFIYGYSMGVQL
TTNNIIAEYFYDQFDLDIRVAGIIAACFGMANLVSRPLGGVLSDLGARYWGMRARLWNI
WILQTAGGAFCLWLGSAKSLPASITAMVLFSFCAQAACGATFGVIPFVSRRSLGIISGMT
GAGGNVGAGVTQLIFFTLSNYSTGKGIQNMGIMAMVCTLPLVLIHFPQWGSMLLPPSAD
ADEERYYASEWSEEEKSLGRHSASLKFAENCRSERGRRNAVLAAAATPPGNTPEHV

Setaria italica SiNRT2-F SiPROV006773m

MASVHEVTGREPTFSFSTEDAGRPDAENAAAARFHLPVDSEHKAKSIRIFSMANP
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VCDLLGPRYGCAFVMMLAAPPVFCMAVIDSAAGYITIRFLIGVSLATFVSCQYWTSTMF
NIKIIGTVNALASGWGDMGGGATQLIMPFVYEGILKCGVSPFEAWRIAYFVPGLMHVV
MGILVLTTGQDLPDGNLRNLQKQGDANKDNFSKVFMHAVTNYRTWVFVFIYGYSMGV
QLTTTNIIAEYYYDQFDLNIRVAGIIAACFGMANLVSRPLGGVLSDLGARYWGMRARL
WNIWILQTAGGAFCLWLGSAKALPASITAMVLFSFCAQAACGATFGVIPFVSRRSLGIIS
GMTGAGGNVGAGVTQLIFFTLSNYSTGKGIQNMGIMAMVCTLPLVLIHFPQWGSMLLP
PSADADEERYYASEWSEEEKSLGRHSASLKFAENCRSERGRRNAVLAAAATPPGDTPEH
V

Setaria italica SiNRT2-G SiPROV028667m

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ASIILLTTPAVYCSAIIDSASSFLLVRFFTGFSLASFVSTQFWMSSMFSPPKVGLANGVAG
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DGNYRKLHKSGDMHKDSFGNVFRHAVTNYRGWILALTYGYCFGVELAVDNIIAQYFY
DRFGVKLRTAGFIAASFGMANIISRPGGGLMSDWLSARYGMRGRLWGLWVVQTIGGVL
CVVLGAVDYSFGASVAVMILFSFFVQAACGLTFGIVPFVSRRSLGLISGMTGGGGNVGA
VLTQVIFFHGSKYKTETGIKYMGLMIIACTLPITLIYFPQWGGMFMGPRPGATAEDYYNR
EWTAQEREKGYNAGCVRFAENSVLEGGRSGSQSKHTTVPVESSPADV

Selaginella moellendorffii SmNRT2-A 168278

MAEQSTSGIGVDAAGDPGVSMHGVTGKEQAFAFSVEAPSPIADPAAKKFALPVD
SEHKSKVFNIFSLANPHMRTFHLSWIAFFTCFTSTFAAPPLLPIIRDNLGLTKLDVGRAGIA
SVTGAIVSRFAMGPVCDLVGPRYGCAFVIMMTAPAVFSMSLVSSATGFILARFFIGFGLA
TFVSCQFWMSSMFNSKIVGSANGTAAGWGNLGGGATQLIMPLVFKAIQSMGSDKFIAW
RIAFFVPGFFHIFMGLMVLTLGQDLPDGNYALLKETGKKNKDAFSKVFVNAIRNYRTWI
FALLYGYSFGVELTVDNIIAEYFYDRFGLDLHTAGIVASTFGMANLFARPLGGILSDVVA
RRFGMRGRLWALWLMQSMGAVLCIVLGLVGSLGPSIGVMILFSLFLQGACGCTFGIIPF
VSHRSLGVISGLTGAGGNVGAVLTQLIFFTSNQYSTQKGISLMGVMSLACTMPVLLVYF
PQWGGALFPASGEVTEEHYYTSEWTKAEKEQGMHNASVKFAENARSERGRRVASAPT
PPHPSSMA

Selaginella moellendorffii SmNRT2-B 136730

MPQRFVDIDLSPPPPSPSQQQHRNPAPNFRLPVDSEHKAKKLDLFSFAQPHMRSF
HLSWIAFFTCFTSTFAAPPLIPVIRDNLDLTKLDVGRASIASISGSILSRFLMGPVCDLVGP
RYGCAILIMITAPPVFCMPLVSDPTGFIIVRFCIGFSLATFVSCQFWMSTMFNTKIVGMAN
GFTGGWGDFGGGVTQLLMPLLYQLILKFGANDFTAWRIAFYVPGLMHVFMGLAVLILG
QDLPDGNYRDLKEQGHKTKDSFGKVLRNAAKNYRTWLFAFVYGYSFGVELTVFNNIAE
YFYDEFGLHLGTAGIVASIFGLANFISRPMGGILSDVIARSYGMRGRLWILFLFQTVGGL
MCVLLGFMNTLGTAIGIVILFSIFLQAACGATFGIVPFVSRRSLGVLAGLTGGGGNLGGV
VTQLIFFTNETFSFEAGFSLMGAMSVGCSLALLGVYFPQWGGMLCRASSDPGATEEAYY
LAEWSEEEKAKGMHLTALKFAENSHSERGRMRSGASSQPQPSAVVNPIL

Salinisphaera shabanensis SsNRTZP_08551421

MELANKATRIRLFDFKSVQMRAFHMSWLAFHLCFFGWFGIAPLMAVVREDLNL
DKSQVGSTIIASVAITVLVRLLIGPLCDKFGPRKTYSSLLILGSIPVMCIGFADSFESFLLAR
LCIGAIGASFVITQYHTSVMFAPNIVGTANATTAGWGNLGGGTTQIVMPLIFTAIVSLGIS
ETLGWRLAMVVPGVILFALGIAYWKFTQDAPDGNYSDLRAAGKIPEAKNENSGWSSFR
NAAKDYRVWALFVVYAGCFGVELTINNVAAIYFFDNFDVDLKTAGLIAGLFGLMNIFA
RTMGGFFSDLSARFMGLNGRVRFLFAAMFIEGIALIAFSQMEVLTAAIATMIVFSLFVQM
SEGATFGLVPFMNKKALGGVNGIVGAGGNAGAVLAGFLFKTESLSYGQGLMILGCAVL
VCSFFAFFVRFSADVLAEEKAVFDTASAGDDPIKARGSDSPEPA

Volvox carteri VcNRT2-A 109952 (estExt_fgenesh4_kg.C_490001)

MATPSTDTPTAKSLEDVHQSKAFPYGIDSEGKAKSVPIWRVTQPHMMAFHLSWI
SFFMSFVATFAPAALVPVIRDDLFLTKPQLGNAGVAAVCGAIGARIFMGTFVDTVGPRY

GSAATLLITAPAVFCMSLVTDFSSFAVARFFIGCSLCMFVCCQFWCGTMFNVRIVGTAN
AIAAGWGNMGGGACLFIMPLIFDGIRKHAPAFQAWRWSFFVPGGIYILSAVGTLLLGIDH
PSGKDYRDLKKDGTLKSKGAVWPVLKCGLGNYRAWILALTYGYSFGVELTVDNIITEY
FYDQFGLNLTIAGAFGAIFGLMNIFTRATGGMISDYVAKYWGMRGRLWALWIIQTLGGI
FCIILGKVSSSLTGTIVILIIFSIFCQQACGAHFGITPFVSRRAYGVVSGLVGAGGNVGAAIT
QAIWFAGTASWQQKLEKKDGFVYMGIQATCLTLVLFLIQFPMWGSMLTGPREGAQEED
YYLREWSAEEVAQGLHQGSMRFAMESKSQRGYRDRSVVAASNGNVQEPTAIKTTPS

Volvox carteri VcNRT2-B "83071 (estExt_Genewise1Plus.C_490008)

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MSFVATFAPAALVPVIRDDLFLSKSELGNAGVAAVCGAIAARIFMGGFVDTVGPRYGTA
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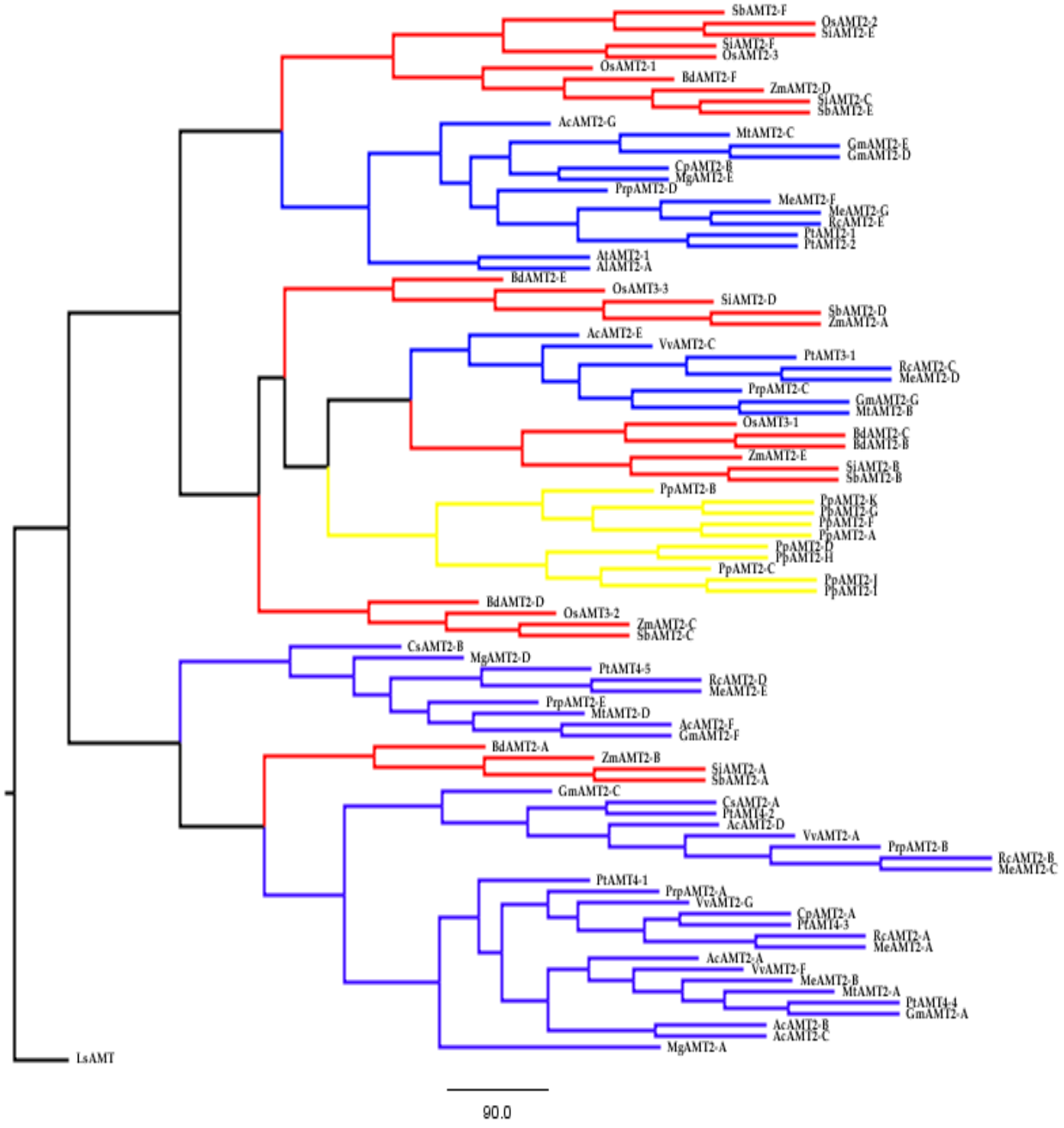
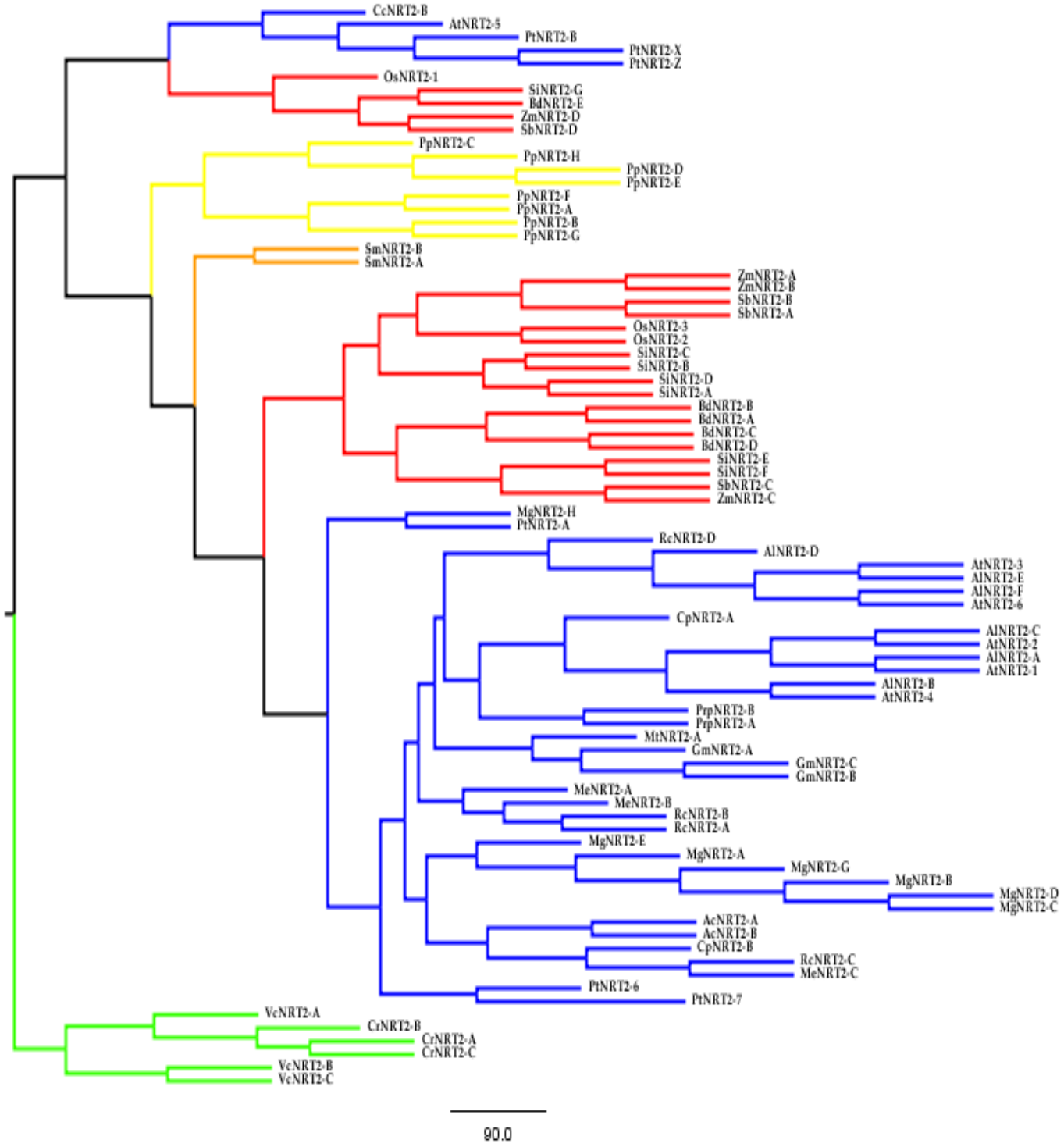
Supplemental File 2. Parsimony phylogenetic reconstruction of the AMT1 family.



Supplemental File 3. Parsimony phylogenetic reconstruction of the AMT2 family.



Supplemental File 4. Parsimony phylogenetic reconstruction of the NRT2 family.