Title: Methods for Obtaining High-Yielding Oil Palm Plants

Technical Field

This application relates to methods for obtaining high-yielding plants, and more particularly to methods for obtaining oil palm plants that are high-yielding with respect to producing palm oil.

Background Art

The African oil palm *Elaeis guineensis* Jacq. is an important oil-food crop. Oil palm plants are monoecious, i.e. single plants produce both male and female flowers, and are characterized by alternating series of male and female inflorescences. The male inflorescence is made up of numerous spikelets, and can bear well over 100,000 flowers. Oil palm is naturally cross-pollinated by insects and wind. The female inflorescence is a spadix which contains several thousands of flowers borne on thorny spikelets. A bunch carries 500 to 4,000 fruits. The oil palm fruit is a sessile drupe that is spherical to ovoid or elongated in shape and is composed of an exocarp, a mesocarp containing palm oil, and an endocarp surrounding a kernel.

Oil palm is important both because of its high yield and because of the high quality of its oil. Regarding yield, oil palm is the highest yielding oil-food crop, with a recent average yield of 3.67 tonnes per hectare per year and with best progenies known to produce about 10 tonnes per hectare per year. Oil palm is also the most efficient plant known for harnessing the energy of sunlight for producing oil. Regarding quality, oil palm is cultivated for both palm oil, which is produced in the mesocarp, and palm kernel oil, which is produced in the kernel. Palm oil in particular is a balanced oil, having almost equal proportions of saturated fatty acids (≈ 55%

including 45% of palmitic acid) and unsaturated fatty acids (≈ 45%), and it includes beta carotene. The palm kernel oil is more saturated than the mesocarp oil. Both are low in free fatty acids. The current combined output of palm oil and palm kernel oil is about 50 million tonnes per year, and demand is expected to increase substantially in the future with increasing global population and per capita consumption of oils and fats.

Although oil palm is the highest yielding oil-food crop, current oil palm crops produce well below their theoretical maximum. Moreover, conventional methods for identifying potential high-yielding palms for use in crosses to generate progeny with higher yields require cultivation of palms and measurement of production of oil thereby over the course of many years, which is both time and labor intensive. In addition, conventional breeding techniques for propagation of oil palm for oil production are also time and labor intensive, particularly because the most productive, and thus commercially relevant, palms exhibit a hybrid phenotype which makes propagation thereof by direct hybrid crosses impractical. Accordingly, a need exists to improve oil palm yields through improved methods for obtaining and identifying high-yielding palms.

Transgenic approaches offer potential solutions to the general problem of the need to increase plant yields. For example, transgenic modification of crops such as soy and corn by the introduction of pest resistance genes derived from other organisms is now well known as a means for increasing crop yields. Moreover, methods for increasing plant yields by increasing or generating in the plant activities of particular proteins have also been disclosed, for example by Schön et al., WO 2010/046221. However, transgenic modification of crops raises potential concerns regarding unintended detrimental effects on individuals and ecosystems.

Proteomics, which encompasses the study of the protein complement of a genome, also offers potential solutions to the general problem of increasing plant yields. For example, difference gel electrophoresis ("DIGE") analysis, corresponding to two dimensional gel electrophoresis employing sensitive fluorescent labeling dyes, as described by Mackintosh et al., 3 Proteomics 2273-88 (2003), has been successfully employed in protein expression analyses in rice and sunflower, as described by Teshima et al., Regulatory Toxicology & Pharmacology (article in press), and Hajduch et al., 6 Journal of Proteome Research 3232-41 (2007), respectively. In rice, this approach was used to differentiate one cultivar from others, and also to compare expression of allergen proteins. In sunflower, several leads in seed oil traits have been identified for further investigation. However, given the many differences in the genetics and metabolism of rice, sunflower, and oil palm, and the highly specific nature of protein expression, these studies in rice and sunflower would not be expected to be useful with respect to improving oil palm yields through improved methods for obtaining and identifying high-yielding palms.

Disclosure of Invention

A method is provided for obtaining a high-yielding oil palm plant. The method comprises determining the level of a protein in mesocarp tissue of a fruit of a parental oil palm plant. The protein is selected from the group consisting of 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase 2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde 3-phosphate dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate

carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog. The method also comprises determining whether there is a difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant. The method also comprises selecting progeny of the parental oil palm plant based on the difference to obtain the high-yielding oil palm plant.

Also provided is a method for predicting oil yield of a test oil palm plant. The method comprises determining the level of a protein in mesocarp tissue of a fruit of the test oil palm plant. The protein is selected from the group consisting of 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase 2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde 3-phosphate dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate

carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog. The method also includes determining whether there is a difference between the level of the protein in the mesocarp tissue of the fruit of the test oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant. The method also includes predicting the oil yield of the test oil palm plant based on the difference.

Also provided is a kit for obtaining a high-yielding oil palm plant. The kit comprises an antibody for detection of a protein selected from the group consisting of 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase 2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde 3-phosphate dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin,

Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog. The kit also comprises an extract of a mesocarp tissue of a fruit of a reference oil palm plant.

The disclosed methods and kits are based on an advantageous combination of proteomics, to identify markers for high and low-yielding traits in current oil palm breeding populations and thus to increase the pace of identification of high yielding palms, and conventional breeding techniques, to generate higher-yielding progeny therefrom. Applications include identifying high-yielding parental palm plants for use in generating higher-yielding progeny and predicting palm oil yields of test palms, in both cases without need for collecting oil yield data from palms over the course of years. Also, although the methods and kits are well suited for application to conventional breeding techniques, thus providing a basis for increasing the pace of obtaining high-yielding palms without relying on transgenics, the methods and kits can also be applied to improve the efficiency of propagation of oil palm by tissue culture or transgenic approaches too.

Brief Description of Drawings

FIG. 1 is a scanned image of a two-dimensional fluorescence difference gel electrophoresis ("DIGE") analytical gel corresponding to mesocarp protein of high-yielding palm H2 and low-yielding palm h1, both tested at 12 weeks post-pollination.

FIG. 2 is a scanned image of a DIGE analytical gel corresponding to mesocarp protein of high-yielding palm H4 and low-yielding palm h6, both tested at 12 weeks post-pollination.

FIG. 3 is a scanned image of a DIGE analytical gel corresponding to mesocarp protein of high-yielding palm H6 and low-yielding palm h9, both tested at 12 weeks post-pollination.

FIG. 4 is a scanned image of a DIGE analytical gel corresponding to mesocarp protein of high-yielding palm H2 and low-yielding palm h1, both tested at 16 weeks post-pollination.

FIG. 5 is a scanned image of a DIGE analytical gel corresponding to mesocarp protein of high-yielding palm H4 and low-yielding palm h6, both tested at 16 weeks post-pollination.

FIG. 6 is a scanned image of a DIGE analytical gel corresponding to mesocarp protein of high-yielding palm H6 and low-yielding palm h9, both tested at 16 weeks post-pollination.

FIG. 7 is a scanned image of a DIGE analytical gel corresponding to mesocarp protein of high-yielding palm H2 and low-yielding palm h1, both tested at 18 weeks post-pollination.

FIG. 8 is a scanned image of a DIGE analytical gel corresponding to mesocarp protein of high-yielding palm H4 and low-yielding palm h6, both tested at 18 weeks post-pollination.

FIG. 9 is a scanned image of a DIGE analytical gel corresponding to mesocarp protein of high-yielding palm H6 and low-yielding palm h9, both tested at 18 weeks post-pollination.

FIG. 10A-M is a list of sequences of the forty-five unique differentially expressed proteins identified herein, abbreviated in one-letter amino acid format.

Best Mode for Carrying Out the Invention

The application is drawn to methods for obtaining high-yielding oil palm plants, methods for predicting oil yield of test oil palm plants, and kits for obtaining high-yielding oil palm plants. As disclosed herein, the level of a protein in mesocarp tissue of a fruit of an oil palm plant can be used for obtaining a high-yielding oil palm plant and for predicting oil yield of a test oil palm plant. Proteins useful in this regard include 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase 2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde 3-phosphate dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog. Accordingly, the application provides methods for obtaining high-yielding oil palm plants comprising determining the level of one of the above-noted proteins in mesocarp tissue of a fruit of a parental oil palm

plant, determining whether there is a difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant, and selecting progeny of the parental oil palm plant based on the difference to obtain the high-yielding oil palm plant. Moreover, the application provides methods for predicting oil yield of test oil palm plants comprising determining the level of one of the above-noted proteins in mesocarp tissue of a fruit of the test oil palm plant, determining whether there is a difference between the level of the protein in the mesocarp tissue of the fruit of the test oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant, and predicting the oil yield of the test oil palm plant based on the difference. In addition, the application provides kits for obtaining high-yielding oil palm plants comprising an antibody for detection of one of the above-noted proteins and an extract of a mesocarp tissue of a fruit of a reference oil palm plant.

Definitions

The term "parental oil palm plant," as used herein, means an oil palm plant from which progeny have been generated, are generated, or will be generated during the course of carrying out methods for obtaining a high-yielding oil palm plant as disclosed herein or using kits for obtaining a high-yielding oil palm plant as disclosed herein.

The term "test oil palm plant," as used herein, means an oil palm plant which has been subjected, is subjected, or will be subjected to a step of determining the level of a protein in mesocarp tissue of a fruit thereof during the course of carrying out methods for predicting oil yield of the plant as disclosed herein.

The term "reference oil palm plant," as used herein, means an oil palm plant used as a basis for comparison in determining oil palm yield traits. The reference oil palm plant can be, for example, an oil palm plant that produces high, average, or low amounts of palm oil, depending on the context of the particular application. For example, the reference oil palm plant can be an oil palm plant that produces 10, 9, 8, 7, 6, 5, 4, 3, 2, or 1 tonnes of palm per hectare per year.

The terms "high-yielding," "low-yielding," and "oil yield," as used herein with respect to the methods and kits disclosed herein, refer to yields of palm oil in mesocarp tissue of fruits of palm oil plants.

The term "homologs" and "homologous," as used herein, refers to two or more genes having highly similar DNA sequences or two or more proteins having highly similar amino acid sequences. Such genes or proteins may be considered to be homologous based on sharing, for example, 60%, 70%, 75%, 80%, 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, or greater sequence identity. The terms homologs and homologous encompass such highly similar genes or proteins, whether the genes or proteins are derived from a single species, and thus may represent structurally and functionally similar genes or proteins of the species, or from different species, and thus may represent orthologous genes or proteins derived from a common ancestor.

Method for Obtaining a High-Yielding Oil Palm Plant

As noted above, a method is provided for obtaining a high-yielding oil palm plant. The method comprises: (i) determining the level of a protein in mesocarp tissue of a fruit of a parental oil palm plant; (ii) determining whether there is a difference between the level of the

protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant; and (iii) selecting progeny of the parental oil palm plant based on the difference to obtain the high-yielding oil palm plant.

Proteins

In accordance with this method, the protein is selected from the group consisting of 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase 2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde 3-phosphate dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog.

In some embodiments, the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase comprises SEQ ID NO: 1, the abscisic stress ripening protein comprises SEQ ID NO: 2, the actin 6 comprises SEQ ID NO: 3, the actin E comprises SEQ ID NO: 4, the biotin carboxylase precursor comprises SEQ ID NO: 5, the caffeic acid O-methyltransferase comprises SEQ ID NO: 6, the catalase 2 comprises SEQ ID NO: 7, the conserved-hypothetical-protein-of-Ricinus-communis ortholog comprises SEQ ID NO: 8, the fibrillin-like protein comprises SEQ ID NO: 9, the flavodoxin-like quinone reductase 1 comprises SEQ ID NO: 10, the fructose-bisphosphate aldolase comprises SEQ ID NO: 11, the glyceraldehyde 3-phosphate dehydrogenase comprises SEQ ID NO: 12, the H0825G02.11 ortholog comprises SEQ ID NO: 13, the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase comprises SEQ ID NO: 14, the Lea1P comprises SEQ ID NO: 15, the methionine synthase protein comprises SEQ ID NO: 16, the mitochondrial peroxiredoxin comprises SEQ ID NO: 17, the Os02g0753300 ortholog comprises SEQ ID NO: 18, the Os05g0482700 ortholog comprises SEQ ID NO: 19, the Os12g0163700 ortholog comprises SEQ ID NO: 20, the OSJNBb0085F13.17 ortholog comprises SEQ ID NO: 21, the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog comprises SEQ ID NO: 22, the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog comprises SEQ ID NO: 23, the predicted-protein-of-Populus-trichocarpa ortholog comprises SEQ ID NO: 24, the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog comprises SEQ ID NO: 25, the nascent polypeptide associated complex alpha comprises SEQ ID NO: 26, the proline iminopeptidase comprises SEQ ID NO: 27, the protein transporter comprises SEQ ID NO: 28, the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog comprises SEQ ID NO: 29, the Ran GTPase binding protein comprises SEQ ID NO: 30, the chloroplastic triosephosphate isomerase comprises SEQ ID NO: 31, the V-

type proton ATPase catalytic subunit A comprises SEQ ID NO: 32, the regulator of ribonuclease activity A comprises SEQ ID NO: 33, the retroelement pol polyprotein-like ortholog comprises SEQ ID NO: 34, the ribosomal protein L10 comprises SEQ ID NO: 35, the short chain type dehydrogenase comprises SEQ ID NO: 36, the temperature-induced lipocalin comprises SEQ ID NO: 37, and the unknown-protein-of-Picea-sitchensis ortholog comprises SEQ ID NO: 38.

The above-noted proteins can be grouped according to function, e.g. lipid metabolism, non-lipid metabolism, and functions other than metabolism. For example, biotin carboxylase precursor and fructose-bisphosphate aldolase function primarily in lipid metabolism. In contrast, 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, caffeic acid O-methyltransferase, catalase 2, glyceraldehyde 3-phosphate dehydrogenase, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, methionine synthase protein, proline iminopeptidase, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, and V-type proton ATPase catalytic subunit A function primarily in non-lipid metabolism. Also in contrast, the remaining proteins, abscisic stress ripening protein, actin 6, actin E, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, H0825G02.11 ortholog, Lea1P, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short

chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog, function primarily in non-metabolic capacities.

Accordingly, in some embodiments the protein is a protein that functions primarily in lipid metabolism selected from the group consisting of biotin carboxylase precursor and fructose-bisphosphate aldolase. Moreover, in some embodiments the protein is a protein that functions primarily in non-lipid metabolism selected from the group consisting of 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, caffeic acid O-methyltransferase, catalase 2, glyceraldehyde 3-phosphate dehydrogenase, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, methionine synthase protein, proline iminopeptidase, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, and V-type proton ATPase catalytic subunit A. In addition, in some embodiments the protein is a protein that functions primarily in a non-metabolic capacity selected from the group consisting of abscisic stress ripening protein, actin 6, actin E, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, H0825G02.11 ortholog, Lea1P, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog.

Determining level of protein

The level of one of the above-noted proteins in mesocarp tissue of a fruit of a parental oil palm plant may be determined in a preparation of proteins from mesocarp tissue, e.g. a crude preparation, a minimally purified preparation, or a highly purified preparation of mesocarp proteins. The preparation may include total mesocarp proteins, or a subset of mesocarp proteins, e.g. soluble proteins, insoluble proteins, proteins having an isoelectric point between pH 4 to 7, or proteins having higher or lower isoelectric points. The mesocarp tissue itself may be obtained and tested at a particular developmental stage of the fruit from which it is derived, at any time following pollination ("post-pollination"), e.g. 11-19 weeks post-pollination, 11-17 weeks post-pollination, 15-19 weeks post-pollination, 11-13 weeks post-pollination, 15-17 weeks post-pollination, 17-19 weeks post-pollination, 12 weeks post-pollination, 16 weeks post-pollination, or 18 weeks post-pollination. The level of the protein may be expressed in absolute quantitative terms, e.g. mass protein per mass mesocarp tissue, or in relative terms, e.g. intensity of signal of protein relative to intensity of signal of reference.

In some embodiments the step of determining the level of the protein in mesocarp tissue of a fruit of a parental oil palm plant is carried out by antibody-based detection, for example by immunoblot, dot-blot, or enzyme-lined immunosorbent assay, in accordance with methods that are well known in the art. The antibody-based detection may be carried out, for example, by use of monoclonal antibodies or polyclonal antibodies raised against the protein. The antibodies may be prepared by methods that are well known in the art or obtained from commercial vendors. The antibody-based detection may be carried out quantitatively.

In some embodiments the step of determining the level of the protein in mesocarp tissue of a fruit of a parental oil palm plant is carried out by fluorescence-based detection, for example by CyDye labeling of total proteins in a sample, followed by separation and detection of the protein, e.g. by DIGE preparative gel analysis, in accordance with known methods.

In some embodiments, levels are determined for more than one of the above-noted proteins. For example, in some embodiments levels are determined for a combination of two to thirty-eight of the above-noted proteins. Also for example, in some embodiments levels are determined for combinations of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, or 38 of the above-noted proteins.

By way of example with respect to determining levels for a combination of two of the above-noted proteins, in some embodiments levels are determined for 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase and one of the following: abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase 2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde 3-phosphate dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group

ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, or unknown-protein-of-Picea-sitchensis ortholog. In other embodiments levels are determined for each of the other possible combinations of the above-noted proteins.

Determining difference between levels of protein

The step of determining whether there is a difference between the level of one of the bove-noted proteins in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant may be carried out by comparing the respective levels of the protein, for example as determined by antibody-based or fluorescence-based detection as described above, and checking for a difference therebetween. In some embodiments such a comparison is considered to reveal a biologically and/or statistically significant difference based, for example, on the level of the protein in the mesocarp tissue of the parental oil palm being higher (or alternatively, lower) than that of the reference oil palm plant by, for example, greater than 1.1 fold, 1.25 fold, 1.5 fold, 2 fold, 4 fold, or more, with p values of, for example, <0.025, <0.05, or <0.1. As will be apparent to one of ordinary skill, the comparison may be facilitated by use of software for determining and comparing signal intensities, for example by use of Image Quant software (version 6.0, Amersham BioSciences), followed by Biological Variation Analysis using DeCyderTM 2D software version 6.5 (Amersham BioSciences).

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue

of the fruit of the reference oil palm plant is that the level of the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is higher than the level of the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the abscisic stress ripening protein in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the abscisic stress ripening protein in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 19 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the abscisic stress ripening protein in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is higher than the level of the abscisic stress ripening protein in the mesocarp tissue of the fruit of the reference oil palm plant 16 or 18 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the actin 6 in the mesocarp tissue of

the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the actin 6 in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the actin 6 in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the actin 6 in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the actin E in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the actin E in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the actin E in the mesocarp tissue of the fruit of the parental oil palm plant 16 or 18 weeks after pollination thereof is higher than the level of the actin E in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the biotin carboxylase precursor in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the biotin carboxylase precursor in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the biotin carboxylase precursor in the mesocarp tissue of the fruit of the parental oil palm plant 16 or 18 weeks after pollination thereof

is higher than the level of the biotin carboxylase precursor in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of caffeic acid O-methyltransferase in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 17 weeks after pollination thereof is lower than the level of caffeic acid O-methyltransferase in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of caffeic acid O-methyltransferase in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is lower than the level of caffeic acid O-methyltransferase in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof. Also for example, in some embodiments the difference is that the level of caffeic acid O-methyltransferase in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of caffeic acid O-methyltransferase in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the catalase 2 in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 19 weeks after pollination thereof is higher than the level of the catalase 2 in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 19 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the catalase 2 in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks

after pollination thereof is higher than the level of the catalase 2 in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof. Also for example, in some embodiments the difference is that the level of the catalase 2 in the mesocarp tissue of the fruit of the parental oil palm plant 18 weeks after pollination thereof is higher than the level of the catalase 2 in the mesocarp tissue of the fruit of the reference oil palm plant 18 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the conserved-hypothetical-protein-of-Ricinus-communis ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the conserved-hypothetical-protein-of-Ricinus-communis ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the conserved-hypothetical-protein-of-Ricinus-communis ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the conserved-hypothetical-protein-of-Ricinus-communis ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the fibrillin-like protein in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the fibrillin-like protein in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some

embodiments the difference is that the level of the fibrillin-like protein in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is higher than the level of the fibrillin-like protein in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the difference is that the level of the flavodoxin-like quinone reductase 1 in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 19 weeks after pollination thereof is lower than the level of the flavodoxin-like quinone reductase 1 in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 19 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the flavodoxin-like quinone reductase 1 in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is lower than the level of the flavodoxin-like quinone reductase 1 in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof. Also for example, in some embodiments the difference is that the level of the flavodoxin-like quinone reductase 1 in the mesocarp tissue of the fruit of the parental oil palm plant 18 weeks after pollination thereof is lower than the level of the flavodoxin-like quinone reductase 1 in the mesocarp tissue of the fruit of the reference oil palm plant 18 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the fructose-bisphosphate aldolase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the fructose-bisphosphate aldolase in the mesocarp tissue of the

fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the fructose-bisphosphate aldolase in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the fructose-bisphosphate aldolase in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the glyceraldehyde 3-phosphate dehydrogenase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the glyceraldehyde 3-phosphate dehydrogenase in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the glyceraldehyde 3-phosphate dehydrogenase in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the glyceraldehyde 3-phosphate dehydrogenase in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the H0825G02.11 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the H0825G02.11 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the H0825G02.11 ortholog in the mesocarp tissue

of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the H0825G02.11 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase in the mesocarp tissue of the fruit of the parental oil palm plant 17 to 19 weeks after pollination thereof is higher than the level of the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase in the mesocarp tissue of the fruit of the reference oil palm plant 17 to 19 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase in the mesocarp tissue of the fruit of the parental oil palm plant 18 weeks after pollination thereof is higher than the level of the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase in the mesocarp tissue of the fruit of the reference oil palm plant 18 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the Lea1P in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the Lea1P in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the Lea1P in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after

pollination thereof is higher than the level of the Lea1P in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the methionine synthase protein in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the methionine synthase protein in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the methionine synthase protein in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the methionine synthase protein in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the mitochondrial peroxiredoxin in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 17 weeks after pollination thereof is higher than the level of the mitochondrial peroxiredoxin in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the mitochondrial peroxiredoxin in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is higher than the level of the mitochondrial peroxiredoxin in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof. Also for example, in some embodiments the difference is that the level of the mitochondrial peroxiredoxin in the mesocarp

tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the mitochondrial peroxiredoxin in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the Os02g0753300 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the Os02g0753300 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the Os02g0753300 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the Os02g0753300 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the Os05g0482700 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the Os05g0482700 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the Os05g0482700 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the Os05g0482700 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the Os12g0163700 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the Os12g0163700 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the Os12g0163700 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 or 18 weeks after pollination thereof is higher than the level of the Os12g0163700 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the OSJNBb0085F13.17 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the OSJNBb0085F13.17 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the OSJNBb0085F13.17 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the OSJNBb0085F13.17 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the predicted-protein-of-

Ostreococcus-lucimarinus-CCE9901 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is lower than the level of the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is lower than the level of the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue

of the fruit of the reference oil palm plant is that the level of the predicted-protein-of-Populus-trichocarpa ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 17 weeks after pollination thereof is lower than the level of the predicted-protein-of-Populus-trichocarpa ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the predicted-protein-of-Populus-trichocarpa ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is lower than the level of the predicted-protein-of-Populus-trichocarpa ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof. Also for example, in some embodiments the difference is that the level of the predicted-protein-of-Populus-trichocarpa ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the predicted-protein-of-Populus-trichocarpa ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is higher than the level

of the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the nascent polypeptide associated complex alpha in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 19 weeks after pollination thereof is higher than the level of the nascent polypeptide associated complex alpha in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 19 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the nascent polypeptide associated complex alpha in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is higher than the level of the nascent polypeptide associated complex alpha in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof. Also for example, in some embodiments the difference is that the level of the nascent polypeptide associated complex alpha in the mesocarp tissue of the fruit of the parental oil palm plant 18 weeks after pollination thereof is higher than the level of the nascent polypeptide associated complex alpha in the mesocarp tissue of the fruit of the reference oil palm plant 18 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the proline iminopeptidase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the proline iminopeptidase in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 19 weeks after pollination thereof. For example, in some

embodiments the difference is that the level of the proline iminopeptidase in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the proline iminopeptidase in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof. Also for example, in some embodiments the difference is that the level of the proline iminopeptidase in the mesocarp tissue of the fruit of the parental oil palm plant 18 weeks after pollination thereof is higher than the level of the proline iminopeptidase in the mesocarp tissue of the fruit of the reference oil palm plant 18 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the protein transporter in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is lower than the level of the protein transporter in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the protein transporter in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is lower than the level of the protein transporter in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than

the level of the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the Ran GTPase binding protein in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the Ran GTPase binding protein in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the Ran GTPase binding protein in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is higher than the level of the Ran GTPase binding protein in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the chloroplastic triosephosphate isomerase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the chloroplastic triosephosphate isomerase in the

mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the chloroplastic triosephosphate isomerase in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the chloroplastic triosephosphate isomerase in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the V-type proton ATPase catalytic subunit A in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the V-type proton ATPase catalytic subunit A in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the V-type proton ATPase catalytic subunit A in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the V-type proton ATPase catalytic subunit A in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the regulator of ribonuclease activity A in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the regulator of ribonuclease activity A in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination

thereof. For example, in some embodiments the difference is that the level of the regulator of ribonuclease activity A in the mesocarp tissue of the fruit of the parental oil palm plant 16 or 18 weeks after pollination thereof is higher than the level of the regulator of ribonuclease activity A in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the retroelement pol polyprotein-like ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is lower than the level of the retroelement pol polyprotein-like ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the retroelement pol polyprotein-like ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is lower than the level of the retroelement pol polyprotein-like ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the ribosomal protein L10 in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is lower than the level of the ribosomal protein L10 in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the ribosomal protein L10 in the mesocarp tissue

of the fruit of the parental oil palm plant 12 weeks after pollination thereof is lower than the level of the ribosomal protein L10 in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the short chain type dehydrogenase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the short chain type dehydrogenase in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the short chain type dehydrogenase in the mesocarp tissue of the fruit of the parental oil palm plant 16 or 18 weeks after pollination thereof is higher than the level of the short chain type dehydrogenase in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the temperature-induced lipocalin in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the temperature-induced lipocalin in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the temperature-induced lipocalin in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the temperature-induced lipocalin in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the unknown-protein-of-Picea-sitchensis ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the unknown-protein-of-Picea-sitchensis ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the unknown-protein-of-Picea-sitchensis ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the unknown-protein-of-Picea-sitchensis ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, differences between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in the mesocarp tissue of the fruit of the reference oil palm plant are determined for more than one of the above-noted proteins. For example, in some embodiments differences are determined for a combination of two to thirty-eight of the above-noted proteins. Also for example, in some embodiments differences are determined for combinations of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, or 38 of the above-noted proteins, e.g. each possible combination.

Selecting progeny

The step of selecting progeny of the parental oil palm plant based on the difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant

and the level of the protein in mesocarp tissue of the fruit of the reference oil palm plant to obtain the high-yielding oil palm plant may be carried out, for example, by choosing a parental oil palm plant for propagation based on the difference and crossing the plant with another oil palm plant, e.g. another oil palm plant also exhibiting the same or a similar difference with respect to one of the above-noted proteins, by conventional breeding techniques to obtain progeny corresponding to the high-yielding oil palm plant.

As is well known in the art, fruit type is a monogenic trait in oil palm that is important with respect to breeding and commercial production of palm oil. Specifically, oil palms with either of two distinct fruit types are generally used in breeding and seed production through crossing in order to generate palms for commercial production of oil (also termed "commercial planting materials" or "agricultural production plants"). The first fruit type is *dura* (genotype: sh+ sh+), which is characterized by a thick shell corresponding to 28 to 35% of the fruit by weight, with no ring of black fibres around the kernel of the fruit. For *dura* fruits, the mesocarp to fruit ratio varies from 50 to 60%, with extractable oil content in proportion to bunch weight of 18 to 24%. The second fruit type is *pisifera* (genotype: sh- sh-), which is characterized by the absence of a shell, the vestiges of which are represented by a ring of fibres around a small kernel. Accordingly, for *pisifera* fruits, the mesocarp to fruit ratio is 90 to 100%. The mesocarp oil to bunch ratio is comparable to the *dura* at 16 to 28%. *Pisiferas* are however usually female sterile as the majority of bunches abort at an early stage of development.

Crossing *dura* and *pisifera* gives rise to palms with a third fruit type, the *tenera* (genotype: sh+ sh-). *Tenera* fruits have thin shells of 8 to 10 % of the fruit by weight, corresponding to a thickness of 0.5 to 4 mm, around which is a characteristic ring of black fibres. For *tenera* fruits, the ratio of mesocarp to fruit is comparatively high, in the range of 60 to 80%.

Commercial *tenera* palms generally produce more fruit bunches than *duras*, although mean bunch weight is lower. The extractable oil to bunch ratio is in the range of 20 to 30%, the highest of the three fruit types, and thus *tenera* are typically used as commercial planting materials.

Dura palm breeding populations used in Southeast Asia include Serdang Avenue, Ulu Remis (which incorporated some Serdang Avenue material), Johor Labis, and Elmina estate, including Deli Dumpy, all of which are derived from Deli *dura*. *Pisifera* breeding populations used for seed production are generally grouped as Yangambi, AVROS, Binga and URT. Other *dura* and *pisifera* populations are used in Africa and South America.

Accordingly, in some embodiments the parental oil palm plant is a *dura* palm selected from the group consisting of Deli *dura*, Serdang Avenue *dura*, Ulu Remis *dura*, Johor Labis *dura*, Elmina estate *dura*, and Deli Dumpy *dura*. Alternatively, in some embodiments the parental oil palm plant is a *pisifera* palm selected from the group consisting of Yangambi *pisifera*, AVROS *pisifera*, Binga *pisifera*, and URT *pisifera*.

Oil palm breeding is primarily aimed at selecting for improved parental *dura* and *pisifera* breeding stock palms for production of superior *tenera* commercial planting materials. Such materials are largely in the form of seeds although the use of tissue culture for propagation of clones continues to be developed. Generally, parental *dura* breeding populations are generated by crossing among selected *dura* palms. Based on the monogenic inheritance of fruit type, 100% of the resulting palms will be *duras*. After several years of yield recording and confirmation of bunch and fruit characteristics, *duras* are selected for breeding based on phenotype. In contrast, *pisifera* palms are normally female sterile and thus breeding populations thereof must be generated by crossing among selected *teneras* or by crossing selected *teneras* with selected *pisiferas*. The *tenera* x *tenera* cross will generate 25% *duras*, 50% *teneras* and 25% *pisiferas*.

The *tenera* x *pisifera* cross will generate 50% *teneras* and 50% *pisiferas*. The yield potential of *pisiferas* is then determined indirectly by progeny testing with the elite *duras*, i.e. by crossing *duras* and *pisiferas* to generate *teneras*, and then determining yield phenotypes of the fruits of the *teneras* over time. From this, *pisiferas* with good general combining ability are selected based on the performance of their *tenera* progenies. Intercrossing among selected parents is also carried out with progenies being carried forward to the next breeding cycle. This allows introduction of new genes into the breeding programme to increase genetic variability. Using this general scheme, priority selection objectives include high oil yield per unit area in terms of high fresh fruit bunch yield and high oil to bunch ratio (thin shell, thick mesocarp), high early yield (precocity), and good oil qualities, among other traits.

Accordingly, in some embodiments, the parental oil palm plant is a *dura* breeding stock plant, the progeny comprises an oil palm plant selected from the group consisting of a *dura* breeding stock plant and a *tenera* agricultural production plant, and the high-yielding oil palm plant is selected from the group consisting of a *dura* breeding stock plant and a *tenera* agricultural production plant. For example, in some embodiments the method is carried out with the purpose of generating improved *dura* breeding stock, in which case the parental *dura* breeding stock plant is crossed with another *dura* breeding stock plant to obtain a high yielding oil palm plant directly among the progeny, which will also be *dura* breeding stock plants. Also for example, in some embodiments the method is carried out with the purpose of generating improved *tenera* agricultural production plants, in which case the parental *dura* breeding stock plant is crossed with a *pisifera* breeding stock plant to obtain a high yielding oil palm plant directly among the progeny, which will be *tenera* agricultural production plants.

Alternatively, in some embodiments the parental oil palm plant is a *tenera* breeding stock plant, the progeny comprises an oil palm plant selected from the group consisting of a *tenera* breeding stock plant, a *pisifera* breeding stock plant, and a *tenera* agricultural production plant, and the high-yielding oil palm plant is selected from the group consisting of a *tenera* breeding stock plant and a *tenera* agricultural production plant. For example, in some embodiments the method may be carried out with the purpose of generating improved *tenera* breeding stock, in which case the parental *tenera* breeding stock plant is crossed with another *tenera* breeding stock plant, to obtain a *tenera* high yielding palm plant directly among the progeny, of which 25% will be *dura*, 50% will be *tenera*, and 25% will be *pisifera*. Also for example, in some embodiments the method is carried out with the purpose of generating improved *tenera* agricultural production plants, in which case the parental *tenera* breeding stock plant is crossed with a *pisifera* breeding stock plant, to yield progeny corresponding to 50% *tenera* and 50% *pisifera*. The *pisifera* resulting from this cross can in turn be used as *pisifera* breeding stock for generation of *tenera* agricultural production plants.

Progeny plants may be cultivated by conventional approaches, e.g. seedlings may be cultivated in polyethylene bags in pre-nursery and nursery settings, raised for about 12 months, and then planted as seedlings, with progeny that are known or predicted to exhibit high yields chosen for further cultivation.

As will be apparent from the foregoing, the step of selecting progeny of the parental oil palm plant may also be based on differences between levels of more than one of the proteins in the mesocarp tissue of the fruit of the parental oil palm plant and the levels of the proteins in mesocarp tissue of a fruit of a reference oil palm plant to obtain the high-yielding oil palm plant. For example, in some embodiments the step of selecting is based on differences with respect to a

combination of two to thirty-eight of the above-noted proteins. Also for example, in some embodiments the step of selecting is based on differences with respect to combinations of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, or 38 of the above-noted proteins, e.g. each possible combination.

Additional proteins

In some embodiments, in addition to determining a difference with respect to one or more than one of the above-noted proteins, a difference is also determined with respect to one or more additional proteins selected from the group consisting of 17.6 kDa class I small heat shock protein, ABC1 family protein, glutathione peroxidase, glutathione S-transferase, glutathione-S-transferase theta, phospholipase D, and VIER F-Box Proteine 2. In some embodiments, the 17.6 kDa class I small heat shock protein comprises SEQ ID NO: 39, the ABC1 family protein comprises SEQ ID NO: 40, the glutathione peroxidase comprises SEQ ID NO: 41, the glutathione S-transferase comprises SEQ ID NO: 42, the glutathione-S-transferase theta comprises SEQ ID NO: 43, the phospholipase D comprises SEQ ID NO: 44, and the VIER F-Box Proteine 2 comprises SEQ ID NO: 45.

In some embodiments, the difference between the level of the additional protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the additional protein in mesocarp tissue of the fruit of the reference oil palm plant is that the level of the 17.6 kDa class I small heat shock protein in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the 17.6 kDa class I small heat shock protein in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the

17.6 kDa class I small heat shock protein in the mesocarp tissue of the fruit of the parental oil palm plant 16 or 18 weeks after pollination thereof is higher than the level of the 17.6 kDa class I small heat shock protein in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof.

In some embodiments, the difference between the level of the additional protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the additional protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the ABC1 family protein in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the ABC1 family protein in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the ABC1 family protein in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than the level of the ABC1 family protein in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the additional protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the additional protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the glutathione peroxidase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the glutathione peroxidase in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the glutathione peroxidase in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is higher than

the level of the glutathione peroxidase in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the additional protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the additional protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the glutathione S-transferase in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 19 weeks after pollination thereof is lower than the level of the glutathione S-transferase in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 19 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the glutathione S-transferase in the mesocarp tissue of the fruit of the parental oil palm plant 12 weeks after pollination thereof is lower than the level of the glutathione S-transferase in the mesocarp tissue of the fruit of the reference oil palm plant 12 weeks after pollination thereof. Also for example, in some embodiments the difference is that the level of the glutathione S-transferase in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the glutathione S-transferase in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof. As a further example, in some embodiments the difference is that the level of the glutathione S-transferase in the mesocarp tissue of the fruit of the parental oil palm plant 18 weeks after pollination thereof is lower than the level of the glutathione S-transferase in the mesocarp tissue of the fruit of the reference oil palm plant 18 weeks after pollination thereof.

In some embodiments, the difference between the level of the additional protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the additional protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the glutathione-

S-transferase theta in the mesocarp tissue of the fruit of the parental oil palm plant 17 to 19 weeks after pollination thereof is higher than the level of the glutathione-S-transferase theta in the mesocarp tissue of the fruit of the reference oil palm plant 17 to 19 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the glutathione-S-transferase theta in the mesocarp tissue of the fruit of the parental oil palm plant 18 weeks after pollination thereof is higher than the level of the glutathione-S-transferase theta in the mesocarp tissue of the fruit of the reference oil palm plant 18 weeks after pollination thereof.

In some embodiments, the difference between the level of the additional protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the additional protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the phospholipase D in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the phospholipase D in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof. For example, in some embodiments the difference is that the level of the phospholipase D in the mesocarp tissue of the fruit of the parental oil palm plant 16 weeks after pollination thereof is lower than the level of the phospholipase D in the mesocarp tissue of the fruit of the reference oil palm plant 16 weeks after pollination thereof.

In some embodiments, the difference between the level of the additional protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the additional protein in the mesocarp tissue of the fruit of the reference oil palm plant is that the level of the VIER F-Box Proteine 2 in the mesocarp tissue of the fruit of the parental oil palm plant 17 to 19 weeks after pollination thereof is higher than the level of the VIER F-Box Proteine 2 in the mesocarp tissue of the fruit of the reference oil palm plant 17 to 19 weeks after pollination thereof. For example,

in some embodiments the difference is that the level of the VIER F-Box Proteine 2 in the mesocarp tissue of the fruit of the parental oil palm plant 18 weeks after pollination thereof is higher than the level of the VIER F-Box Proteine 2 in the mesocarp tissue of the fruit of the reference oil palm plant 18 weeks after pollination thereof.

Method for obtaining palm oil

A method for obtaining palm oil from a high-yielding oil palm plant is also disclosed. The method includes the steps of obtaining a high-yielding oil palm plant as explained above; and isolating palm oil from a fruit of the high-yielding oil palm plant. The step of isolating palm oil may be carried out by conventional approaches, e.g. harvesting of fruit bunches followed by extraction of oil, within 24 hours, from the fresh and non-wounded fruits thereof.

Method for Predicting Oil Yield of a Test Oil Palm Plant

As noted above, also provided is a method for predicting oil yield of a test oil palm plant. The method comprises: (i) determining the level of a protein in mesocarp tissue of a fruit of the test oil palm plant; (ii) determining whether there is a difference between the level of the protein in the mesocarp tissue of the fruit of the test oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant; and (iii) predicting the oil yield of the test oil palm plant based on the difference.

The proteins described above as being useful in the method for obtaining a high-yielding oil palm plant are also useful in the method for predicting oil yield of a test oil palm plant.

The step of determining the level of a protein in mesocarp tissue of a fruit of the test oil palm plant may also be carried out similarly as described above, e.g. based on two-dimensional

fluorescence difference gel electrophoresis, antibody-based detection, immunoblot detection, or dot-blot detection, and/or with respect to more than one of the proteins, except that the level of the protein in the mesocarp tissue of the fruit is determined with respect to a fruit of a test oil palm plant rather than a parental oil palm plant.

The step of determining whether there is a difference between the level of the protein in the mesocarp tissue of the fruit of the test oil palm plant and the level of the protein in the mesocarp tissue of a fruit of a reference oil palm plant may also be carried as described above, based for example on the level of the protein of the mesocarp of the test oil palm plant being higher (or alternatively, lower) than that of the reference oil palm plant by, for example, greater than 1.1 fold, 1.25 fold, 1.5 fold, 2 fold, 4 fold, or more, with p values of, for example, <0.025, <0.05, or <0.1. Moreover, the difference may be based on any of the specific differences noted above with respect to each specific protein, e.g. in some embodiments the difference between the level of the protein in the mesocarp tissue of the fruit of the test oil palm plant and the level of the protein in mesocarp tissue of the fruit of the reference oil palm plant is that the level of the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase in the mesocarp tissue of the fruit of the test oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof. In addition, differences may be determined with respect to levels of more than one of the proteins.

The predicting step may be carried out, for example, based on the amount of the difference in the level of the protein in the mesocarp tissue of the fruit of the test oil palm plant and the level of the protein in mesocarp tissue of the fruit of the reference oil palm plant, and/or based on correlations between levels of expression of the protein and yield. The predicting step

also may be carried out, for example, based on differences with respect to the levels of more than one of the proteins.

Kit for Obtaining a High-Yielding Oil Palm Plant

As noted above, also provided is a kit for obtaining a high-yielding oil palm plant. The kit comprises: (i) an antibody for detection of a protein; and (ii) an extract of a mesocarp tissue of a fruit of a reference oil palm plant. The proteins described above as being useful in the method for obtaining a high-yielding oil palm plant are also useful in the kit for obtaining a high-yielding oil palm plant. Also, as noted above, antibodies to the above-noted proteins may be prepared by methods that are well known in the art or obtained from commercial vendors.

In some embodiments, the kit further comprises instructions indicating use of the antibody for determining whether there is a difference between the level of the protein in mesocarp tissue of a fruit of a parental oil palm plant and the level of the protein in the extract of the mesocarp tissue of the fruit of the reference oil palm plant. The step of determining whether there is such a difference may also be carried as described above. In some embodiments, the kit also further comprises instructions indicating selection of progeny of the parental oil palm plant based on the difference to obtain the high-yielding oil palm plant. The step of selecting progeny of the parental oil palm plant may also be carried out as described above. In addition, in some embodiments, the kit further comprises at least another antibody for detection of at least another of the proteins.

The following examples are for purposes of illustration and are not intended to limit the scope of the claims.

Example 1

Two-Dimensional Difference Gel Electrophoresis and Identification of Proteins

Objectives

Objectives included identifying proteins that are differentially expressed in oil palm mesocarp tissue across high- and low-yielding traits and across time of fruit development.

Methods

Screening populations:

Two screening populations of oil palm plants, a high-yielding screening population and a low-yielding screening population, each consisting of three individual palm plants, were used. The screening populations were derived from crosses of Serdang Avenue *dura* (at least 75% of Serdang Avenue *dura*) and AVROS *pisifera* (at least 75% of AVROS *pisifera*) to yield *tenera* progeny. More specifically, the high-yielding screening population was derived from a population of oil palm plants that had previously been determined to yield relatively high amounts of palm oil, specifically more than 10 tonnes of palm oil per hectare per year, and thus to have a high-yielding phenotype, also termed an H phenotype. The low-yielding screening population was derived from a population of oil palm plants that had previously been determined to yield relatively low amounts of palm oil, specifically lower than 6 tonnes of palm per hectare per year, and thus to have a low-yielding phenotype, also termed an h phenotype. The yield determinations for the high-yielding and low-yielding populations were defined by 4-year statistical data collected by reliable oil palm breeders. For the high-yielding screening populations, the three high-yielding palms thereof were designated H2, H4, and H6. For the

low-yielding screening population, the three low-yielding palms thereof were designated h1, h6, and h9.

Comparisons:

Each of the three high-yielding palms and the three low-yielding palms of the screening populations were sampled across three time points, 12 weeks post-pollination (time "a"), 16 weeks post-pollination (time "b"), and 18 weeks post-pollination (time "c"), to provide for the following comparisons:

1. High yield (12 weeks) v. Low yield (12 weeks) (also termed "Ha vs ha")
2. High yield (16 weeks) v. Low yield (16 weeks) (also termed "Hb vs hb")
3. High yield (18 weeks) v. Low yield (18 weeks) (also termed "Hc vs hc")
4. High yield (12 weeks) v. High yield (16 weeks) (also termed "Ha vs Hb")
5. High yield (12 weeks) v. High yield (18 weeks) (also termed "Ha vs Hc")
6. Low yield (12 weeks) v. Low yield (16 weeks) (also termed "ha vs hb")
7. Low yield (12 weeks) v. Low yield (18 weeks) (also termed "ha vs hc")

Specifically, mesocarp tissue was obtained from fruitlets of each of the palms at each of the time points. For reference, oil deposition in the endosperm starts at approximately 12 weeks post-pollination and is almost complete by 16 weeks post-pollination, whereas oil deposition in the mesocarp starts at approximately 15 weeks post-pollination and continues until fruit maturity at about 20 weeks post-pollination. The time points of 12, 16, and 18 weeks post-pollination were chosen because 12 weeks post-pollination marks the start of oil deposition in endosperm but precedes the start of oil deposition in mesocarp, 16 weeks post-pollination marks the point of highest transcript expression level in mesocarp, following the initiation of oil biosynthesis after

pollination, and 18 weeks post-pollination marks the time at which transcript expression would be expected to decrease as the fruit matures.

Preparation of protein samples:

Samples of total mesocarp protein were extracted from oil palm fruitlets from each of the three high-yielding palm plants and each of the three low-yielding palm plants at 12, 16, and 18 weeks post-pollination based on a modified protein extraction method of He et al, 7 Forestry Studies in China 20, 20-23 (2005). The protein samples were resuspended in 2-D cell lysis buffer (30 mM Tris-HCl, pH 8.8, containing 7 M urea, 2M thiourea and 4% CHAPS). The mixture was sonicated at 4°C followed by shaking for 30 minutes at room temperature. The samples were centrifuged for 30 minutes at 14,000 rpm and the supernatant was collected. Protein concentration of the supernatant fraction was measured using Bio-Rad protein assay method (Bradford, 1976).

Internal standard:

An internal standard was made by mixing an equal amount of protein from each sample, i.e. total mesocarp protein from each of the three high-yielding palms and three low-yielding palms, at each of the three time points of 12, 16, and 18 weeks post-pollination. The internal standard was used to match and normalize protein patterns across different gels, thereby negating the problem of inter-gel variation. This approach allowed accurate quantification of differences between samples with an associated statistical significance. Quantitative comparisons of protein between samples were made based on the relative change of each protein spot to its own in-gel internal standard.

CyDye labeling:

For each sample, 30µg of protein was mixed with 1.0 µl of diluted CyDye, and kept in dark on ice for 30 min. Samples from each pairwise comparison were labeled with Cy3 and Cy5 respectively. The internal standard was labeled with Cy2. The labeling reaction was stopped by adding 1.0 µl of 10 mM lysine to each sample, and incubating in dark on ice for an additional 15 min. The three labeled samples were then mixed together. The 2X 2-D Sample buffer (8 M urea, 4% CHAPS, 20 mg/ml DTT, 2% pharmalytes and trace amount of bromophenol blue), 100 µl de-streak solution and rehydration buffer (7 M urea, 2 M thiourea, 4% CHAPS, 20 mg/ml DTT, 1% pharmalytes and trace amount of bromophenol blue) were added to the labeling mix to make the total volume of 250 µl. Samples were mixed well and spun down. Then samples were loaded onto immobilized pH gradient gel ("IPG") strips housed in a strip holder.

Difference gel electrophoresis gels:

Difference gel electrophoresis ("DIGE") analytical gels were designed to contain the appropriate sample pairings in order to facilitate gel analysis in the later part of the experiment. A total of nine DIGE gels were produced with the sample pairings as follow:

Gel 1: H2a, h1a, and internal standard

Gel 2: H4a, h6a, and internal standard

Gel 3: H6a, h9a, and internal standard

Gel 4: H2b, h1b, and internal standard

Gel 5: H4b, h6b, and internal standard

Gel 6: H6b, h9b, and internal standard

Gel 7: H2c, h1c, and internal standard

Gel 8: H4c, h6c, and internal standard

Gel 9: H6c, h9c, and internal standard

Accordingly, gels 1-3, 4-6, and 7-9 correspond to comparisons of high- versus low-yielding palms at 12, 16, and 18 weeks post-pollination, respectively.

Isoelectric focusing and SDS-polyacrylamide gel electrophoresis:

After loading the labeled samples onto IPG strips of pH 4-7, isoelectric focusing ("IEF") was conducted following a known protocol of Amersham BioSciences, 2-D Electrophoresis: Principles and Methods, pp. 43-72 (2004). Upon finishing the IEF, the IPG strips were incubated in freshly made equilibration buffer-1 (50 mM Tris-HCl, pH 8.8, containing 6 M urea, 30% glycerol, 2% SDS, trace amount of bromophenol blue and 10 mg/ml DTT) for 15 minutes with gentle shaking. Then the IPG strips were rinsed in the freshly made equilibration buffer-2 (50 mM Tris-HCl, pH 8.8, containing 6 M urea, 30% glycerol, 2% SDS, trace amount of bromophenol blue and 45 mg/ml DTT) for 10 minutes with gentle shaking. The IPG strips were rinsed in the SDS- polyacrylamide gel electrophoresis ("SDS-PAGE") gel running buffer and then transferred into 12% SDS-PAGE gels. The SDS-PAGE gels were run at 15° C until the dye front ran out of the gels.

Image scan and data analysis:

Gel images were scanned immediately following SDS-PAGE using Typhoon TRIO (Amersham BioSciences) in accordance with known methods for use thereof. The scanned images were then analyzed by Image Quant software (version 6.0, Amersham BioSciences),

followed by Biological Variation Analysis ("BVA") using DeCyderTM 2D software version 6.5 (Amersham BioSciences).

Results

Results from 2D-DIGE analytical gels:

Results for 2D-DIGE analytical gels are shown in FIGS. 1-9, corresponding to comparisons of (1) H2a vs. h1a, (2) H4a vs. h6a, (3) H6a vs. h9a, (4) H2b vs. h1b, (5) H4b vs. h6b, (6) H6b vs. h9b, (7) H2c vs. h1c, (8) H4c vs. h6c, and (9) H6c vs. h9c, respectively.

The DIGE analytical gels were used for cross-gel BVA analysis as follows:

i) Hb vs hb , corresponding to (H2b, H4b, H6b) vs (h1b, h6b, h9b)

ii) Ha vs ha, corresponding to (H2a, H4a, H6a) vs. (h1a, h6a, h9a)

iii) Hc vs hc, corresponding to (H2c, H4c, H6c) vs. (h1c, h6c, h9c)

iv) Ha vs Hb vs Hc, corresponding to (H2a, H4a, H6a) vs. (H2b, H4b, H6b) vs. (H2c, H4c, H6c)

v) ha vs hb vs hc, corresponding to (h1a, h6a, h9a) vs. (h1b, h6b, h9b) vs. (h1c, h6c, h9c)

Based on matching multiple gels for comparison and conducting statistical analysis of protein-abundance changes, the BVA analysis provides an accurate indication of the differential expression of protein spots. For purposes of determining statistical significance in this analysis, p value < 0.1 was applied due to the small sample size (n=3) for each gel-to-gel comparison. The number of differentially expressed proteins found in this analysis was narrowed down to those with expression ratios of > 1.5 fold change. The corresponding protein spots in the gels were cross-checked by eye to ensure good quality/resolution spots with no artificial streaks. The screened spots were subsequently picked for identification via mass spectrometry ("MS").

In accordance with these methods, 84 protein spots were detected as differentially expressed from 2D-DIGE BVA analysis in one or more of the above-noted analyses, as shown as in FIGS. 1-9 as protein spots that are circled and numbered.

The 84 spots were narrowed down further to 61 spots for mass spectrometry identification via MALDI-ToF/ToF. The selection criteria practiced here was based on i) visibility of the spots on the DIGE gel, ii) differences in protein expression greater than 1.5 fold, and iii) the occurrence of protein isoforms. Candidate spots that were not clearly visible on the DIGE gel, that had lower than 1.5 fold change in expression, or that were redundant based on an isoform thereof having been identified already, were not selected for further analysis.

2D-DIGE preparative gels:

Three preparative gels were run with 3 CyDye labeling. Samples of total protein from individual palms were mixed for identification purposes, because individual samples did not include sufficient protein. Samples selected for preparative gels were as follows:

Gel 1: H4a, h6a, mix of other Ha/ha

Gel 2: H4b, h6b, mix of other Hb/hb

Gel 3: H2c, h1c, mix of other Hc/hc

The preparative gels were used for spot-picking all of the 61 protein spots of interest. For each picked spot, the identity of the corresponding protein was determined by MS. Specifically, each protein was subjected to MALDI-ToF/ToF, amino acid sequences of peptide fragments thereof were determined, the sequences were compared to the NCBI non-redundant database for identification of the nearest homolog, and an identity was assigned to the protein based on the identity of the nearest homolog.

This analysis resulted in 45 unique protein identifications corresponding to oil palm proteins that are homologous to proteins previously identified in oil palm or other organisms, as shown in TABLE 1, and that are differentially expressed with respect to high- or low-yielding palms and/or across the time points of 12, 16, and 18 weeks post-pollination, as shown in TABLE 2, and that thus are related to high/low yielding traits in oil palm. Specifically, of the 61 protein spots, 8 yielded matches of no confidence, i.e. the confidence index scores for the matches between each of the 8 protein spots and the nearest homologous proteins in the NCBI non-redundant database were below 80%. These 8 protein spots were not considered further. Moreover, 8 protein spots yielded repetitive identifications, i.e. the identifications were redundant with respect to other protein spots. These 8 protein spots also were not considered further. The remaining 45 unique protein identifications correspond to the following oil palm proteins: 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase comprising SEQ ID NO: 1, abscisic stress ripening protein comprising SEQ ID NO: 2, actin 6 comprising SEQ ID NO: 3, actin E comprising SEQ ID NO: 4, biotin carboxylase precursor comprising SEQ ID NO: 5, caffeic acid O-methyltransferase comprising SEQ ID NO: 6, catalase 2 comprising SEQ ID NO: 7, conserved-hypothetical-protein-of-Ricinus-communis ortholog comprising SEQ ID NO: 8, fibrillin-like protein comprising SEQ ID NO: 9, flavodoxin-like quinone reductase 1 comprising SEQ ID NO: 10, fructose-bisphosphate aldolase comprising SEQ ID NO: 11, glyceraldehyde 3-phosphate dehydrogenase comprising SEQ ID NO: 12, H0825G02.11 ortholog comprising SEQ ID NO: 13, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase comprising SEQ ID NO: 14, Lea1P comprising SEQ ID NO: 15, methionine synthase protein comprising SEQ ID NO: 16, mitochondrial peroxiredoxin comprising SEQ ID NO: 17, Os02g0753300 ortholog comprising SEQ ID NO: 18, Os05g0482700 ortholog comprising SEQ

ID NO: 19, Os12g0163700 ortholog comprising SEQ ID NO: 20, OSJNBb0085F13.17 ortholog comprising SEQ ID NO: 21, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog comprising SEQ ID NO: 22, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog comprising SEQ ID NO: 23, predicted-protein-of-Populus-trichocarpa ortholog comprising SEQ ID NO: 24, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog comprising SEQ ID NO: 25, nascent polypeptide associated complex alpha comprising SEQ ID NO: 26, proline iminopeptidase comprising SEQ ID NO: 27, protein transporter comprising SEQ ID NO: 28, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog comprising SEQ ID NO: 29, Ran GTPase binding protein comprising SEQ ID NO: 30, chloroplastic triosephosphate isomerase comprising SEQ ID NO: 31, V-type proton ATPase catalytic subunit A comprising SEQ ID NO: 32, regulator of ribonuclease activity A comprising SEQ ID NO: 33, retroelement pol polyprotein-like ortholog comprising SEQ ID NO: 34, ribosomal protein L10 comprising SEQ ID NO: 35, short chain type dehydrogenase comprising SEQ ID NO: 36, temperature-induced lipocalin comprising SEQ ID NO: 37, unknown-protein-of-Picea-sitchensis ortholog comprising SEQ ID NO: 38, 17.6 kDa class I small heat shock protein comprising SEQ ID NO: 39, ABC1 family protein comprising SEQ ID NO: 40, glutathione peroxidase comprising SEQ ID NO: 41, glutathione S-transferase comprising SEQ ID NO: 42, glutathione-S-transferase theta comprising SEQ ID NO: 43, phospholipase D comprising SEQ ID NO: 44, and VIER F-Box Proteine 2 comprising SEQ ID NO: 45. The sequences of the 45 proteins are provided in FIG. 10A-M. Of note, SEQ ID NOs: 1, 3-6, 8-12, 17-21, 24-28, 31-33, 35-41, 43, and 44 correspond to amino acid sequences of full length proteins, as deduced by determining nucleotide sequences of the corresponding mRNA transcripts, which themselves were identified based on amino acid sequences of various non-

consecutive peptide fragments of the proteins as determined by MS. In contrast, SEQ ID NOs: 2, 7, 13-16, 22, 23, 29, 30, 34, 42, and 45 correspond to non-full length protein sequences, i.e. the N- and or C-terminal sequences of the corresponding full length protein have not been determined, or amino acid sequences of various non-consecutive peptide fragments of the proteins as determined by MS.

Example 2

Functions of the 45 Unique Differentially Expressed Proteins

The 45 unique differentially expressed proteins identified in Example 1 were annotated based on predicted molecular function, pathway involvement and enzyme classification, as shown in TABLE 1. Surprisingly, of the 45 proteins, only three are functionally related to lipid metabolism. The three proteins are phospholipase D, biotin carboxylase precursor, and fructose-bisphosphate aldolase. Moreover, only 17 have been successfully mapped to so-called KEGG Pathways, i.e. pathways for which the proteins thereof play a role in metabolism of carbohydrates, amino acids, lipids, nucleotides, energy, or secondary metabolites, in accordance with the KEGG (Kyoto Encyclopedia of Genes and Genomes) pathway database, available at: http://www. genome.jp/keg/pathway,html (last accessed Nov. 2010). The 17 proteins include the three above-noted lipid metabolism proteins and 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, caffeic acid O-methyltransferase, catalase 2, glyceraldehyde 3-phosphate dehydrogenase, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, methionine synthase protein, proline iminopeptidase, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, glutathione peroxidase, glutathione S-transferase, glutathione-S-transferase theta, and VIER F-Box Proteine 2. The

remaining 28 differentially expressed proteins were not known to be involved in oil biosynthesis. The remaining proteins include abscisic stress ripening protein, actin 6, actin E, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, H0825G02.11 ortholog, Lea1P, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, unknown-protein-of-Picea-sitchensis ortholog, 17.6 kDa class I small heat shock protein, and ABC1 family protein.

Example 3

Dot Blot-Based Detection of Various of the 45 Unique Differentially Expressed Proteins

Objectives

Objectives included validating protein leads obtained from the DIGE experiment of Example 1 in larger populations of high and low yielding oil palms.

Methods

Samples: Mesocarp tissues of 8 high and 8 low yielding palms obtained across 6 time points, namely 12, 14, 16, 18, 20 and 22 weeks post-pollination, were used.

Antibodies: Antibodies against 27 of the 45 unique differentially expressed proteins were obtained from various suppliers, as indicated in Table 3.

Protein extraction (TCA extraction): TCA extraction buffer (containing 10% TCA (10g), 0.007% DTT (70 mg), and acetone (to 100 ml) and stored at -20°C) pre-cooled at -20° C (0.2g + 0.5 ml) was added to mesocarp samples in the form of fine powder. Samples were ground further using a mini plastic grinder. Samples were mixed and mashed well. Then another 1 ml of buffer was added and samples were incubated at -20°C for 1 hour. Samples were then subjected to centrifugation at maximum speed (13.2g) at 4°C for 15 min. Tubes were placed on ice and supernatant was removed by use of a pipette. A volume of 1.8 ml wash buffer (containing 0.007% DTT (70 mg) and acetone (to 100 ml) and stored at -20°C) was added and pellets were resuspended and crushed by use of pipette tips. Samples were incubated at -20°C for 1 hour. Samples were again subjected to centrifugation at maximum speed at 4°C for 15 min. Supernatant was removed and washing steps were repeated for a total of three times. Sample powders were air-dried on ice for 30 min. Dried sample powders were then resuspended in 500 µl of lysis / USB buffer (containing 9M urea (5.4g), 4% CHAPS (0.4g), 1% DTT (0.1g), 1% ampholytes pH 3-10 (250 µl), 35 mM Tris Base (0.0424g), sterile MilliQ water (to 10 ml), all filtered through 0.2 µm pore size membrane and stored at -20°C). Samples were incubated at 37°C for 1 hour with continuous shaking. Samples were subjected to centrifugation at max speed at room temperature for 15 min. Supernatants were transferred to clean tubes and stored at

-80°C. Pellets were stored at -80°C as back-up for further use. To further elute protein from pellet, an additional 500 µl of lysis / USB buffer can be added, followed by incubation of the pellet at room temperature for 1 hour with shaking, transfer of the back-up supernatants to clean microcentrifuge tubes, and finally storage at -80°C.

Protein quantification (Bradford assay): Samples corresponding to 5-fold dilutions of protein stocks were prepared for quantification. The BSA stock concentration was 1.4 µg/µl. Six points of 2-fold serial dilutions were used to construct the standard curve. Concentrations obtained for samples ranged from 0.244 µg/µl (lowest) to 2.934 µg/µl (highest). Having determined the concentrations of protein stocks, working stocks (330µl) at a final concentration of 0.2 µg/µl were prepared by use of PBS buffer (+10% glycerol) for dot-blotting onto membrane.

Dot-blot screening:

Dot-blot arrays using a 386 pin replicator: For each blot, a nitrocellulose membrane was cut to 2.95 x 4.6 inches and pasted onto single well plates. A plate was stacked with membrane on top of another empty plate and then the stamping guide was stacked over both plates. Protein samples were prepared in two concentrations, 0.20 µg/µl and 0.02 µg/µl (10x dilution). The replicator was dipped into the 386-well plate and swirled. The replicator was lifted and the guiding pins were slotted into the guide slots on the stamping guide. The blot was then stamped and fan dried. When the membrane was fully dried, the stamping procedure was repeated for a total of 5 rounds (equivalent to stamping 0.20 µg or 0.02 µg of protein on each spot since replicator pins delivers 0.2 µl of sample), with the membrane being fan dried after each application. Membranes were then allowed to air dry overnight. Membranes were removed

from plates and cut down to size. The membranes were kept sandwiched between the original protective paper and stored in air-tight containers in a dry environment until use.

Preparation for screening: Individual membranes were clipped onto glass slides, two on each slide, with their backs facing inward. The clipped membranes were dipped into a container filled with cold 0.1% PBS-T (pH 7.4) and stirred at about speed 7 on a magnetic stirrer for 40 minutes. The 0.1% PBS-T was replaced with cold 0.05% PBS-T and washing was continued for 15 minutes. The 0.05% PBS-T was replaced with fresh cold 0.05% PBS-T, stirring was continued for 7 minutes, and then the replacement and stirring steps were repeated.

Antibody incubations: Membranes were laid in clean and appropriately sized incubation containers, and any bubbles trapped underneath the membranes were removed. A volume of 1 ml of PBS-T 0.05% was pipetted onto blank membranes and 1 ml antibody was diluted in PBS-T 0.05% onto corresponding membranes. The membranes were shaken to ensure that the whole surface of membranes was covered. Containers were covered with wet c-fold towels before wrapping with cling-film to keep in moisture. The membranes were then incubated overnight on a Belly Dancer laboratory shaker at 4°C or at room temperature for 2 to 3 hours depending on optimized conditions for individual antibodies. Used sera were retained for further experiments or discarded into a bottle to be autoclaved. Membranes were clipped onto glass slides. Membranes were washed in cold 0.05% PBS-T for 15 min, and then were twice washed in fresh 0.05% PBS-T for 7 min each time. Membranes were laid back into clean incubation containers to ensure that no bubbles were trapped underneath the membranes. A volume of 1 ml of secondary antibody diluted in 0.05% PBS-T was added to each membrane. For secondary antibodies with background signals, pre-adsorption was performed with 1% BSA with shaking at room temperature for 40 min. Containers were covered in a similar pattern as above and

incubated for 2.5 hours on a Belly Dancer laboratory shaker at room temperature. Secondary antibody was discarded and then the above-described washing steps were repeated for 15 min, 7 min, and 7 min, each round with fresh, cold 0.05% PBS-T.

Development and documentation: Membranes were laid back in incubation containers, it was ensured that no bubbles were trapped underneath the membranes, and any remaining 0.05% PBS-T was flicked off of the membranes. Fresh NBT/BCIP was prepared according to manufacturer guidelines using alkaline phosphatase (AP) buffer (100 mM Tris [pH 9.0], 150 mM NaCl, 1 mM MgCl2). A volume of 1.5 ml of NBT/BCIP solution was added to each membrane, followed by incubation on a Belly Dancer laboratory shaker until the purple color of the positive controls was well developed (approximately 30-45 min). The reactions were then stopped by rinsing and soaking membranes in water. The developed membranes were scanned by use of an HP paper scanner (while the membrane remained wet) with HP Director software and the resulting images were saved in TIFF format. Settings were as follows: (a) Highlights: 255; (b) Shadows: 50; (c) Midtones: 2.00; (d) Sharpen: Medium; (e) Resolution: 150; and (f) White Level: 240. Scanned images were further processed by use of Adobe Photoshop C84 Extended & Olympus Micro software to automatically capture and transform spot densities into Microsoft Excel spreadsheets. Data generated from dot-blot immunoassays were analyzed using the Mann Whitney statistical test.

Results:

Result of the dot-blot immunoassays indicated significant differences in the expression of 11 out of the 27 proteins assayed, as shown in TABLE 4. Specifically, in mesocarp tested 12 weeks post-pollination the proteins caffeic acid O-methyltransferase, chloroplastic

triosephosphate isomerase, ABC1 family protein, nascent polypeptide-associated complex alpha, glutathione peroxidase and fructose-bisphosphate aldolase were found to be differentially expressed. In mesocarp tested 14 weeks post-pollination, nascent polypeptide-associated complex alpha and ribosomal L10 proteins were found to be differentially expressed between high and low yielding palms. In mesocarp tested 16 weeks post-pollination, chloroplastic triosephosphate isomerase was differentially expressed. In mesocarp tested 20 weeks post-pollination, glutathione-S-transferase theta and predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog were differentially expressed in mesocarps of high and low yielders. And in mesocarp tested 22 weeks post-pollination, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase protein and 17.6 kDa class I small heat shock protein were differentially expressed between high and low yielding palms.

Industrial Applicability

The methods and kits disclosed herein are useful for obtaining high-yielding oil palms and for predicting oil yields of test oil palm plants, and thus for improving commercial production of palm oil.

TABLE 1. Forty-five unique differentially expressed proteins.

Protein	Spot #	Top Ranked Protein Name [Species]	Accession #	Function	Pathways/Metabolism	Enzyme Class
SEQ ID NO: 1	65	5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, putative, expressed [Oryza sativa]	gi|108862992	Catalyzes methionine formation in amino-acid biosynthesis pathway	Cysteine and methionine metabolism; biosynthesis of plant hormones	EC2.1.1.14 5--methyltetrahydropteroyltriglutamate-homocysteine methyltransferase
SEQ ID NO: 2	78	abscisic stress ripening protein [Musa acuminata subsp. burmannicoides]	gi|219963178	Stress related protein	-	-
SEQ ID NO: 3	22	actin 6 [Populus trichocarpa]	gi|224117708	Housekeeping, monomeric subunit of microfilaments	-	-
SEQ ID NO: 4	76	actin E [Elaeis guineensis]	gi|48527433	Actin	-	-
SEQ ID NO: 5	67	biotin carboxylase precursor [Glycine max]	gi|3219361	Component of acetyl CoA carboxylase & involved in fatty acid biosynthesis	Fatty acid biosynthesis; pyruvate; propanoate metabolism	EC6.3.4.14 biotin carboxylase
SEQ ID NO: 6	23	caffeic acid O-methyltransferase [Vanilla planifolia]	gi|45444737	-	Biosynthesis of secondary metabolites	2.1.1.68 Transferases, methyltransferase
SEQ ID NO: 7	9	catalase 2 [Elaeis guineensis]	gi|192910916	Hydrogen peroxidase metabolism activity	Energy; methane; amino acid and tryptophan metabolism	EC1.11.1.6 Catalase
SEQ ID NO: 8	59	conserved hypothetical protein [Ricinus communis]	gi|223539131	-	-	-
SEQ ID NO: 9	73	fibrillin-like protein [Elaeis guineensis]	gi|32250939	Fibrillin= microfibrils surrounding amorphous elastin	--	-
SEQ ID NO: 10	46	FQR1 (FLAVODOXIN-LIKE QUINONE REDUCTASE 1) [Arabidopsis thaliana]	gi|15239652	Quinone reductase family, involved in redox and auxin response	-	-
SEQ ID NO: 11	74	fructose-bisphosphate aldolase [Elaeis guineensis]	gi|192910908	-	Carbohydrate metabolism, energy metabolism	EC4.1.2.13 Lyases, Aldehydelyases

SEQ ID NO: 12	26	glyceraldehyde 3-phosphate dehydrogenase [Elaeis guineensis]	gi|82400215	Intermediate in glycolysis, gluconeogenesis and photosynthesis	Carbohydrate metabolism, glycolysis and gluconeogenesis, energy metabolism, carbon fixation in photosynthesis	EC1.2.1.9 GAP (NADP); EC1.2.1.12 GAP A; EC1.2.1.59 GAP2 (NAD(P)); EC1.2.1.13 GAP2 (NADP+ phosphorylating); EC1.2.1.12 GAPDHS (spermatogenic)
SEQ ID NO: 13	19	H0825G02.11 [Oryza sativa (indica cultivar-group)]	gi|116309131	Contains transposase domain; Transposase= enzyme binds to end of transposon to catalyze movement of transposon	-	-
SEQ ID NO: 14	56	large subunit of ribulose-1, 5-bisphosphate carboxylase/oxygenase [Chlorogonium elongatum]	gi|74267421	RuBisCO= used in Calvin cycle to catalyze carbon fixation	Glyoxylate and dicarboxylate metabolism; photosynthesis carbon fixation	EC4.1.1.39 ribulose-bisphosphate carboxylase
SEQ ID NO: 15	48	Lea1P [Daucus carota]	gi|10945667	A small nuclear ribonucleoprotein (snRNP), required in prespliceosome formation	-	-
SEQ ID NO: 16	5	methionine synthase protein [Sorghum bicolor]	gi|18483235	Oxidoreductases family	Cysteine and methionine metabolism	EC2.1.1.13; methionine synthase
SEQ ID NO: 17	51	mitochondrial peroxiredoxin [Pisum sativum]	gi|47775654	Antioxidant enzyme; regulates changes in phosphorylation, redox & oligomerization	Unclassified	EC1.11.1.15 Peroxiredoxin; EC1.8.98.2 Peroxiredoxin-(S-hydroxy-S-oxocystein) reductase
SEQ ID NO: 18	58	Os02g0753300 [Oryza sativa (japonica cultivar-group)]	gi|115448731	Homolog= A. thaliana lipid-associated family protein	-	-
SEQ ID NO: 19	66	Os05g0482700 [Oryza sativa (japonica cultivar-group)]	gi|115464537	Unknown protein	-	-
SEQ ID NO: 20	68	Os12g0163700 [Oryza sativa (japonica cultivar-group)]	gi|115487492	Homologous to ACTG2-actin gamma 2	-	-

SEQ ID NO: 21	7	OSJNBb0085F13.17 [Oryza sativa (japonica cultivar-group)]	gi|38345312	Heat shock protein 90 homolog	NOD-like receptor signaling pathway	-
SEQ ID NO: 22	34	predicted protein [Ostreococcus lucimarinus CCE9901]	gi|145345862	Contains a p23-like domain and several HSP90 binding sites	-	-
SEQ ID NO: 23	79	predicted protein [Physcomitrella patens subsp. patens]	gi|168027637	Ortholog of Glutathione S-transferase theta from A. thaliana	-	-
SEQ ID NO: 24	20	predicted protein [Populus trichocarpa]	gi|224129424	-	-	-
SEQ ID NO: 25	55	PREDICTED: hypothetical protein isoform 1 [Vitis vinifera]	gi|225434277	Contains a cystathione beta-synthase (CBS) domain	-	-
SEQ ID NO: 26	33	PREDICTED: similar to nascent polypeptide associated complex alpha-like protein 1 [Arabidopsis thaliana]	gi|225470846	-	-	-
SEQ ID NO: 27	24	proline iminopeptidase, putative [Ricinus communis]	gi|223538638	-	Amino acid metabolism	EC3.4.11.5 Hydrolases, Aminopeptidases
SEQ ID NO: 28	39	protein transporter [Elaeis guineensis]	gi|192910836	Transmembrane protein that helps certain substances to cross the membrane	-	-
SEQ ID NO: 29	12	putative NBS-LRR disease resistance protein homologue [Oryza sativa Japonica Group]	gi|38636971	Nucleotide-binding sequence-leucine rich region, plant defensive system	-	-
SEQ ID NO: 30	32	Ran GTPase binding protein, putative [Ricinus communis]	gi|223534074	Ran=Ras-related nuclear protein. Involved in transportation of cell nucleus during interphase	Purine metabolism	EC3.1.5.1 dGTPase; EC3.6.5.3 protein-synthesizing GTPase; EC3.6.5.5 dynamic GTPase; EC3.6.5.2 small monomeric GTPase; EC3.6.5.4 signal recognition particle GTPase
SEQ ID NO: 31	37	Triosephosphate isomerase, chloroplastic [Spinacia oleracea]	gi|1174745	Involved in glycolysis and energy production.	Glycolysis/gluconeogenesis; fructose and mannose metabolism; inositol phosphate metabolism	EC5.3.1.1 triosephosphate isomerase (TIM)

SEQ ID NO: 32	13	V-type proton ATPase catalytic subunit A [Daucus carota]	gi|137460	Catalyzes ATP to ADP to release energy	Energy metabolism; photosynthesis	EC3.6.3.9 ATP1A Na+/K+ exchanging ATPase alpha subunit; EC3.6.3.14 ATPF F-type H+-transporting ATPase subunit a,b and c
SEQ ID NO: 33	84	regulator of ribonuclease activity A [Zea mays]	gi|195638112	Inhibits the endonuclease activity	-	-
SEQ ID NO: 34	36	retroelement pol polyprotein-like [Arabidopsis thaliana]	gi|9759493	Transposons via RNA intermediates.	-	-
SEQ ID NO: 35	72	ribosomal protein L10 [Elaeis guineensis]	gi|192910684	Mitochodrial protein, key protein for large ribosomal subunit assembly and protein synthesis	Ribosome	-
SEQ ID NO: 36	75	short chain type dehydrogenase, putative [Ricinus communis]	gi|223550344	NAD or NADP-dependent oxidoreductases	Unclassified	EC1.1.1.100 Short chain type dehydrogenase
SEQ ID NO: 37	53	temperature-induced lipocalin [Elaeis guineensis]	gi|192911934	Lipocalin=proteins that transport lipid & steroids. TIL is responsive to heat stress	-	-
SEQ ID NO: 38	38	unknown [Picea sitchensis]	gi|224285125	Contains conserved region of 3-oxoacyl-(acyl-carrier-protein) reductase & Rossmann-fold NAD(P)(+)-binding proteins	-	-
SEQ ID NO: 39	81	17.6 kDa class I small heat shock protein (HSP17.6C-CI) (AA 1-156) [Arabidopsis thaliana]	gi|15220832	Induced by heat stress and involved in chaperone functions by protecting the proteins from irreversible denaturation	-	-
SEQ ID NO: 40	49	ABC1 family protein [Arabidopsis thaliana]	gi|79325958	ABC1= novel chaperonins in electron transfer	-	-

SEQ ID NO: 41	54	glutathione peroxidase [Triticum monococcum subsp. aegilopoides]	gi|148529480	-	Metabolism of other amino acids, lipid metabolism	EC1.11.1.9 Oxidoreductases, Peroxidases
SEQ ID NO: 42	41	glutathione S-transferase [Matricaria chamomilla]	gi|17385642	-	Metabolism of other amino acids	EC2.5.1.18 Transferases
SEQ ID NO: 43	43	glutathione-s-transferase theta, gst, putative [Ricinus communis]	gi|223528475	-	-	-
SEQ ID NO: 44	63	phospholipase D [Oryza sativa Japonica Group]	gi|1020415	Located in plasma membrane and catalyzes hydrolysis of phosphatidylcholine	Glycerophospholipid; ether lipid; arachidonic acid; linoleic acid; alphalinoleic acid metabolism	EC3.1.4.4 phospholipase D; EC3.1.4.11 phospholipase C, delta
SEQ ID NO: 45	30	VFB2 (VIER F-BOX PROTEINE 2); ubiquitin-protein ligase [Arabidopsis thaliana]	gi|18409012	Involved in polyubiquitination (marks protein for degradation by proteosome)	Ubiquitin mediated proteolysis; Wnt and p53 signaling pathway	EC6.3.2.19 ubiquitin-protein ligase

TABLE 2. Details of differential expression of the forty-five proteins.

Protein	Spot #	Top Ranked Protein Name [Species]	Week 12 (High vs Low)	Week 16 (High vs Low)	Week 18 (High vs Low)	High (Week 12 vs 16)	High (Week 12 vs 18)	Low (Week 12 vs 16)	Low (Week 12 vs 18)
SEQ ID NO: 1	65	5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, putative, expressed [Oryza sativa]	Upregulated in high	-	-	Upregulated in H12	Upregulated in H12	Upregulated in L12	Upregulated in L12
SEQ ID NO: 2	78	abscisic stress ripening protein [Musa acuminata subsp. burmannicoides]	-	-	-	Upregulated in H12	Upregulated in H12	Upregulated in L12	Upregulated in L12
SEQ ID NO: 3	22	actin 6 [Populus trichocarpa]	-	Upregulated in low	-	Upregulated in H12	-	-	-
SEQ ID NO: 4	76	actin E [Elaeis guineensis]	-	-	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 5	67	biotin carboxylase precursor [Glycine max]	-	-	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 6	23	caffeic acid O-methyltransferase [Vanilla planifolia]	Upregulated in low	Upregulated in low	-	Upregulated in H12	Upregulated in H12	-	Upregulated in L12

SEQ ID NO: 7	9	catalase 2 [Elaeis guineensis]	Upregulated in high	-	Upregulated in high	Upregulated in H12	Upregulated in H12	Upregulated in L12	Upregulated in L12
SEQ ID NO: 8	59	conserved hypothetical protein [Ricinus communis]	-	Upregulated in high	-	Upregulated in H16	Upregulated in H18	-	Upregulated in L18
SEQ ID NO: 9	73	fibrillin-like protein [Elaeis guineensis]	Upregulated in high	-	-	Upregulated in H12	-	-	Upregulated in L18
SEQ ID NO: 10	46	FQR1 (FLAVODOXIN-LIKE QUINONE REDUCTASE 1) [Arabidopsis thaliana]	Upregulated in low	-	Upregulated in low	Upregulated in H16	-	-	-
SEQ ID NO: 11	74	fructose-bisphosphate aldolase [Elaeis guineensis]	-	Upregulated in high	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 12	26	glyceraldehyde 3-phosphate dehydrogenase [Elaeis guineensis]	-	Upregulated in low	-	-	-	-	-
SEQ ID NO: 13	19	H0825G02.11 [Oryza sativa (indica cultivar-group)]	-	Upregulated in low	-	-	Upregulated in H18	Upregulated in L16	-
SEQ ID NO: 14	56	large subunit of ribulose-1, 5-bisphosphate carboxylase/oxygenase [Chlorogonium elongatum]	-	-	Upregulated in high	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 15	48	Lea1P [Daucus carota]	-	Upregulated in high	-	Upregulated in H16	-	-	-
SEQ ID NO: 16	5	methionine synthase protein [Sorghum bicolor]	-	Upregulated in low	-	Upregulated in H12	-	-	-
SEQ ID NO: 17	51	mitochondrial peroxiredoxin [Pisum sativum]	Upregulated in high	Upregulated in high	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18

SEQ ID NO: 18	58	Os02g0753300 [Oryza sativa (japonica cultivar-group)]	-	Upregulated in high	-	-	-	-	-
SEQ ID NO: 19	66	Os05g0482700 [Oryza sativa (japonica cultivar-group)]	-	Upregulated in low	-	Upregulated in H12	Upregulated in H12	-	-
SEQ ID NO: 20	68	Os12g0163700 [Oryza sativa (japonica cultivar-group)]	-	-	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 21	7	OSJNBb0085F13.17 [Oryza sativa (japonica cultivar-group)]	-	Upregulated in low	-	Upregulated in H12	-	-	Upregulated in L18
SEQ ID NO: 22	34	predicted protein [Ostreococcus lucimarinus CCE9901]	-	Upregulated in high	-	Upregulated in H16	-	-	-
SEQ ID NO: 23	79	predicted protein [Physcomitrella patens subsp. patens]	Upregulated in low	-	-	Upregulated in H16	Upregulated in H18	-	-
SEQ ID NO: 24	20	predicted protein [Populus trichocarpa]	Upregulated in low	Upregulated in low	-	-	Upregulated in H18	-	-
SEQ ID NO: 25	55	PREDICTED: hypothetical protein isoform 1 [Vitis vinifera]	Upregulated in high	-	-	Upregulated in H12	Upregulated in H12	-	Upregulated in L12
SEQ ID NO: 26	33	PREDICTED: similar to nascent polypeptide associated complex alpha-like protein 1 [Arabidopsis thaliana]	Upregulated in high	-	Upregulated in high	Upregulated in H12	Upregulated in H12	-	Upregulated in L12
SEQ ID NO: 27	24	proline iminopeptidase, putative [Ricinus communis]	-	Upregulated in high	Upregulated in high	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 28	39	protein transporter [Elaeis guineensis]	Upregulated in low	-	-	Upregulated in H16	Upregulated in H18	-	-

SEQ ID NO: 29	12	putative NBS-LRR disease resistance protein homologue [Oryza sativa Japonica Group]	-	Upregulated in low	-	Upregulated in H12	-	-	-
SEQ ID NO: 30	32	Ran GTPase binding protein, putative [Ricinus communis]	Upregulated in high	-	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 31	37	Triosephosphate isomerase, chloroplastic [Spinacia oleracea]	-	Upregulated in low	-	-	-	-	-
SEQ ID NO: 32	13	V-type proton ATPase catalytic subunit A [Daucus carota]	-	Upregulated in low	-	Upregulated in H12	-	-	-
SEQ ID NO: 33	84	regulator of ribonuclease activity A [Zea mays]	-	-	-	Upregulated in H16	Upregulated in H18	-	Upregulated in L18
SEQ ID NO: 34	36	retroelement pol polyprotein-like [Arabidopsis thaliana]	Upregulated in low	-	-	Upregulated in H16	-	-	-
SEQ ID NO: 35	72	ribosomal protein L10 [Elaeis guineensis]	Upregulated in low	-	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 36	75	short chain type dehydrogenase, putative [Ricinus communis]	-	-	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18
SEQ ID NO: 37	53	temperature-induced lipocalin [Elaeis guineensis]	-	Upregulated in high	-	Upregulated in H16	-	-	-
SEQ ID NO: 38	38	unknown [Picea sitchensis]	-	Upregulated in high	-	Upregulated in H16	Upregulated in H18	-	Upregulated in L18
SEQ ID NO: 39	81	17.6 kDa class I small heat shock protein (HSP17.6C-CI) (AA 1-156) [Arabidopsis thaliana]	-	-	-	Upregulated in H16	Upregulated in H18	Upregulated in L16	Upregulated in L18

SEQ ID NO: 40	49	ABC1 family protein [Arabidopsis thaliana]	-	Upregulated in high	Upregulated in low	Upregulated in H16	Upregulated in H12	-	-
SEQ ID NO: 41	54	glutathione peroxidase [Triticum monococcum subsp. aegilopoides]	-	Upregulated in high	-	-	-	-	-
SEQ ID NO: 42	41	glutathione S-transferase [Matricaria chamomilla]	Upregulated in low	Upregulated in low	Upregulated in low	Upregulated in H16	Upregulated in H18	Upregulated in L16	-
SEQ ID NO: 43	43	glutathione-s-transferase theta, gst, putative [Ricinus communis]	Upregulated in low	-	Upregulated in high	Upregulated in H16	Upregulated in H18	-	-
SEQ ID NO: 44	63	phospholipase D [Oryza sativa Japonica Group]	-	Upregulated in low	-	Upregulated in H12	-	-	Upregulated in L12
SEQ ID NO: 45	30	VFB2 (VIER F-BOX PROTEINE 2); ubiquitin-protein ligase [Arabidopsis thaliana]	-	-	Upregulated in high	-	-	-	Upregulated in L12

TABLE 3. Antibodies against 27 of the 45 unique differentially expressed proteins.

Antibody No.	**Protein Spot No.**	**Antibody Ref. No.**	**Antibody Name**		**Company**
1	5	AB9209	MTR antibody		Abcam
2	7	AB19104	HSP90 antibody		Abcam
3	9 & 14	AS09501	Catalase		Agrisera
4	13	AS09503	V-ATPase B, vacuolar H+ ATPase subunit B		Agrisera
5	22 & 76	A0480-200 µl	Anti-actin (plant), Clone 10-B3		Sigma Aldrich
6	23 & 25	AB51984	COMT		Abcam
7	24	GW22303B-50 µg	Chicken Anti-XPNPEP (X-prolyl aminopeptidase	(aminopeptidase P)1)(N-193)	GenWay
8	26	10494-1-AP	GAPDH		
9	30	AB90146	HECT E3 ubiquitin ligase antibody		Abcam
10	32	AS07217	FtsZ, prokaryotic cell division GTPase		Agrisera
11	33	ABIN337196	Nascent-polypeptide-associated+Complex+Alpha+Polypeptide+(NACA) (Human)		Antibodies-online

12	37	AB58329	Triosephosphate isomerase antibody		Abcam
13	41 & 42	AS09479	GST class-phi, glutathione S transferase		Agrisera
14	43 & 79	AB55188	glutathione s-transferase theta 1		Abcam
15	48	SC-102147	U2 snRNP A (F-22)		Santa-Cruz
16	49	AB18180	ABCA1 antibody [AB.H10]		Abcam
17	51	AS05093	PrxQ, peroxiredoxin, thioredoxin reductase		Agrisera
18	53 & 82	AB61866	Prostaglandin D Synthase (Lipocalin) antibody		Abcam
19	54	AS04055	GPX, chloroplastic glutathione peroxidase		Agrisera
20	56	AS03037	RbcL, Rubisco large subunit, form I and form II		Agrisera
21	63	AS09556	PLD, phospholipase D		Agrisera
22	65	M4697-50	Anti-MTR (5-Methyltetrahydrofolate-homocysteine Methyltransferase)		US Biological
23	67	GTX110062	MCCC1		GeneTex Inc
24	68	ABIN229498	0 actin, Gamma 2, Smooth muscle enteric ACTG2		Antibodies-online
25	72	17013-1-AP	RPL10		Proteintech Group
26	74	AS08294	ALD, fructose-1,6 bisphosphate aldolase		Agrisera
27	80, 81 & 83	AS07254	HSP17.6 cytosolic class I HSP 17.6		Agrisera

TABLE 4. Dot-blot immunoassay results, as supported by Mann Whitney test.

Antibody No.	Antibody Name (Ref. No.)	Protein Spot No.	Top Ranked Protein Name (Species)		Accession No.	Differential Expression
1	COMT (AB51984)	23 & 25	Caffeic acid O-methyltransferase (Vanilla planifolia)		gi/45444737	Week 12
2	TIM (AB58329)	37	Triosephosphate isomerase, chloroplastic (Spinacia oleracea)		gi/1174745	Weeks 12 & 16
3	GST theta (AB55188)	43	Glutathione-s-transferase theta, gst, putative (Ricinus communis)		gi/223528475	Week 20
4	GST theta (AB55188)	79	Predicted protein (Physcomitrella patens subsp. Patens)		gi/168027637	Week 20
5	ABCA1 (AB18180)	49	ABC1 family protein (Arabidopsis thaliana)		gi/79325958	Week 12
6	NACA (ABIN337196)	33	Predicted: Similar to nascent polypeptide associated complex alpha-like protein 1		gi/225470846	Weeks 12 & 14
7	GPX (AS04055)	54	Glutathione peroxidase (Triticum monococcum subsp. aegilopoides)		gi/148529480	Week 12
8	RbcL(AS03037)	56	Large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase		gi/74267421	Week 22
9	RPL10 (17013-1-AP)	72	Ribosomal protein L10 (Elaeis guineensis)		gi/192910684	Week 14
10	ALD (AS08294)	74	Fructose-bisphosphate aldolase (Elaeis guineensis)		gi/192910908	Week 12
11	HSP17.6 (AS07254)	80, 81 & 83	17.6 kDa class I small heat shock protein (HSP17.6C-CI) (Arabidopsis thaliana)		gi/15220832	Week 22

RDQL-J4432 seq project for proteomics appl_ST25.txt
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            100                 105                 110

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        115                 120                 125

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    130                 135                 140

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145                 150                 155                 160

Val Ser His Thr Val Pro Ile Tyr Glu Gly Tyr Ala Leu Pro His Ala
                165                 170                 175

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            180                 185                 190

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            260                 265                 270

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Asn Pro Lys Ala Asn Arg Glu Lys Met Thr Gln Ile Met Phe Glu Thr
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Phe Asn Val Pro Ala Met Tyr Val Ala Ile Gln Ala Val Leu Ser Leu
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            180                 185                 190

Lys Ile Leu Thr Glu Arg Gly Tyr Ser Phe Thr Thr Thr Ala Glu Arg
        195                 200                 205

Glu Ile Val Arg Asp Ile Lys Glu Lys Leu Gly Tyr Val Ala Leu Asp
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65                  70                  75                  80

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Ala Gly Val Pro Thr Val Pro Gly Ser Asp Gly Leu Leu Gln Ser Thr
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His Trp Arg Pro Thr Cys Gly Val Lys Cys Leu Leu Glu Asp Glu Ala
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Val Ile Val Gly Gly Asn Asn His Ser His Ala Thr Lys Asp Leu Tyr
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Met Gly Leu Pro Leu Ala Ala Ala Pro Ile Arg Pro Arg Ala Ile Ala
    50                  55                  60

Asp Asp Glu Glu Trp Gly Gly Glu Leu Gly Glu Glu Glu Gly Ala Ala
65                  70                  75                  80

Ala Gly Gly Leu Ala Val Ala Glu Gln Glu Glu Glu Glu Val Lys Val
                85                  90                  95

Glu Pro Ile Glu Val Gly Glu Leu Lys Arg Lys Leu Met Asp Leu Leu
            100                 105                 110

Tyr Gly Thr Asp Arg Gly Leu Gln Ala Ser Ser Glu Thr Arg Ala Glu
        115                 120                 125

Ile Val Glu Val Ile Asn Gln Leu Glu Val Arg Asn Pro Thr Pro Ala
    130                 135                 140

Pro Thr Glu Ala Leu Thr Leu Leu Asn Gly Lys Trp Ile Leu Ala Tyr
145                 150                 155                 160

Thr Ser Phe Ser Pro Leu Phe Pro Leu Leu Gly Ser Ala Arg Leu Pro
                165                 170                 175

Glu Leu Val Lys Val Glu Glu Ile Ser Gln Thr Ile Asp Ser Glu Asn
            180                 185                 190
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Phe Thr Val Gln Asn Ser Val Gln Phe Ala Val Pro Leu Ala Thr Thr
195 200 205

Ser Val Thr Thr Asn Ala Lys Phe Glu Val Arg Ser Pro Lys Arg Val
210 215 220

Gln Ile Lys Phe Glu Glu Gly Ile Ile Gly Thr Pro Gln Leu Thr Asp
225 230 235 240

Ser Ile Val Leu Pro Glu Lys Val Glu Phe Leu Gly Gln Asn Ile Asp
245 250 255

Leu Ser Pro Phe Lys Ser Val Ile Thr Ser Val Gln Asn Ala Ala Ser
260 265 270

Ser Val Ala Arg Thr Ile Ser Glu Arg Pro Pro Trp Lys Ile Ser Ile
275 280 285

Asn Asn Asp Asn Ala Gln Ser Trp Leu Leu Thr Thr Tyr Leu Asp Glu
290 295 300

Glu Leu Lys Ile Ser Arg Ala Asp Gly Gly Gly Ile Phe Leu Leu Ile
305 310 315 320

Lys Glu Gly Ser Ser Leu Leu Asn
325

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<213> Elaeis guineensis

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Met Ala Thr Lys Val Tyr Ile Val Tyr Tyr Ser Met Tyr Gly His Val
1 5 10 15

Glu Lys Leu Ala Glu Glu Ile Lys Arg Gly Ala Ser Thr Val Gly Gly
20 25 30

Val Glu Ala Lys Met Trp Gln Val Pro Glu Thr Leu Pro Glu Glu Val
35 40 45

Leu Gly Lys Met Gly Ala Pro Pro Lys Ser Asp Val Pro Ile Ile Thr
50 55 60

Pro Asn Glu Leu Ala Glu Ala Asp Gly Ile Ile Phe Gly Phe Pro Thr
65 70 75 80

```
Arg Phe Gly Met Met Ala Ala Gln Phe Lys Ala Phe Leu Asp Ala Thr
                85                  90                  95

Gly Gly Leu Trp Arg Ala Gln Gln Leu Ala Gly Lys Pro Ala Gly Ile
            100                 105                 110

Phe Tyr Ser Thr Gly Ser Gln Gly Gly Gly Gln Glu Thr Thr Pro Leu
        115                 120                 125

Thr Ala Ile Thr Gln Leu Val His His Gly Met Ile Phe Val Pro Ile
    130                 135                 140

Gly Tyr Thr Phe Gly Ala Gly Met Phe Glu Met Glu Lys Val Lys Gly
145                 150                 155                 160

Gly Ser Pro Tyr Gly Ala Gly Thr Tyr Ala Gly Asp Gly Ser Arg Phe
                165                 170                 175

Pro Ser Glu Leu Glu Leu Glu Gln Ala Phe His Gln Gly Lys Tyr Phe
            180                 185                 190

Ala Gly Ile Ala Lys Lys Phe Lys Ser Ser Ser
        195                 200


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<213>  Elaeis guineensis

<400>  11

Met Ser Ala Tyr Cys Gly Lys Tyr His Asp Glu Leu Ile Lys Asn Ala
1               5                   10                  15

Ala Tyr Ile Gly Thr Pro Gly Lys Gly Ile Leu Ala Ala Asp Glu Ser
            20                  25                  30

Thr Gly Thr Ile Gly Lys Arg Leu Ala Ser Ile Asn Val Glu Asn Val
        35                  40                  45

Glu Glu Asn Arg Arg Ala Leu Arg Glu Leu Leu Phe Cys Thr Pro Gly
    50                  55                  60

Ala Leu Gln Tyr Leu Ser Gly Val Ile Leu Phe Glu Glu Thr Leu Tyr
65                  70                  75                  80

Gln Lys Thr Lys Asp Gly Lys Pro Phe Val Glu Val Leu Lys Glu Gly
                85                  90                  95
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```
Gly Val Leu Pro Gly Ile Lys Val Asp Lys Gly Thr Ile Glu Leu Ala
           100                 105                 110

Gly Thr Asn Gly Glu Thr Thr Thr Gln Gly His Asp Asp Leu Ala Lys
       115                 120                 125

Arg Cys Gln Lys Tyr Tyr Glu Ala Gly Ala Arg Phe Ala Lys Trp Arg
   130                 135                 140

Ala Val Leu Lys Ile Gly Pro Thr Glu Pro Ser Gln Leu Ala Ile Asp
145                 150                 155                 160

Leu Asn Ala His Gly Leu Ala Arg Tyr Ala Ile Ile Cys Gln Glu Asn
               165                 170                 175

Gly Leu Val Pro Ile Val Glu Pro Glu Ile Leu Val Asp Gly Pro His
           180                 185                 190

Asp Ile Lys Arg Cys Ala Asp Val Thr Glu Arg Val Leu Ala Ala Cys
       195                 200                 205

Tyr Lys Ala Leu Asn Asp His His Val Leu Leu Glu Gly Thr Leu Leu
   210                 215                 220

Lys Pro Asn Met Val Thr Pro Gly Ser Glu Ser Ala Lys Val Ala Pro
225                 230                 235                 240

Glu Val Val Ala Glu Tyr Ala Val Arg Ala Leu Gln Arg Thr Val Pro
               245                 250                 255

Ala Ala Val Pro Ala Ile Val Phe Leu Ser Gly Gly Gln Ser Glu Glu
           260                 265                 270

Glu Ala Thr Leu Asn Leu Asn Ala Met Asn Lys Leu Gly Gly Lys Lys
       275                 280                 285

Pro Trp Ser Leu Ser Phe Ser Phe Gly Arg Ala Leu Gln Gln Ser Thr
   290                 295                 300

Leu Lys Ala Trp Ala Gly Lys Val Glu Asn Val Glu Lys Ala Arg Ala
305                 310                 315                 320

Ala Phe Leu Ala Arg Cys Lys Ala Asn Ser Glu Ala Thr Leu Gly Lys
               325                 330                 335

Tyr Glu Gly Asp Ala Ala Gly Gly Glu Gly Val Ser Glu Ser Leu His
           340                 345                 350
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Val Lys Asp Tyr Lys Tyr
        355


<210>  12
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<213>  Elaeis guineensis

<400>  12

Met Phe Val Val Gly Val Asn Glu Lys Glu Tyr Lys Ser Asp Ile Asn
1               5                   10                  15


Val Val Ser Asn Ala Ser Cys Thr Thr Asn Cys Leu Ala Pro Leu Ala
            20                  25                  30


Lys Val Ile His Asp Lys Phe Gly Ile Val Glu Gly Leu Met Thr Thr
        35                  40                  45


Val His Ser Ile Thr Ala Thr Gln Lys Thr Val Asp Gly Pro Ser Ser
    50                  55                  60


Lys Asp Trp Arg Gly Gly Arg Ala Ala Ser Phe Asn Ile Ile Pro Ser
65                  70                  75                  80


Ser Thr Gly Ala Ala Lys Ala Val Gly Lys Val Leu Pro Ala Leu Asn
                85                  90                  95


Gly Lys Leu Thr Gly Met Ala Phe Arg Val Pro Thr Val Asp Val Ser
            100                 105                 110


Val Val Asp Leu Thr Val Arg Leu Glu Lys Ser Ala Thr Tyr Asp Gln
        115                 120                 125


Ile Lys Asp Ala Ile Lys Glu Glu Ser Glu Gly Lys Met Lys Gly Ile
    130                 135                 140


Leu Gly Tyr Val Asp Glu Asp Leu Val Ser Thr Asp Phe Leu Gly Asp
145                 150                 155                 160


Ser Arg Ser Ser Ile Phe Asp Ala Lys Ala Gly Ile Ala Leu Asn Gly
                165                 170                 175


Asn Phe Val Lys Leu Val Ser Trp Tyr Asp Asn Glu Trp Gly Tyr Ser
            180                 185                 190


Ser Arg Val Val Asp Leu Ile Arg His Ile His Gly Thr Gln
        195                 200                 205
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<400> 13

Met Asp Leu Gly Lys Ser Ala Ser Thr Ser Ala Thr Leu Lys Phe Tyr
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Tyr Glu Leu Arg Tyr Val Pro Phe Gln Cys Pro Ser Ser Arg Arg Ile
20 25 30

Gln Pro Leu Gln Ala Arg Glu Leu Ala Glu Ala His Glu Asp Leu Thr
35 40 45

Lys Leu Ser Cys Pro Glu Leu Asp Leu Arg Glu Ile Leu Asp Gln Gly
50 55 60

Ala Ala Ser Asp Val Arg Phe Glu Val Ala Glu Leu Glu Arg Glu Lys

65 70 75 80

Ala Val Glu Thr Leu Arg Gly Arg Glu Val Trp Phe Ser Ser Tyr Leu
85 90 95

Gln Ser Cys Cys Thr Ser Met Ala Arg Val Cys Arg Ser Met Ser Pro
100 105 110

Leu Ala Glu Lys
115

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Asp Tyr Arg Leu Thr Tyr Tyr Thr Pro Asp Tyr Val Val Arg Asp Thr
1 5 10 15

Asp Val Leu Ala Ala Phe Arg Ala Leu Arg Leu Glu Asp Leu Arg Ser
20 25 30

Gln Ala Glu Thr Gly Glu Val Lys Gly His Tyr Leu Asn Val Thr Ala
35 40 45

Gly Thr Ala Glu Glu Met Leu Lys
50 55

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<400> 15

Met Ala Ser His Gln Asp Thr Ser Tyr Lys Asp Gln Thr Gly Ser Tyr
1 5 10 15

Val Ser Asp Lys Ala Ser Ala Ala Arg Ser Cys Glu Thr Gly Gln Ala
20 25 30

Ala Lys Glu Lys Ala Ser Gln Met Gly Glu Ser Ala Lys Thr Gly Gly
35 40 45

Val Ile Ser Ser Ala Ala Glu Gln Val Lys Gly Met Ala Gln Gly Ala
50 55 60

Thr Glu Ala Val Lys Asn Thr Phe Gly Met Gly Gly Gly Asn Glu Glu
65 70 75 80

Lys

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Met Gly Pro Lys Arg Glu Leu Lys Phe Ala Leu Glu Ser Phe Trp Asp
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Gly Lys Ser Ser Ala Asp Asp Leu Gln Lys Val Ala Ala Asp Leu Arg
20 25 30

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Cys Ser Ile Trp Lys Gln Met Ala Asp Ala Gly Ile Lys Tyr Ile Pro
        35                  40                  45

Ser Asn Thr Phe Ser Tyr Tyr Asp Gln Val Leu Asp Thr Thr Ala Met
    50                  55                  60

Leu Gly Ala Val Pro Gln Arg Tyr Gly Trp Ser Gly Ala Glu Ile Gly
65                  70                  75                  80

Phe Asp Thr Tyr Phe Ser Met Ala Arg Gly Asn Ala Leu Val Pro Ala
                85                  90                  95

Met Glu Met Thr Lys Trp Phe Asp Thr Asn Tyr His Tyr Ile Val Pro
            100                 105                 110

Glu Leu Ala Pro Asp Thr Lys Phe Thr Tyr Ala Ser His Lys Ala Val
      115                 120                 125

Ser Glu Tyr Lys Glu Ala Lys Ala Leu Gly Ile Asp Thr Val Pro Val
    130                 135                 140

Leu Ile Gly Pro Val Thr Tyr Leu Leu Leu Ser Lys Pro Ala Lys Gly
145                 150                 155                 160

Val Glu Lys Ser Phe Ala Thr Leu Ser Leu Leu Gly Asn Val Leu Pro
                165                 170                 175

Ile Tyr Gln Glu Val Ile Met Glu Leu Lys Ala Ala Gly Ala Ser Trp
            180                 185                 190

Ile Gln Phe Asp Glu Pro Thr Leu Val Met Asp Leu Asp Ala His Gln
        195                 200                 205

Leu Glu Ala Phe Thr Lys Ala Tyr Ser Glu Leu Glu Ser Ser Phe Ser
    210                 215                 220

Gly Leu Asn Val Leu Val Glu Thr Tyr Phe Ala Asp Val Pro Ala Glu
225                 230                 235                 240

Ala Tyr Lys Thr Ile Thr Thr Leu Asn Gly Val Ser Gly Phe Gly Phe
                245                 250                 255

Asp Leu Val Arg Gly Thr Asn Thr Leu Asp Leu Ile Lys Ser Ala Gly
            260                 265                 270

Phe Pro Ser Gly Lys Tyr Leu Phe Ala Gly Val Val Asp Gly Arg Asn
        275                 280                 285
```

Ile Trp Ala Asn Asp Leu Ala Ser Ser Leu Ser Ser Leu Gly Val Leu
290 295 300

Glu Ala Ile Val Gly Lys Asp Asn Leu Val Val Ser Thr Ser Cys Ser
305 310 315 320

Leu Met His Thr Ala Val Asp Leu Val Asn Glu Thr Lys Leu Asp Gly
325 330 335

Glu Ile Lys Ser Trp Leu Ala Phe Ala Ala Gln Lys Val Val Glu Val
340 345 350

Asn Ala Leu Ala Lys Ala Leu Ala Gly His Lys Asp Glu Ala Phe Phe
355 360 365

Ser Ala Asn Ala Ala Ala Gln Ala Ser Arg Lys Ser Ser Pro Arg Val
370 375 380

Thr Asn Glu Glu Val Gln Thr Ala Ala Ala Ala Leu Lys Gly Ser Asp
385 390 395 400

His Cys Arg Ala Thr Asn Val Ser Ala Arg Leu Asp Ala
405 410

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<212> PRT
<213> Elaeis guineensis

<400> 17

Met Ala Ser Ala Leu Met Arg Ala Arg Arg Ser Ala Ala Leu Pro Ser
1 5 10 15

Ala Ala Val Met Ala Leu Arg Arg Ala Phe Ala Ala Ala Ser Val Gly
20 25 30

Cys Asp Ile Val Ser Ala Ala Pro Gly Val Ala Leu Gln Lys Ala Arg
35 40 45

Ser Trp Asp Glu Gly Val Ser Ser Lys Phe Ser Thr Thr Pro Leu Lys
50 55 60

Asp Ile Phe Leu Gly Lys Gln Val Val Val Phe Gly Leu Pro Gly Ala
65 70 75 80

Phe Thr Gly Val Cys Ser Ala Gln His Val Pro Ser Tyr Lys Asn Asn
85 90 95

Ile Asp Lys Phe Lys Ala Lys Gly Ile Asp Ser Val Ile Cys Val Ala
100 105 110

Val Asn Asp Pro Tyr Val Leu Asn Gly Trp Ala Glu Asn Leu Gln Ala
115 120 125

Lys Glu Ala Ile Asp Phe Tyr Gly Asp Phe Asp Gly Ser Phe His Lys
130 135 140

Ser Leu Glu Leu Asp Leu Asp Leu Ser Ala Ala Leu Leu Gly His Arg
145 150 155 160

Ser Gln Arg Trp Ser Ala Tyr Val Val Asp Gly Lys Ile Lys Val Leu
165 170 175

Asn Val Glu Lys Val Pro Ser Glu Phe Lys Val Ser Gly Gly Glu Val
180 185 190

Ile Leu Gly Gln Phe
195

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<211> 195
<212> PRT
<213> Elaeis guineensis

<400> 18

Met Met Lys Gly Thr Lys Lys Ala Ile Phe Leu Phe Leu Leu Leu Ser
1 5 10 15

Ser Leu Val Ile Ile Ser His Cys Val Thr Pro Leu Thr Ile Lys Pro
20 25 30

Val Asn Arg Asp Asp Asp Glu Tyr Gln Cys Val Tyr Thr Val Tyr Ile
35 40 45

Arg Thr Gly Ser Ile Trp Lys Gly Gly Thr Asp Ser Val Ile Ser Leu
50 55 60

Val Leu Ala Gly Ser Asp Gly Trp Gly Val Ala Ile Thr Asp Ile Glu
65 70 75 80

Ser Trp Gly Gly Ile Met Glu Ala Gly His Asn Tyr Phe Glu Arg Gly
85 90 95

Asn Leu Asp Ile Phe Ser Gly Arg Gly Pro Cys Leu Ser Thr Pro Pro
100 105 110

Cys Trp Met Asn Leu Thr Ser Asp Gly Ser Gly Ser His His Gly Trp
115 120 125

Tyr Cys Asn Tyr Val Glu Val Thr Thr Thr Gly Pro His Met Gly Cys
130 135 140

Ala Gln Gln Leu Phe Thr Val Glu Gln Trp Leu Ala Thr Asp Ala Ala
145 150 155 160

Pro Tyr Gln Leu Tyr Ala Thr Arg Asp Ser Cys Thr Gly Arg Gly Asn
165 170 175

Ala Glu Glu Glu Pro Lys Ile Gly Asp Arg Ile Gly Arg His Val Thr
180 185 190

His Val Ala
195

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<213> Elaeis guineensis

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Met Gly Ser Ser Glu Phe Ser Trp Lys Leu Ala Asp His Pro Lys Leu
1 5 10 15

Pro Lys Gly Lys Thr Val Ala Val Val Val Leu Asp Gly Trp Gly Glu
20 25 30

Ala Asn Pro Asp Lys Tyr Asn Cys Ile His Val Ala Glu Thr Pro Ala
35 40 45

Met Asp Ser Leu Lys Lys Gly Ala Pro Asp Arg Trp Arg Leu Val Arg
50 55 60

Ala His Gly Thr Ala Val Gly Leu Pro Thr Glu Asp Asp Met Gly Asn
65 70 75 80

Ser Glu Val Gly His Asn Ala Leu Gly Ala Gly Arg Ile Tyr Ala Gln
85 90 95

Gly Ala Lys Leu Val Asp Leu Ala Leu Ala Ser Gly Lys Ile Tyr Glu
100 105 110

Gly Glu Gly Phe Lys Tyr Ile Lys Glu Cys Phe Asp Gln Gly Thr Leu
115 120 125

```
His Leu Ile Gly Leu Leu Ser Asp Gly Gly Val His Ser Arg Leu Asp
    130                 135                 140

Gln Leu Gln Leu Leu Leu Lys Gly Ala Ser Glu Asn Gly Ala Lys Arg
145                 150                 155                 160

Ile Arg Val His Val Leu Thr Asp Gly Arg Asp Val Leu Asp Gly Ser
                165                 170                 175

Ser Val Gly Phe Val Glu Thr Leu Glu Asn Asp Leu Leu Lys Leu Arg
            180                 185                 190

Glu Lys Gly Val Asp Ala Gln Ile Ala Ser Gly Gly Gly Arg Met Tyr
        195                 200                 205

Val Thr Met Asp Arg Tyr Glu Asn Asp Trp Gly Val Val Lys Arg Gly
    210                 215                 220

Trp Asp Ala Gln Val Leu Gly Glu Ala Pro His Lys Phe Gln Ser Ala
225                 230                 235                 240

Val Glu Ala Val Lys Lys Leu Arg Glu Val Pro Lys Ala Asn Asp Gln
                245                 250                 255

Tyr Leu Ala Pro Phe Val Ile Val Asp Glu Ser Gly Lys Ala Val Gly
            260                 265                 270

Pro Ile Val Asp Gly Asp Ala Val Val Thr Phe Asn Phe Arg Ala Asp
        275                 280                 285

Arg Met Val Met Leu Ala Lys Ala Leu Glu Tyr Glu Asp Phe Asp Lys
    290                 295                 300

Phe Asp Arg Val Arg Phe Pro Lys Ile Gln Tyr Ala Gly Met Leu Gln
305                 310                 315                 320

Tyr Asp Gly Glu Leu Lys Leu Pro Ser His Tyr Leu Val Ser Pro Pro
                325                 330                 335

Glu Ile Glu Arg Thr Ser Gly Glu Tyr Leu Val His Asn Gly Ile Arg
            340                 345                 350

Thr Phe Ala Cys Ser Glu Thr Val Lys Phe Gly His Val Thr Phe Phe
        355                 360                 365

Trp Asn Gly Asn Arg Ser Gly Tyr Phe Asp Pro Ser Met Glu Glu Tyr
```

370 375 380

Val Glu Ile Pro Ser Asp Ala Gly Ile Thr Phe Asn Val Lys Pro Lys
385 390 395 400

Met Lys Ala Val Glu Ile Ala Glu Lys Ala Arg Asp Ala Ile Leu Ser
405 410 415

Arg Lys Phe Asp Gln Val Arg Val Asn Leu Pro Asn Gly Asp Met Val
420 425 430

Gly His Thr Gly Asp Ile Glu Ala Thr Val Val Ala Cys Lys Ala Ala
435 440 445

Asp Asp Ala Val Lys Met Ile Leu Asp Ala Ile Glu Gln Val Gly Gly
450 455 460

Ile Tyr Val Val Thr Ala Asp His Gly Asn Ala Glu Asp Met Val Lys
465 470 475 480

Arg Asn Lys Ser Gly Gln Pro Gln Leu Asp Lys Asn Gly Asp Ile Gln
485 490 495

Ile Leu Thr Ser His Thr Leu Gln Pro Val Pro Val Ala Ile Gly Gly
500 505 510

Pro Gly Leu Ala Pro Gly Val Gly Phe Arg Lys Asp Val Pro Asn Gly
515 520 525

Gly Leu Ala Asn Ile Ala Ala Thr Val Met Asn Leu His Gly Phe Glu
530 535 540

Ala Pro Ser Asp Tyr Glu Pro Thr Leu Ile Glu Val Val Asp Asn
545 550 555

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Met Ala Asp Ala Glu Asp Ile Gln Pro Leu Val Cys Asp Asn Gly Thr
1 5 10 15

Gly Met Val Lys Ala Gly Phe Ala Gly Asp Asp Ala Pro Arg Ala Val
20 25 30

Phe Pro Ser Ile Val Gly Arg Pro Arg His Thr Gly Val Met Val Gly

35 40 45

Met Gly Gln Lys Asp Ala Tyr Val Gly Asp Glu Ala Gln Ser Lys Arg
50 55 60

Gly Ile Leu Thr Leu Lys Tyr Pro Ile Glu His Gly Ile Val Ser Asn
65 70 75 80

Trp Asp Asp Met Glu Lys Ile Trp His His Thr Phe Tyr Asn Glu Leu
85 90 95

Arg Val Ala Pro Glu Glu His Pro Ile Leu Leu Thr Glu Ala Pro Leu
100 105 110

Asn Pro Lys Ala Asn Arg Glu Lys Met Thr Gln Ile Met Phe Glu Thr
115 120 125

Phe Asp Val Pro Ala Met Tyr Val Ala Ile Gln Ala Val Leu Ser Leu
130 135 140

Tyr Ala Ser Gly Arg Thr Thr Gly Ile Val Leu Asp Ser Gly Asp Gly
145 150 155 160

Val Ser His Thr Val Pro Ile Tyr Glu Gly Tyr Ala Leu Pro His Ala
165 170 175

Ile Leu Arg Leu Asp Leu Ala Gly Arg Asp Leu Thr Asp Ala Leu Met
180 185 190

Lys Ile Leu Thr Glu Arg Gly Tyr Ser Phe Thr Thr Thr Ala Glu Arg
195 200 205

Glu Ile Val Arg Asp Ile Lys Glu Lys Leu Ala Tyr Val Ala Leu Asp
210 215 220

Tyr Glu Gln Glu Leu Glu Thr Ala Lys Ser Ser Ser Ala Val Glu Lys
225 230 235 240

Ser Tyr Glu Leu Pro Asp Gly Gln Val Ile Thr Ile Gly Ala Glu Arg
245 250 255

Phe Arg Cys Pro Glu Val Leu Phe Gln Pro Ser Leu Ile Gly Met Glu
260 265 270

Ser Pro Gly Ile His Glu Thr Thr Tyr Asn Ser Ile Met Lys Cys Asp
275 280 285

Val Asp Ile Arg Lys Asp Leu Tyr Gly Asn Ile Val Leu Ser Gly Gly
290 295 300

Ser Thr Met Phe Pro Gly Ile Gly Asp Arg Met Ser Lys Glu Ile Thr
305 310 315 320

Ala Leu Ala Pro Ser Ser Met Lys Ile Lys Val Val Ala Pro Pro Glu
325 330 335

Arg Lys Tyr Ser Val Trp Ile Gly Gly Ser Ile Leu Ala Ser Leu Ser
340 345 350

Thr Phe Gln Gln Met Trp Ile Thr Lys Ala Glu Tyr Asp Glu Ser Gly
355 360 365

Pro Ala Ile Val His Arg Lys Cys Phe
370 375

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<212> PRT
<213> Elaeis guineensis

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Met Ala Asp Ile Gln Met Gly Glu Ala Glu Thr Phe Ala Phe Gln Ala
1 5 10 15

Glu Ile Asn Gln Leu Leu Ser Leu Ile Ile Asn Thr Phe Tyr Ser Asn
20 25 30

Lys Glu Ile Phe Leu Arg Glu Leu Ile Ser Asn Ser Ser Asp Ala Leu
35 40 45

Asp Lys Ile Arg Tyr Glu Gly Leu Thr Asp Lys Ser Lys Leu Asp Ala
50 55 60

Gln Pro Glu Leu Phe Ile Arg Leu Val Pro Asp Lys Ala Asn Lys Thr
65 70 75 80

Leu Ser Ile Ile Asp Ser Gly Ile Gly Met Thr Lys Ala Asp Leu Val
85 90 95

Asn Asn Leu Gly Thr Ile Ala Arg Ser Gly Thr Lys Glu Phe Met Glu
100 105 110

Ala Leu Gln Ala Gly Ala Asp Val Ser Met Ile Gly Gln Phe Gly Val
115 120 125

Gly Phe Tyr Ser Ala Tyr Leu Val Ala Glu Lys Val Val Val Thr Thr
130 135 140

Lys His Asn Asp Asp Glu Gln Tyr Ile Trp Glu Ser Gln Ala Gly Gly
145 150 155 160

Ser Phe Thr Val Thr Arg Asp Val Ser Gly Glu Gln Leu Gly Arg Gly
165 170 175

Thr Lys Ile Thr Leu Tyr Leu Lys Glu Asp Gln Leu Asp Tyr Leu Glu
180 185 190

Glu Arg Arg Leu Lys Asp Leu Val Lys Lys His Ser Glu Phe Ile Ser
195 200 205

Tyr Pro Ile Tyr Leu Trp Thr Glu Lys Thr Thr Glu Lys Glu Ile Ser
210 215 220

Asp Asp Glu Asp Glu Glu Thr Lys Lys Glu Glu Glu Gly Asp Val Glu
225 230 235 240

Asn Ile Asp Glu Glu Lys Glu Thr Lys Ser Lys Lys Lys Lys Val Lys
245 250 255

Glu Val Leu His Glu Trp Ser Leu Val Asn Lys Gln Lys Pro Ile Trp
260 265 270

Leu Arg Lys Pro Glu Glu Ile Thr Lys Glu Glu Tyr Ala Ser Phe Tyr
275 280 285

Lys Ser Leu Thr Asn Asp Trp Glu Asp His Leu Ala Val Lys His Phe
290 295 300

Ser Val Glu Gly Gln Leu Glu Phe Lys Ala Ile Leu Phe Val Pro Lys
305 310 315 320

Arg Ala Pro Phe Asp Leu Phe Asp Thr Arg Lys Lys Met Asn Asn Ile
325 330 335

Lys Leu Tyr Val Arg Arg Val Phe Ile Met Asp Asn Cys Glu Glu Leu
340 345 350

Ile Pro Glu Tyr Leu Gly Phe Val Lys Gly Val Val Asp Ser Asp Asp
355 360 365

Leu Pro Leu Asn Ile Ser Arg Glu Met Leu Gln Gln Asn Lys Ile Leu
370 375 380

```
Lys Val Ile Arg Lys Asn Leu Val Lys Lys Cys Ile Glu Leu Phe Ser
385                 390                 395                 400

Glu Ile Ala Glu Asn Lys Glu Asp Tyr Asn Lys Phe Tyr Glu Ala Phe
                405                 410                 415

Ser Lys Asn Leu Lys Leu Gly Ile His Glu Asp Ser Gln Asn Arg Ala
            420                 425                 430

Lys Leu Ala Asp Leu Leu Arg Tyr His Ser Thr Lys Ser Gly Asp Glu
        435                 440                 445

Met Thr Ser Leu Lys Asp Tyr Val Thr Arg Met Lys Glu Asp Gln Lys
    450                 455                 460

Asp Ile Tyr Tyr Ile Thr Gly Glu Ser Lys Lys Ala Val Glu Asn Ser
465                 470                 475                 480

Pro Phe Leu Glu Lys Leu Lys Lys Lys Gly Tyr Glu Val Leu Phe Met
                485                 490                 495

Val Asp Ala Ile Asp Glu Tyr Ala Val Gly Gln Leu Lys Glu Tyr Asp
            500                 505                 510

Gly Lys Lys Leu Val Ser Ala Thr Lys Glu Gly Leu Lys Ile Asp Glu
        515                 520                 525

Ser Glu Asp Glu Lys Lys Arg Lys Glu Glu Lys Lys Ala Ala Phe Glu
    530                 535                 540

Ser Leu Cys Lys Val Met Lys Asp Ile Leu Gly Asp Lys Val Glu Lys
545                 550                 555                 560

Val Val Val Ser Asp Arg Ile Val Asp Ser Pro Cys Cys Leu Val Thr
                565                 570                 575

Gly Glu Tyr Gly Trp Thr Ala Asn Met Glu Arg Ile Met Lys Ala Gln
            580                 585                 590

Ala Leu Lys Asp Asn Ser Met Gly Ser Tyr Met Ser Ser Lys Lys Thr
        595                 600                 605

Met Glu Ile Asn Pro Glu Asn Gly Ile Met Glu Glu Met Arg Lys Arg
    610                 615                 620

Ala Glu Ala Asp Lys Asn Asp Lys Ser Val Lys Asp Leu Val Leu Leu
625                 630                 635                 640
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Leu Phe Glu Thr Ala Ile Leu Thr Ser Gly Phe Ser Leu Asp Asp Pro
                645                 650                 655

Asn Thr Phe Ala Gly Arg Ile His Arg Met Leu Lys Leu Gly Leu Ser
            660                 665                 670

Ile Asp Glu Asp Glu Ala Ala Gly Asp Asp Thr Asp Met Pro Ala Leu
        675                 680                 685

Glu Glu Asp Gly Asn Glu Glu Ser Lys Met Glu Glu Val Asp
    690                 695                 700
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Met Lys Trp Cys Glu Arg Val Tyr Leu Thr Ile Glu Leu Pro Asp Ala
1               5                   10                  15

Lys Asp Ala Glu Val Thr Ile Glu Ala Arg
            20                  25
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Tyr Ile Ala Asn Lys Phe Glu Gly Gln Gly Thr Pro Ile Tyr Gly Ser
1 5 10 15

Thr Pro Val Glu Lys Val Leu Asp Ile Tyr Glu Ala Arg
20 25

<210> 24
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<212> PRT
<213> Elaeis guineensis

<400> 24

Met Ala Ser Ser Ser Ala Gln Ile His Val Leu Gly Ser Ala Ala Ala
1 5 10 15

Phe Pro Ser Ser Arg Lys Pro Ser Ala Arg Ile Ser Ser Ser Lys Ser
20 25 30

Leu Phe Phe Gly Asn Arg His Ser Asn Gly Ile Asn Gly Ala Phe Leu
35 40 45

Ser Ile Arg Arg Gly Ala Gly Arg Gly Asn Arg Gly Tyr Gly Gly Pro
50 55 60

Leu Arg Val Val Ser Glu Lys Val Val Gly Ile Asp Leu Gly Thr Thr
65 70 75 80

Asn Ser Ala Val Ala Ala Met Glu Gly Gly Lys Pro Thr Ile Val Thr
85 90 95

Asn Ala Glu Gly Gln Arg Thr Thr Pro Ser Val Val Ala Tyr Thr Lys
100 105 110

Asn Gly Asp Arg Leu Val Gly Gln Ile Ala Lys Arg Gln Ala Val Val
115 120 125

Asn Pro Glu Asn Thr Phe Phe Ser Val Lys Arg Phe Ile Gly Arg Lys
130 135 140

Met Ser Glu Val Asp Glu Glu Ser Lys Gln Val Ser Tyr Arg Val Val
145 150 155 160

Lys Asp Glu Asn Gly Asn Val Lys Leu Glu Cys Pro Ala Ile Gly Lys
165 170 175

Gln Phe Ala Ala Glu Glu Ile Ser Ala Gln Val Leu Arg Lys Leu Val

```
          180                 185                 190

Asp Asp Ala Ser Lys Phe Leu Asn Asp Lys Val Thr Lys Ala Val Val
        195                 200                 205

Thr Val Pro Ala Tyr Phe Asn Asp Ser Gln Arg Thr Ala Thr Lys Asp
    210                 215                 220

Ala Gly Arg Ile Ala Gly Leu Asp Val Leu Arg Ile Ile Asn Glu Pro
225                 230                 235                 240

Thr Ala Ala Ser Leu Ala Tyr Gly Phe Glu Lys Lys Asn Asn Glu Thr
                245                 250                 255

Ile Leu Val Phe Asp Leu Gly Gly Gly Thr Phe Asp Val Ser Val Leu
            260                 265                 270

Glu Val Gly Asp Gly Val Phe Glu Val Leu Ser Thr Ser Gly Asp Thr
        275                 280                 285

His Leu Gly Gly Asp Asp Phe Asp Lys Arg Val Val Asp Trp Leu Ala
    290                 295                 300

Gly Asn Phe Lys Arg Asp Glu Gly Ile Asp Leu Leu Lys Asp Lys Gln
305                 310                 315                 320

Ala Leu Gln Arg Leu Thr Glu Thr Ala Glu Lys Ala Lys Met Glu Leu
                325                 330                 335

Ser Ser Leu Thr Gln Thr Asn Ile Ser Leu Pro Phe Ile Thr Ala Thr
            340                 345                 350

Ala Asp Gly Pro Lys His Ile Glu Thr Thr Ile Thr Arg Ala Lys Phe
        355                 360                 365

Glu Glu Leu Cys Ser Asp Leu Leu Asp Arg Leu Arg Thr Pro Val Asp
    370                 375                 380

Asn Ala Leu Lys Asp Ala Lys Leu Ser Phe Lys Asp Ile Asp Glu Val
385                 390                 395                 400

Ile Leu Val Gly Gly Ser Thr Arg Ile Pro Ala Val Gln Glu Leu Val
                405                 410                 415

Lys Lys Met Thr Gly Lys Glu Pro Asn Val Thr Val Asn Pro Asp Glu
            420                 425                 430
```

```
Val Val Ala Leu Gly Ala Ala Val Gln Ala Gly Val Leu Ala Gly Asp
        435                 440                 445

Val Ser Asp Ile Val Leu Leu Asp Val Thr Pro Leu Ser Leu Gly Leu
    450                 455                 460

Glu Thr Leu Gly Gly Val Met Thr Lys Ile Ile Pro Arg Asn Thr Thr
465                 470                 475                 480

Leu Pro Thr Ser Lys Ser Glu Val Phe Ser Thr Ala Ala Asp Gly Gln
                485                 490                 495

Thr Ser Val Glu Ile Asn Val Leu Gln Gly Glu Arg Glu Phe Val Arg
            500                 505                 510

Asp Asn Lys Ser Leu Gly Ser Phe Arg Leu Asp Gly Ile Pro Pro Ala
        515                 520_________________525

Pro Arg Gly Val Pro Gln Ile Glu Val Lys Phe Asp Ile Asp Ala Asn
    530                 535                 540

Gly Ile Leu Ser Val Thr Ala Val Asp Lys Gly Thr Gly Lys Lys Gln
545                 550                 555                 560

Asp Ile Thr Ile Thr Gly Ala Ser Thr Leu Pro Gly Asp Glu Val Asp
                565                 570                 575

Arg Met Val Lys Glu Ala Glu Arg Tyr Ala Lys Glu Asp Lys Glu Lys
            580                 585                 590

Arg Asp Ala Ile Asp Thr Lys Asn Gln Ser Glu Ser Val Val Tyr Gln
        595                 600                 605

Thr Glu Lys Gln Leu Lys Glu Leu Gly Asp Lys Val Pro Ala Ala Val
    610                 615                 620

Lys Glu Lys Val Glu Ala Lys Leu Lys Glu Leu Lys Asp Ala Ile Ala
625                 630                 635                 640

Gly Gly Ser Thr Gln Ser Met Lys Asp Ala Met Ala Ala Leu Asn Gln
                645                 650                 655

Glu Val Met Gln Leu Gly Gln Ser Leu Tyr Asn Gln Pro Gly Ala Ala
            660                 665                 670

Gly Ala Gly Pro Ala Pro Gly Ala Asp Ala Gly Ser Ala Gly Ser Thr
        675                 680                 685
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Gly Lys Gly Pro Asp Asp Gly Gly Asp Val Ile Asp Ala Asp Phe Thr
690 695 700

Asp Ser Lys
705

<210> 25
<211> 205
<212> PRT
<213> Elaeis guineensis

<400> 25

Met Gln Gly Ala Leu Gln Ala Ile Arg Ala Gln Gly Asn Val Leu Lys
1 5 10 15

Cys Ala Val Leu Arg His Val Arg Ile Met Asn Pro Ala Met Leu Pro
20 25 30

Thr Ala Ile Ser Arg Phe Glu Ser Thr Ser Pro Ala Gln Leu Glu Glu
35 40 45

His Gly Phe Glu Ser Thr Thr Ile Ser Asp Val Leu Lys Ala Lys Gly
50 55 60

Lys Gly Ala Asp Gly Ser Trp Leu Trp Cys Thr Thr Asp Asp Thr Val
65 70 75 80

Tyr Asp Ala Val Lys Ser Met Thr Gln His Asn Val Gly Ala Leu Val
85 90 95

Val Val Lys Pro Gly Ala Asp Lys Ala Ile Ala Gly Ile Ile Thr Glu
100 105 110

Arg Asp Tyr Leu Arg Lys Ile Ile Val Gln Gly Arg Ser Ser Lys Ser
115 120 125

Thr Lys Val Gly Asp Ile Met Thr Glu Glu Asn Lys Leu Ile Thr Val
130 135 140

Thr Pro Asp Thr Lys Val Leu Gln Ala Met Gln Leu Met Thr Asp Asn
145 150 155 160

Arg Ile Arg His Ile Pro Val Ile Asp Ala Lys Gly Met Met Gly Met
165 170 175

Val Ser Ile Gly Asp Val Val Arg Ala Val Val Thr Glu His Arg Glu
180 185 190

```
Glu Leu Asp Arg Leu Asn Ala Tyr Ile Gln Gly Gly Tyr
        195                 200                 205


<210>  26
<211>  201
<212>  PRT
<213>  Elaeis guineensis

<400>  26

Met Thr Ala Gln Thr Gln Glu Glu Leu Leu Ala Ala His Leu Glu Gln
1               5                  10                  15

Gln Lys Ile Asp Tyr Asp Glu Pro Val Val Glu Asp Glu Asp Asp Asp
            20                  25                  30

Glu Asp Asp Glu Asp Asp Asp Asp Lys Asp Glu Asp Asp Ala Glu Gly
        35                  40                  45

Gln Ala Gly Asp Ala Ser Gly Arg Ser Lys Gln Ser Arg Ser Glu Lys
    50                  55                  60

Lys Ser Arg Lys Ala Met Leu Lys Leu Gly Met Lys Pro Ile Pro Gly
65                  70                  75                  80

Val Ser Arg Val Thr Val Lys Lys Ser Lys Asn Ile Leu Phe Val Ile
                85                  90                  95

Ser Lys Pro Asp Val Phe Lys Ser Pro Thr Ser Asp Thr Tyr Val Ile
            100                 105                 110

Phe Gly Glu Ala Lys Ile Glu Asp Leu Ser Ser Gln Leu Gln Thr Gln
        115                 120                 125

Ala Ala Glu Gln Phe Lys Ala Pro Asp Leu Ser His Val Ile Ser Lys
    130                 135                 140

Pro Glu Thr Ser Ala Met Ala Gln Asp Asp Glu Glu Val Asp Glu Thr
145                 150                 155                 160

Gly Val Glu Pro Lys Asp Ile Glu Leu Val Met Thr Gln Ala Gly Val
                165                 170                 175

Ser Arg Ser Lys Ala Val Lys Ala Leu Lys Ala Ala Asp Gly Asp Ile
            180                 185                 190

Val Thr Ala Ile Met Glu Leu Thr Asn
        195                 200
```

<210> 27
<211> 312
<212> PRT
<213> Elaeis guineensis

<400> 27

Met Glu Thr Ser Lys Glu Ser Gln Glu Leu Asn Arg Ser Leu Tyr Pro
1 5 10 15

His Ile Glu Pro Tyr Ser Ser Gly Phe Leu Lys Val Ser Asp Ile His
20 25 30

Thr Leu Tyr Trp Glu Gln Ser Gly Asn Pro Asn Gly His Pro Val Val
35 40 45

Phe Leu His Gly Gly Pro Gly Ala Gly Thr Ser Ala Ser Asn Arg Arg
50 55 60

Phe Phe Asp Pro Glu Phe Tyr Arg Ile Ile Leu Phe Asp Gln Arg Gly
65 70 75 80

Ser Gly Lys Ser Thr Pro His Ala Cys Leu Glu Asp Asn Thr Thr Trp
85 90 95

Asp Leu Val Asn Asp Ile Glu Lys Leu Arg Glu His Leu Glu Ile Pro
100 105 110

Glu Trp Gln Val Thr Gly Ile Ile Leu Arg Gly Ile Phe Leu Leu Arg
115 120 125

Lys Lys Glu Leu Asp Trp Phe Tyr Glu Gly Gly Ala Ala Ala Ile Phe
130 135 140

Pro Asp Ala Trp Glu Pro Phe Arg Asp Phe Ile Pro Glu Asn Glu Arg
145 150 155 160

Asn Asn Phe Ile Val Ala Tyr His Lys Arg Leu Asn Ser Asp Asp Asn
165 170 175

His Ile Gln Val Thr Ala Ala Lys Ile Trp Thr Thr Trp Glu Leu Met
180 185 190

Thr Ala His Leu Ile Gln Asn Glu Glu Asn Ile Lys Arg Gly Glu Asp
195 200 205

Asp Asp Phe Ser Leu Ala Phe Ala Arg Ile Glu Asn His Tyr Phe Val
210 215 220

```
Asn Lys Gly Phe Phe Pro Ser Asp Ser Tyr Leu Leu Asp Asn Val Asp
225                 230                 235                 240

Lys Ile Arg His Ile Ser Thr Val Ile Val Gln Gly Arg Tyr Asp Val
                245                 250                 255

Cys Cys Pro Met Met Ser Ala Trp Asp Leu His Lys Ala Trp Pro Glu
            260                 265                 270

Ala Glu Leu Lys Val Val Pro Asp Ala Gly His Ser Ala Asn Glu Ile
        275                 280                 285

Gly Ile Ala Ala Glu Leu Val Ala Ala Asn Glu Lys Phe Lys Asn Ile
    290                 295                 300

Leu Lys Ser Gly Gly Phe Lys Met
305                 310
```

<210> 28
<211> 289
<212> PRT
<213> Elaeis guineensis

<400> 28

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Met Ala Ser Ser Gly Pro Asp His Leu Phe Asn Leu Arg Asn Ser Phe
1               5                   10                  15

Tyr Leu Gly Ala Tyr Gln Asp Ala Ile Asn Lys Ser Asp Ile Pro Asn
            20                  25                  30

Leu Ser Gly Asp Asp Ala Val Glu Arg Asp Ser Ile Val Tyr Arg Ser
        35                  40                  45

Tyr Ile Ala Leu Gly Ser Tyr Gln Leu Val Ile Asn Glu Ile Asp Ser
    50                  55                  60

Ser Ala Pro Thr Ala Leu Gln Ala Val Lys Leu Leu Ala Leu Tyr Leu
65                  70                  75                  80

Ala Gly Asp Lys Glu Ser Ala Ile Ala Ser Leu Gln Glu Trp Leu Asn
                85                  90                  95

Asp Ala Ala Ile Gly Asn Asn His Val Leu Arg Leu Ile Ala Gly Ile
            100                 105                 110

Ile Tyr Met His Glu Gln Asn Tyr Val Glu Ala Leu Lys His Thr Asn
        115                 120                 125
```

Ser Gly Gly Thr Met Glu Leu His Ala Leu Asn Val Gln Ile Tyr Leu
130 135 140

Lys Met His Arg Ser Asp Tyr Ala Glu Lys Gln Leu Lys Ile Met Leu
145 150 155 160

Gln Ile Asp Glu Asp His Thr Leu Thr Gln Leu Ala Asn Ala Trp Val
165 170 175

Asn Leu Ala Val Gly Gly Ser Lys Ile Gln Glu Ala Tyr Leu Ile Tyr
180 185 190

Gln Asp Phe Ser Glu Lys Asn Gln Met Thr Pro Leu Ile Leu Asn Gly
195 200 205

Lys Ala Val Cys Cys Leu His Met Gly Arg Phe Asp Glu Ala Glu Ser
210 215 220

Leu Leu Leu Asp Ala Leu Asn Lys Asp Ala Lys Asp Ala Glu Thr Leu
225 230 235 240

Ala Asn Leu Val Val Cys Ser Leu His Leu Gly Lys Ser Ala Ala Arg
245 250 255

Tyr Leu Asn Gln Leu Lys Leu Ser His Pro Asp His Met Leu Val Gln
260 265 270

Arg Ala Ser Ser Ala Glu Asp Ser Phe Glu Arg Ala Val Gln Ser Ile
275 280 285

Ala

<210> 29
<211> 224
<212> PRT
<213> Elaeis guineensis

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<400> 29

Glu Arg Gln Glu Ile Asp Arg Ser Ala Met Val Gly Ala Leu Ala Ser
1 5 10 15

Ala Ser Thr Gly Val Met Asn Ser Val Ile Ala Lys Leu Ser Lys Leu
20 25 30

Leu Glu Asp Glu Tyr Ala Lys Ala His Val Val Glu Glu Ser Lys Arg
35 40 45

Leu Arg Asp Thr Leu Gln Asp Lys Tyr Leu Val Val Ile Asp Asp Val

50 55 60

Trp Ala Thr Glu Ala Trp Glu Thr Ile Lys Leu Ala Leu Leu Ser Asn
65 70 75 80

Asn Cys Asp Ser Arg Cys Ser Tyr His Gly Gly Tyr Val Tyr His Met
85 90 95

Glu Pro Leu Ser Phe Val Asp Ser Lys Arg Val Leu Ala Ala Ile Gly
100 105 110

Ser Ala Leu Ala Lys Asp Pro Asn Ala Gly Asn Met Arg Arg Ser Leu
115 120 125

Ile Gln Pro Val Asp Val Gln Tyr Gly Lys Pro Val Ala Cys Arg Glu
130 135 140

Asn Val Ile Met Ala Thr Asn Leu Ser Leu Lys Met Gln Ser Leu Glu
145 150 155 160

Glu Leu Gln Thr Phe Asp Ile Phe Thr Tyr Ser Ser Arg Trp Met Asn
165 170 175

Met Leu Ala Cys Leu Thr Glu Leu Asp Leu Thr Leu Cys Ser Thr Lys
180 185 190

Leu Gln His Leu Met Ile Lys Cys Leu Asn Gly Ala Ser Asp Leu Gly
195 200 205

Ile Arg Ser Val Asn Tyr Glu Ile Glu Val Asn Leu Gly Glu Val Arg
210 215 220

<210> 30
<211> 176
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<213> Elaeis guineensis

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<400> 30

Phe Gln Lys Asp Met Ser Phe Arg Phe Val Thr Pro Ala Tyr Gly Cys
1 5 10 15

Thr Gln Ile Gly Lys Asn Asp Ser Leu Lys Asp Val Leu Met Trp Gly
20 25 30

Glu Gly Val Glu Gly Gly Asn Ile Gly Gly Met Val Gln Arg Val Asn
35 40 45

Met Asp Val Gly Met Pro Lys Val Val Glu Ser Leu Asp Asp Val His
50 55 60

Ile Lys Phe Asn Ala Val Gly Gly Lys Leu Phe Thr Trp Gly Asp Gly
65 70 75 80

Asp Lys Ser Ile Ser Val Thr Asp Gln Ser Ser Cys Ser Gly Cys Arg
85 90 95

Met Pro Phe Gly Leu Thr Arg His Asn Cys Tyr Asn Cys Gly Leu Leu
100 105 110

Phe Cys His Ser Cys Ser Ser Lys Met Ser Lys Pro Gly Thr His Gly
115 120 125

Ser Lys Asp Gln Gly Glu His Gln His His Val Glu Thr Val Ser Ser
130 135 140

```
Leu Ser Ala Gly Leu Pro Arg Ala Met Ser Glu Lys Ile Ser Ala Gly
145                 150                 155                 160

Arg Gly Gly Val Glu Leu Ser Val Ser Gln Asn Thr Pro Ala Tyr Lys
                165                 170                 175


<210>  31
<211>  307
<212>  PRT
<213>  Elaeis guineensis

<400>  31

Met Ala Ala Ala Ser Ser Leu Val Pro Gln Phe Ser Gly Leu Ala Val
1               5                   10                  15

Ala Arg Glu Arg Ala Pro Ser Leu Ser Ser Ile Leu Phe Phe His Asp
            20                  25                  30

Ala Ser Ser Gln Arg Arg Pro Phe Ser Thr Arg Arg Ala Pro Arg Gly
        35                  40                  45

Val Val Ala Met Ala Gly Thr Gly Lys Phe Phe Val Gly Gly Asn Trp
    50                  55                  60

Lys Cys Asn Gly Met Lys Asp Ser Ile Ser Lys Leu Val Ala Asp Leu
65                  70                  75                  80

Asn Asp Ala Lys Met Glu Asn Asp Val Asp Val Ala Val Ala Pro Pro
                85                  90                  95

Phe Ile Tyr Ile Asp Gln Val Asn Asn Ser Leu Thr Asp Arg Ile Asp
            100                 105                 110

Ile Ser Ala Gln Asn Cys Trp Val Gly Lys Gly Gly Ala Phe Thr Gly
        115                 120                 125

Glu Ile Ser Ala Glu Gln Leu Ile Asp Met Gly Cys Lys Trp Val Ile
    130                 135                 140

Leu Gly His Ser Glu Arg Arg His Ile Ile Gly Glu Asp Asp Gln Phe
145                 150                 155                 160

Ile Gly Lys Lys Ala Ala Tyr Ala Leu Ser Gln Asn Leu Lys Val Ile
                165                 170                 175

Ala Cys Ile Gly Glu Lys Leu Glu Glu Arg Glu Ala Gly Lys Thr Phe
            180                 185                 190
```

Val Cys Phe Gln Gln Met Gln Ala Phe Ala Asp Ser Ile Thr Ser
195 200 205

Glu Asn Val Val Ile Ala Tyr Glu Pro Val Trp Ala Ile Gly Thr
210 215 220

Lys Val Ala Thr Pro Glu Gln Ala Gln Glu Val His Val Ala Val
225 230 235 240

Asp Trp Leu Lys Lys Asn Ile Ser Ala Glu Val Ala Ser Ser Thr
245 250 255

Ile Ile Tyr Gly Gly Ser Val Asn Gly Ser Asn Cys Ser Glu Leu
260 265 270

Lys Gln Glu Asp Ile Asp Gly Phe Leu Val Gly Gly Ala Ser Leu
275 280 285

Gly Pro Glu Phe Ala Thr Ile Val Asn Ser Val Thr Ser Lys Lys
290 295 300

Ala Val

10> 32
11> 621
12> PRT
13> Elaeis guineensis

00> 32

Ala Tyr Gly Asp Arg Leu Thr Thr Phe Glu Asp Ser Glu Lys Glu
1 5 10 15

Glu Tyr Gly Tyr Val Arg Lys Val Ser Gly Pro Val Val Val Ala
20 25 30

Gly Met Gly Gly Ala Ala Met Tyr Glu Leu Val Arg Val Gly His
35 40 45

Asn Leu Ile Gly Glu Ile Ile Arg Leu Glu Gly Asp Ser Ala Thr
50 55 60

Gln Val Tyr Glu Glu Thr Ala Gly Leu Met Val Asn Asp Pro Val
65 70 75 80

Arg Thr His Lys Pro Leu Ser Val Glu Leu Gly Pro Gly Ile Leu
85 90 95

```
Glu Val Cys Phe Gln Gln Met Gln Ala Phe Ala Asp Ser Ile Thr Ser
        195                 200                 205

Trp Glu Asn Val Val Ile Ala Tyr Glu Pro Val Trp Ala Ile Gly Thr
    210                 215                 220

Gly Lys Val Ala Thr Pro Glu Gln Ala Gln Glu Val His Val Ala Val
225                 230                 235                 240

Arg Asp Trp Leu Lys Lys Asn Ile Ser Ala Glu Val Ala Ser Ser Thr
                245                 250                 255

Arg Ile Ile Tyr Gly Gly Ser Val Asn Gly Ser Asn Cys Ser Glu Leu
            260                 265                 270

Ala Lys Gln Glu Asp Ile Asp Gly Phe Leu Val Gly Gly Ala Ser Leu
        275                 280                 285

Lys Gly Pro Glu Phe Ala Thr Ile Val Asn Ser Val Thr Ser Lys Lys
    290                 295                 300

Val Ala Val
305


<210>  32
<211>  621
<212>  PRT
<213>  Elaeis guineensis

<400>  32

Met Ala Tyr Gly Asp Arg Leu Thr Thr Phe Glu Asp Ser Glu Lys Glu
1               5                   10                  15

Ser Glu Tyr Gly Tyr Val Arg Lys Val Ser Gly Pro Val Val Val Ala
            20                  25                  30

Asp Gly Met Gly Gly Ala Ala Met Tyr Glu Leu Val Arg Val Gly His
        35                  40                  45

Asp Asn Leu Ile Gly Glu Ile Ile Arg Leu Glu Gly Asp Ser Ala Thr
    50                  55                  60

Ile Gln Val Tyr Glu Glu Thr Ala Gly Leu Met Val Asn Asp Pro Val
65                  70                  75                  80

Leu Arg Thr His Lys Pro Leu Ser Val Glu Leu Gly Pro Gly Ile Leu
                85                  90                  95
```

```
Gly Asn Ile Phe Asp Gly Ile Gln Arg Pro Leu Lys Thr Ile Ala Leu
            100                 105                 110

Lys Ser Gly Asp Val Tyr Ile Pro Arg Gly Val Ser Val Pro Ala Leu
        115                 120                 125

Asp Lys Asp Thr Leu Trp Glu Phe Glu Pro Lys Lys Leu Ala Ala Gly
    130                 135                 140

Asp Leu Leu Thr Gly Gly Asp Leu Tyr Ala Thr Val Phe Glu Asn Thr
145                 150                 155                 160

Leu Met Gln His His Val Ala Leu Pro Pro Gly Ser Met Gly Lys Ile
                165                 170                 175

Thr Tyr Ile Ala Pro Ala Gly Gln Tyr Ser Leu Lys Asp Thr Val Leu
            180                 185                 190

Glu Leu Glu Phe Gln Gly Val Lys Lys Gln Phe Thr Met Leu Gln Thr
        195                 200                 205

Trp Pro Val Arg Thr Pro Arg Pro Val Ala Ala Lys Leu Ala Ala Asp
    210                 215                 220

Thr Pro Leu Leu Thr Gly Gln Arg Val Leu Asp Ala Leu Phe Pro Ser
225                 230                 235                 240

Val Leu Gly Gly Thr Cys Ala Ile Pro Gly Ala Phe Gly Cys Gly Lys
                245                 250                 255

Thr Val Ile Ser Gln Ala Leu Ser Lys Tyr Ser Asn Ser Asp Thr Val
            260                 265                 270

Val Tyr Val Gly Cys Gly Glu Arg Gly Asn Glu Met Ala Glu Val Leu
        275                 280                 285

Met Asp Phe Pro Gln Leu Thr Met Thr Leu Pro Asp Gly Arg Glu Glu
    290                 295                 300

Ser Val Met Lys Arg Thr Thr Leu Val Ala Asn Thr Ser Asn Met Pro
305                 310                 315                 320

Val Ala Ala Arg Glu Ala Ser Ile Tyr Thr Gly Ile Thr Ile Ala Glu
                325                 330                 335

Tyr Phe Arg Asp Met Gly Tyr Asn Val Ser Met Met Ala Asp Ser Thr
            340                 345                 350
```

Ser Arg Trp Ala Glu Ala Leu Arg Glu Ile Ser Gly Arg Leu Ala Glu
355 360 365

Met Pro Ala Asp Ser Gly Tyr Pro Ala Tyr Leu Ala Ala Arg Leu Ala
370 375 380

Ser Phe Tyr Glu Arg Ala Gly Lys Val Lys Cys Leu Gly Gly Pro Asp
385 390 395 400

Arg Thr Gly Ser Val Thr Ile Val Gly Ala Val Ser Pro Pro Gly Gly
405 410 415

Asp Phe Ser Asp Pro Val Thr Ser Ala Thr Leu Gly Ile Val Gln Val
420 425 430

Phe Trp Gly Leu Asp Lys Lys Leu Ala Gln Arg Lys His Phe Pro Ser
435 440 445

Val Asn Trp Leu Ile Ser Tyr Ser Lys Tyr Ser Lys Ala Leu Glu Ser
450 455 460

Phe Tyr Glu Lys Phe Asp Pro Asp Phe Ile Asp Ile Arg Thr Lys Ala
465 470 475 480

Arg Glu Val Leu Gln Arg Glu Asp Asp Leu Asn Glu Ile Val Gln Leu
485 490 495

Val Gly Lys Asp Ala Leu Ala Glu Ser Asp Lys Ile Thr Leu Glu Thr
500 505 510

Ala Lys Leu Leu Arg Glu Asp Tyr Leu Ala Gln Asn Ala Phe Thr Pro
515 520 525

Tyr Asp Lys Phe Cys Pro Phe Tyr Lys Ser Val Trp Met Met Arg Asn
530 535 540

Ile Ile His Phe Asn Ala Leu Ala Asn Gln Ala Val Glu Arg Gly Ala
545 550 555 560

Gly Ser Asp Gly Gln Lys Ile Thr Tyr Ser Val Ile Lys His Arg Leu
565 570 575

Gly Asp Leu Phe Tyr Arg Leu Val Ser Gln Lys Phe Glu Asp Pro Ala
580 585 590

Glu Gly Glu Glu Val Leu Val Ala Lys Phe Lys Lys Leu Tyr Asp Asp

595 600 605

Leu Ser Ala Gly Phe Arg Asn Leu Glu Asp Glu Thr Arg
610 615 620

<210> 33
<211> 168
<212> PRT
<213> Elaeis guineensis

<400> 33

Met Ala Ala Leu Pro Leu Ala Thr Ala Glu Val Cys Asp Ala Asn Ala
1 5 10 15

His Leu Ile Gln Asn Gly Glu Leu Arg Ala Leu Gln Pro Ile Phe Gln
20 25 30

Ile Tyr Gly Arg Arg Gln Val Phe Ala Gly Pro Ile Val Thr Leu Lys
35 40 45

Val Phe Glu Asp Asn Val Leu Val Arg Glu Phe Leu Glu Glu Lys Gly
50 55 60

Asn Gly Arg Val Leu Val Val Asp Gly Gly Gly Ser Met Arg Cys Ala
65 70 75 80

Ile Leu Gly Gly Asn Pro Val Gln Gln Ala Gln Asn Asn Gly Trp Ala
85 90 95

Gly Ile Val Val Asn Gly Cys Ile Arg Asp Val Asp Glu Ile Asn Gly
100 105 110

Cys Asp Ile Gly Val Arg Ala Leu Ala Ser His Pro Met Lys Ala Asn
115 120 125

Lys Lys Gly Phe Gly Glu Lys His Val Pro Val Asn Ile Ala Gly Thr
130 135 140

Arg Ile Cys Asp Gly Glu Trp Leu Tyr Ala Asp Ser Asp Gly Ile Leu
145 150 155 160

Val Ser Arg Met Glu Leu Thr Val
165

<210> 34
<211> 192
<212> PRT
<213> Elaeis guineensis

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Met Thr Ile Asp Ser Glu Leu Leu Thr Asn Ile Ser His Arg Asp Val
1 5 10 15

Ala Arg Met Lys Ala Asp Leu Ala Thr Cys Lys Gln Glu Gly Met Thr
20 25 30

Met Glu Gly Tyr Tyr Gly Lys Ile Cys Ala Ser His His Met Thr Gly
35 40 45

Asn Leu Glu Leu Leu Ser Asp Met Arg Thr Pro Ser Tyr Ser Gly Ala
50 55 60

```
Arg Tyr Phe Leu Thr Ile Val Asp Asp Tyr Ser Ser Asp Asn Gly Thr
65                  70                  75                  80

Glu Phe Leu Cys Met Arg Phe Gln Ser Tyr Leu Pro Ile Gln Phe Trp
                85                  90                  95

Gly Glu Cys Ile Leu Ser Ala Ala Tyr Leu Ile Asn Arg Thr Pro Ser
            100                 105                 110

Met Leu Leu Gln Gly Lys Ser Pro Tyr Glu Met Leu Tyr Lys Leu Phe
        115                 120                 125

Asp Leu Glu Glu Gln Lys Val Asn Gln Thr Phe Ser Ile Val Asn Leu
    130                 135                 140

Pro Pro Gly Lys Glu Glu Val Tyr Met Lys Leu Pro Gln Gly Phe Gln
145                 150                 155                 160

Cys Asp Asp Pro Ser Lys Ala Met Ala Phe Leu Thr Gln Glu Leu Met
                165                 170                 175

Trp Leu Lys Gln Leu Ala Asp Ile Leu Thr Lys Ala Leu Gly Glu Lys
            180                 185                 190

<210>  35
<211>  321
<212>  PRT
<213>  Elaeis guineensis

<400>  35

Met Thr Val Lys Leu Ser Lys Ser Glu Lys Lys Ile Glu Tyr Asp Lys
1               5                   10                  15

Lys Leu Cys Arg Leu Leu Asp Glu Tyr Ser Gln Val Leu Ile Ala Ala
            20                  25                  30

Ala Asp Asn Val Gly Ser Asn Gln Leu Gln Asn Ile Arg Lys Gly Leu
        35                  40                  45

Arg Gly Asp Ser Val Val Leu Met Gly Lys Asn Thr Leu Ile Arg Arg
    50                  55                  60

Cys Ile Lys Ile His Ala Glu Lys Thr Gly Asn Lys Asp Tyr Leu Asn
65                  70                  75                  80

Leu Leu Pro Leu Leu Val Gly Asn Val Gly Leu Ile Phe Thr Lys Gly
                85                  90                  95
```

Asp Leu Lys Glu Val Arg Glu Glu Val Ala Lys Tyr Lys Val Gly Ala
100 105 110

Pro Ala Arg Val Gly Leu Val Ala Pro Ile Asp Val Val Val Pro Pro
115 120 125

Gly Asn Thr Gly Leu Asp Pro Ser Gln Thr Ser Phe Phe Gln Val Leu
130 135 140

Asn Ile Pro Thr Lys Ile Asn Lys Gly Thr Val Glu Ile Ile Thr Pro
145 150 155 160

Val Glu Leu Ile Arg Lys Gly Asp Lys Val Gly Ser Ser Glu Ala Ala
165 170 175

Leu Leu Ala Lys Leu Gly Ile Arg Pro Phe Ser Tyr Gly Leu Val Ile
180 185 190

Gln Ala Val Tyr Asp Asn Gly Ser Val Phe Ser Pro Glu Val Leu Asp
195 200 205

Leu Thr Glu Asp Asp Leu Val Glu Lys Phe Ala Ala Gly Val Ser Met
210 215 220

Val Thr Ser Leu Ser Leu Ala Leu Ser Tyr Pro Thr Leu Val Ala Ala
225 230 235 240

Pro His Met Phe Ile Asn Ala Tyr Lys Asn Val Leu Ala Val Ala Ile
245 250 255

Ala Thr Glu Tyr Thr Phe Glu Gln Ala Glu Lys Val Lys Glu Tyr Leu
260 265 270

Lys Asp Pro Ser Lys Phe Ala Val Ala Val Pro Val Glu Ala Ala Ala
275 280 285

Ala Ala Ala Ala Ala Pro Ala Ala Ala Ala Lys Glu Glu Glu Lys Lys
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<210> 36
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<213> Elaeis guineensis

<400> 36

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20 25 30

Pro Gln Trp Gln Glu Val Ile Asp Leu Asn Leu Thr Gly Val Phe Leu
35 40 45

Cys Thr Gln Ala Ala Ala Lys Leu Met Met Lys Lys Lys Lys Gly Lys
50 55 60

Ile Ile Asn Met Thr Ser Val Ile Gly Leu Thr Gly Asn Ile Gly Gln
65 70 75 80

Ala Asn Tyr Ser Ala Ala Lys Ala Gly Val Ile Gly Phe Thr Lys Thr
85 90 95

Val Ala Arg Glu Tyr Ala Ser Arg Asn Ile Asn Val Asn Ala Val Ala
100 105 110

Pro Gly Phe Ile Ala Ser Asp Met Thr Ala Lys Leu Gly Ala Asp Ile
115 120 125

Glu Thr Lys Phe Leu Gln Thr Ile Pro Leu Gly Arg Phe Gly Gln Pro
130 135 140

Glu Glu Val Ala Gly Leu Val Glu Phe Leu Ala Leu Asn Pro Ala Ala
145 150 155 160

Asn Tyr Ile Thr Gly Gln Val Phe Thr Ile Asp Gly Gly Leu Val Met
165 170 175

<210> 37
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<400> 37

Met Ala Thr Thr Ser Thr Lys Glu Met Thr Val Val Lys Gly Leu Asp
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Val Glu Arg Tyr Met Gly Arg Trp Tyr Glu Ile Ala Ser Phe Pro Ser
20 25 30

Phe Phe Gln Pro Lys Asn Gly Glu Asn Thr Arg Ala Thr Tyr Thr Leu
35 40 45

Asn Ser Asp Gly Thr Val His Val Leu Asn Glu Thr Trp Ser Asp Gly
50 55 60

Lys Arg Asp Ala Ile Glu Gly Thr Ala Tyr Lys Ala Asn Pro Asn Ser
65 70 75 80

Asp Glu Ala Lys Leu Lys Val Lys Phe Tyr Val Pro Pro Phe Phe Pro
85 90 95

Ile Ile Pro Val Thr Gly Asp Tyr Trp Val Leu Tyr Ile Asp Asp Asp
100 105 110

Tyr Gln Tyr Ala Leu Ile Gly Gln Pro Ser Arg Lys Tyr Leu Trp Ile
115 120 125

Leu Cys Arg Gln Thr His Met Asp Asp Glu Val Tyr Asn Leu Leu Leu
130 135 140

Glu Lys Ala Lys Glu Glu Gly Tyr Asp Val Lys Lys Leu His Lys Thr
145 150 155 160

Pro Gln Ala Asp Pro Pro Pro Glu Ala Glu Ala Gly Pro Lys Asp Thr
165 170 175

Lys Gly Ile Trp Trp Ile Lys Ser Leu Phe Gly Lys
180 185

<210> 38
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<212> PRT
<213> Elaeis guineensis

<400> 38

Met Ala Ala Ser Ile Ala Phe Asn Pro His Val Ile Pro Ala Arg Ser
1 5 10 15

Ala Ala Pro Arg Arg Val Ala Pro Leu Gln Thr Leu Ser Ala Ala Pro
20 25 30

Arg Leu Ala Ala Arg Ser Leu Cys Phe Lys Ser Ser Leu Arg Ser Asp
35 40 45

Gly Thr Ala Ala Phe Ser Gly Val Arg Thr Gln Ala Ala Val Val Glu
50 55 60

```
Gln Ala Ser Ile Glu Gln Ala Gln Asn Val Glu Ala Pro Val Ala Ile
65                  70                  75                  80

Val Thr Gly Gly Ser Arg Gly Ile Gly Lys Ala Ile Ala Leu Ala Leu
                85                  90                  95

Gly Lys Ala Gly Cys Lys Val Leu Ile Asn Tyr Ala Thr Ser Thr Glu
            100                 105                 110

Glu Ala Glu Glu Val Ser Lys Glu Ile Glu Ala Ser Gly Gly Gln Ala
        115                 120                 125

Ile Ile Phe Phe Gly Asp Ile Ser Lys Glu Asp Asp Val Glu Ser Met
    130                 135                 140

Ile Lys Ile Ala Ala Asp Ala Trp Gly Thr Val Asp Ile Leu Val Asn
145                 150                 155                 160

Asn Ala Gly Ile Thr Arg Asp Thr Leu Leu Met Arg Met Lys Lys Ser
                165                 170                 175

Gln Trp Gln Glu Val Ile Asp Val Asn Leu Thr Gly Val Phe Leu Cys
            180                 185                 190

Thr Gln Ala Ala Ala Lys Leu Met Met Lys Lys Lys Lys Gly Lys Ile
        195                 200                 205

Ile Asn Ile Ala Ser Val Val Gly Leu Thr Gly Asn Ala Gly Gln Ala
    210                 215                 220

Asn Tyr Ser Ala Ser Lys Ala Gly Val Ile Gly Phe Thr Lys Thr Val
225                 230                 235                 240

Ala Arg Glu Tyr Ala Ser Arg Asn Ile Asn Val Asn Ala Val Ala Pro
                245                 250                 255

Gly Phe Ile Ala Ser Pro Met Thr Ala Gln Leu Gly Glu Asp Val Glu
            260                 265                 270

Lys Lys Ile Leu Gln Thr Ile Pro Leu Gly Arg Tyr Gly Gln Pro Glu
        275                 280                 285

Glu Val Ala Gly Leu Val Glu Phe Leu Ala Leu Asn Pro Ala Ala Asp
    290                 295                 300

Tyr Ile Thr Gly Gln Val Phe Thr Ile Asp Gly Gly Met Val Met
305                 310                 315
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Met Ser Leu Ile Pro Arg Gly Trp Gly Phe Gly Ser Ser Ile Phe Asp
1 5 10 15

Pro Trp Asp Ser Phe Glu Gly Phe Pro Phe Asn Ser Ser Leu Ser Ser
20 25 30

Phe Pro Arg Pro Ser Phe Pro Ser Glu Ser Ser Ala Phe Ala Asn Ala
35 40 45

Arg Ile Asp Trp Lys Glu Thr Pro Glu Ala His Val Phe Lys Ala Asp
50 55 60

Leu Pro Gly Leu Lys Lys Glu Glu Val Lys Val Glu Val Glu Glu Gly
65 70 75 80

Asn Val Leu Gln Ile Ser Gly Glu Arg Ser Arg Glu Gln Glu Glu Lys
85 90 95

Thr Asp Thr Trp His Arg Val Glu Arg Ser Ser Gly Lys Phe Leu Arg
100 105 110

Arg Phe Arg Leu Pro Glu Asn Ala Lys Met Asp Arg Val Lys Ala Ala
115 120 125

Met Glu Asn Gly Val Leu Thr Val Thr Val Pro Lys Glu Glu Val Lys
130 135 140

Lys Leu Glu Val Arg Ser Ile Glu Ile Ser Gly
145 150 155

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Met Glu Phe Tyr Thr Thr Cys Leu Pro Arg Ser Ser Met Ser Tyr Cys
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Ala His Pro Arg Leu Ser Pro Pro Val Pro Arg Ser Lys Gln Phe Leu
20 25 30

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Ser Phe Arg Ile Lys Asn Ala Ala Ser Thr Ser Ser Val Pro Ala Pro
        35                  40                  45

Pro Ala Thr Thr Pro Ser Ser Ser Arg Asn Gly Asn Ile Thr Thr Lys
    50                  55                  60

Ser Leu Thr Glu Lys Leu Ser Ser Ala Met Asp Gln Leu Asp Ile Glu
65                  70                  75                  80

Arg Gly Val Cys Ile Pro Phe Arg Lys Tyr Thr Pro Glu Thr Val Arg
                85                  90                  95

Asn Lys Val Leu Glu Ser Arg Gly Ala Ile Leu Ser Leu Ile Gly Arg
            100                 105                 110

Gly Val Glu Ile Val Trp Asn Leu Gly Leu Tyr Trp Ser Ala Leu Thr
        115                 120                 125

Tyr Asp Cys Leu Val Gly Arg Asp Glu Glu Val Val Pro Tyr Arg Ala
    130                 135                 140

Arg Gln Leu Arg Asn Leu Leu Cys Asn Leu Gly Pro Ser Phe Ile Lys
145                 150                 155                 160

Ala Gly Gln Val Leu Ala Asn Arg Pro Asp Ile Ile Arg Glu Asp Tyr
                165                 170                 175

Met Asn Glu Leu Cys Ile Leu Gln Asp Asp Val Pro Pro Phe Pro Asn
            180                 185                 190

Gln Glu Ala Phe Ser Ile Ile Glu Glu Glu Leu Gly Gln Pro Leu Glu
        195                 200                 205

Lys Val Phe Ser Arg Ile Ser Ser Glu Thr Ile Ala Ala Ala Ser Leu
    210                 215                 220

Gly Gln Val Tyr Arg Ala Thr Leu Arg Glu Thr Arg Glu Asp Val Ala
225                 230                 235                 240

Ile Lys Val Gln Arg Pro Gly Ile Glu Pro Ile Ile Tyr Arg Asp Leu
                245                 250                 255

Phe Leu Phe Arg Thr Leu Ala Ser Phe Leu Asn Gly Ile Ser Leu Gln
            260                 265                 270

Lys Leu Gly Cys Asn Ala Glu Leu Ile Val Asp Glu Phe Gly Glu Lys
        275                 280                 285
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Leu Leu Glu Glu Leu Asp Tyr Thr Leu Glu Ala Arg Asn Ile Glu Asp
    290                 295                 300

Phe Leu Glu Asn Phe Lys Asn Asp Pro Thr Val Lys Ile Pro Arg Val
305                 310                 315                 320

Tyr Lys Gln Leu Ser Gly Arg Arg Val Leu Val Met Glu Trp Ile Asp
                325                 330                 335

Gly Ile Arg Cys Thr Asp Pro Glu Ala Val Lys Glu Ala Gly Ile Asp
            340                 345                 350

Val Asn Gly Phe Leu Thr Val Gly Val Ser Ala Ala Leu Arg Gln Leu
        355                 360                 365

Leu Glu Phe Gly Leu Phe His Gly Asp Pro His Pro Gly Asn Ile Phe
    370                 375                 380

Ala Met Arg Asp Gly Arg Ile Ala Tyr Val Asp Phe Gly Asn Val Ala
385                 390                 395                 400

Val Leu Ser Gln Gln Asn Lys Gln Ile Leu Ile Asp Ala Val Val His
                405                 410                 415

Ala Val Asn Glu Asp Tyr Ala Glu Met Ala Asn Asp Phe Thr Arg Leu
            420                 425                 430

Gly Phe Leu Ala Ser Gly Thr Asp Val Ser Pro Ile Ile Pro Ala Leu
        435                 440                 445

Glu Ala Ile Trp Gln Asn Ser Ala Gly Lys Gly Leu Ala Asp Phe Asn
    450                 455                 460

Phe Arg Ser Val Thr Gly Lys Phe Asn Gln Leu Val Tyr Asn Tyr Pro
465                 470                 475                 480

Ile Arg Ile Pro Glu Arg Phe Ser Leu Val Ile Arg Ser Leu Leu Thr
                485                 490                 495

Gln Glu Gly Ile Cys Phe Thr Leu Lys Pro Asp Phe Lys Phe Leu Glu
            500                 505                 510

Val Ala Tyr Pro Tyr Ile Ala Lys Arg Leu Leu Thr Asp Pro Asn Pro
        515                 520                 525

Ala Leu Arg Glu Arg Leu Ile Gln Val Leu Phe Lys Asp Gly Leu Phe
    530                 535                 540
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Gln Trp Lys Arg Leu Glu Asn Leu Ile Val Leu Ala Lys Glu Asn Val
545                 550                 555                 560

Ala Lys Met Asn Gln Asn Pro Ala Leu Gln Val Thr Asn Thr Gln Asn
                565                 570                 575

Ser Arg Asn Trp Gln Val Glu Lys Lys Leu Asp Leu Thr Glu Thr Ile
            580                 585                 590

Lys Asp Gly Ala Arg Met Phe Leu Ile Asp Ala Gly Ile Arg Arg Gln
        595                 600                 605

Leu Ile Met Ala Leu Thr Glu Asp Ser Lys Leu His Ile Gln Glu Leu
    610                 615                 620

Val Asp Val Tyr Arg Leu Val Glu Asp Asp Val Asp Ile Pro Ala Val
625                 630                 635                 640

Ala Phe Glu Val Leu Gln Asp Leu Pro Ser Val Thr Arg Asp Leu Met
                645                 650                 655

Leu Ser Trp Ser Glu Ala Val Leu Ser Asp Arg
            660                 665


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<400>  41

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Val Lys Asp Ala Arg Gly Asn Asp Val Asn Leu Gly Thr Tyr Lys Gly
            20                  25                  30

Lys Val Leu Leu Ile Val Asn Val Ala Ser Gln Cys Gly Leu Thr Asn
        35                  40                  45

Ser Asn Tyr Thr Glu Leu Thr Ala Leu Tyr Glu Lys Tyr Lys Asp Lys
    50                  55                  60

Gly Leu Glu Ile Leu Ala Phe Pro Cys Asn Gln Phe Gly Ala Gln Glu
65                  70                  75                  80

Pro Gly Ser Asn Glu Gln Ile Leu Glu Phe Ala Cys Thr Arg Phe Lys
                85                  90                  95
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Ala Glu Tyr Pro Ile Phe Asp Lys Val Asp Val Asn Gly Asp Asn Ala
100 105 110

Ala Pro Ile Tyr Lys Phe Leu Lys Ser Ser Lys Gly Gly Leu Phe Gly
115 120 125

Glu Ser Ile Lys Trp Asn Phe Ser Lys Phe Leu Val Asp Lys Glu Gly
130 135 140

His Val Val Asp Arg Tyr Ala Pro Thr Thr Ser Pro Leu Ser Ile Glu
145 150 155 160

Lys Asp Val Lys Lys Leu Leu Gly Leu Asn
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Val His Lys Phe Trp Ala Asp Phe Val Asp Lys Lys Gly Glu Glu Gln
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Glu Thr Ala Lys Lys
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Met Gly Val Lys Val Tyr Gly Pro Thr Met Ser Thr Cys Thr Ala Arg
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Val Leu Leu Cys Leu Glu Glu Val Gly Ala Glu Tyr Glu Leu Val Pro
20 25 30

Ile Asn Leu Ser Thr Gly Glu His Lys Gln Pro Ala His Leu Ala Arg
35 40 45

Asn Pro Phe Gly Gln Val Pro Ala Phe Glu Asp Gly Ala Leu Met Leu
50 55 60

His Glu Ser Arg Ala Ile Ala Arg Tyr Val Ser Arg Lys Tyr Lys Ser
65 70 75 80

Ser Gly Ala Asp Leu Leu Lys Glu Gly Gly Leu Glu Glu Ser Ala Met
85 90 95

Val Asp Val Trp Leu Glu Val Glu Ser His Gln Phe Asp Pro Ala Ile
100 105 110

Gly Pro Ile Phe Phe Gln Ser Phe Ile Val Pro Met Ile Gly Gly Val
115 120 125

Pro Asp Gln Thr Val Ile Asn Thr Asn Leu Glu Lys Leu Cys Lys Val
130 135 140

Leu Asp Ile Tyr Glu Ala Arg Leu Ser Lys Thr Lys Tyr Leu Ala Gly
145 150 155 160

Asp Phe Phe Ser Leu Ala Asp Leu Ser His Val Pro Leu Leu Tyr Tyr
165 170 175

Phe Met Gly Ser Pro His Ala Ser Val Val Asn Ser Arg Pro His Val
180 185 190

Lys Ala Trp Trp Glu Ala Val Ser Ser Arg Pro Ala Cys Lys Lys Val
195 200 205

Thr Ser Ala Met Pro Gly Ser Ala
210 215

<210> 44

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<400> 44

Met Ala Gln Ile Leu Leu His Gly Thr Leu His Val Thr Ile Phe Glu
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Ala Asn Ser Leu Ser Asn Pro Asn Arg Ala Ser Gly Gly Ala Pro Lys
20 25 30

Phe Ile Arg Gln Leu Val Glu Gly Ile Glu Asp Thr Ile Gly Leu Gly
35 40 45

Lys Gly Ser Ser Lys Leu Tyr Ala Thr Ile Asp Leu Glu Lys Ala Arg
50 55 60

Val Gly Arg Thr Arg Leu Ile Thr Lys Glu Pro Val Asn Pro Arg Trp
65 70 75 80

Tyr Glu Ser Phe His Ile Tyr Cys Ala His Met Ser Ala Asn Val Ile
85 90 95

Phe Thr Val Lys Phe Asp Asn Pro Ile Gly Ala Ser Leu Ile Gly Arg
100 105 110

Ala Tyr Leu Pro Val Thr Glu Ile Leu Asn Gly Glu Glu Val Asp Arg
115 120 125

Trp Ile Glu Ile Cys Asp Glu Asp Arg Asn Pro Leu Asp Gly Gly Ala
130 135 140

Arg Ile His Val Lys Val Gln Tyr Phe Asp Ile Ser Lys Asp Arg Asn
145 150 155 160

Trp Ala Arg Gly Ile Arg Ser Ala Lys Tyr Pro Gly Val Pro Tyr Thr
165 170 175

Phe Phe Ser Gln Arg Gln Gly Cys Lys Val Thr Leu Tyr Gln Asp Ala
180 185 190

His Val Pro Asp Asn Phe Ile Pro Lys Ile Pro Leu Ala Asp Gly Lys
195 200 205

Tyr Tyr Glu Pro His Arg Cys Trp Glu Asp Ile Phe Asp Ala Ile Ser
210 215 220

Asn Ala Gln His Leu Ile Tyr Ile Thr Gly Trp Ser Val Tyr Thr Glu

225 230 235 240

Ile Thr Leu Val Arg Asp Ala Lys Arg Gln Lys Pro Gly Gly Asp Val
245 250 255

Thr Leu Gly Glu Leu Leu Lys Arg Lys Ala Ser Glu Gly Val Arg Val
260 265 270

Leu Met Leu Val Trp Asp Asp Arg Thr Ser Val Gly Leu Leu Lys Lys
275 280 285

Asp Gly Leu Met Ala Thr His Asp Glu Glu Thr Ala Asn Tyr Phe Gln
290 295 300

Asp Thr Asp Val His Cys Val Leu Cys Pro Arg Asn Pro Asp Asp Gly
305 310 315 320

Gly Ser Phe Val Gln Asp Leu Gln Ile Ser Thr Met Phe Thr His His
325 330 335

Gln Lys Ile Val Val Val Asp His Glu Met Pro Asn Lys Ser Ser Gln
340 345 350

Gln Arg Arg Ile Val Ser Phe Val Gly Gly Ile Asp Leu Cys Asp Gly
355 360 365

Arg Tyr Asp Thr Gln Phe His Ser Leu Phe Arg Thr Leu Asp Thr Ala
370 375 380

His His Asp Asp Phe His Gln Pro Asn Phe Ala Asp Ala Ser Ile Lys
385 390 395 400

Lys Gly Gly Pro Arg Glu Pro Trp His Asp Ile His Ser Arg Leu Glu
405 410 415

Gly Pro Ile Ala Trp Asp Val Leu Tyr Asn Phe Glu Gln Arg Trp Arg
420 425 430

Lys Gln Gly Gly Lys Asp Leu Leu Val Gln Leu Arg Asp Leu Ala Asp
435 440 445

Ile Val Ile Pro Pro Ser Pro Val Met Phe Pro Glu Asp Arg Glu Thr
450 455 460

Trp Asn Val Gln Leu Phe Arg Ser Ile Asp Gly Gly Ala Ala Phe Gly
465 470 475 480

RDQL-J4432 seq project for proteomics appl_ST25.txt

Phe Pro Glu Thr Pro Glu Asp Ala Ala Arg Ala Gly Leu Val Ser Gly
485 490 495

Lys Asp Asn Ile Ile Asp Arg Ser Ile Gln Asp Ala Tyr Ile Asn Ala
500 505 510

Ile Arg Arg Ala Lys Asn Phe Ile Tyr Ile Glu Asn Gln Tyr Phe Leu
515 520 525

Gly Ser Ser Phe Gly Trp Arg Ala Asp Asp Ile Lys Pro Glu Glu Val
530 535 540

Gly Ala Leu His Leu Ile Pro Lys Glu Leu Ser Leu Lys Ile Val Ser
545 550 555 560

Lys Ile Glu Ala Gly Glu Arg Phe Thr Val Tyr Val Val Val Pro Met
565 570 575

Trp Pro Glu Gly Val Pro Glu Ser Gly Ser Val Gln Ala Ile Leu Asp
580 585 590

Trp Gln Arg Arg Thr Met Glu Met Met Tyr Thr Asp Ile Ile Leu Ala
595 600 605

Leu Gln Ala Lys Gly Ile Glu Ala Asn Pro Lys Asp Tyr Leu Thr Phe
610 615 620

Phe Cys Leu Gly Asn Arg Glu Val Lys Lys Gly Gly Glu Tyr Glu Pro
625 630 635 640

Glu Glu Gln Pro Glu Ala Asp Thr Asp Tyr Ser Arg Ala Gln Gln Ala
645 650 655

Arg Arg Phe Met Ile Tyr Val His Thr Lys Met Met Ile Val Asp Asp
660 665 670

Glu Tyr Ile Ile Ile Gly Ser Ala Asn Ile Asn Gln Arg Ser Met Asp
675 680 685

Gly Ala Arg Asp Ser Glu Ile Ala Met Gly Ala Tyr Gln Pro Phe Tyr
690 695 700

Leu Ser Thr Arg Gly Leu Ala Arg Gly Arg Ile His Gly Phe Arg Met
705 710 715 720

Ala Leu Trp Tyr Glu His Leu Gly Met Leu Asp Asp Ala Phe Leu His
725 730 735

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Pro Glu Ser Val Glu Cys Val Gln Lys Val Asn Arg Ile Ala Asp Lys
            740                 745                 750

Tyr Trp Asp Leu Tyr Ser Ser Asp Asn Leu Asp Arg Asp Leu Pro Gly
        755                 760                 765

His Leu Leu Ser Tyr Pro Ile Gly Val Ser Ser Asp Gly Val Ile Thr
    770                 775                 780

Glu Leu Pro Gly Met Glu Phe Phe Pro Asp Thr Arg Ala Arg Val Leu
785                 790                 795                 800

Gly Thr Lys Ala Asp Tyr Leu Pro Pro Ile Leu Thr Thr
                805                 810
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<400> 45

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1               5                   10                  15
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Phe Asn Arg Phe Asp Ser Val Thr Lys Glu Ile Thr Asp Leu Gly Met
            20                  25                  30

Glu Ser Phe Ala Arg Leu Ser Cys Gly Ser Cys Thr Phe Gly Ala Lys
        35                  40                  45

Gly Ile Asn Ala Met Leu Glu His Cys Lys Leu Gln Val Thr Asp Ile
    50                  55                  60

Gly Leu Phe Gly Ile Ser Lys Arg Ile Gly Asp Gln Gly Leu Met Ser
65                  70                  75                  80

Val Ala Lys Asn Leu Val Ala Cys Thr Leu Arg Arg
                85                  90
```

Claims

1. A method for obtaining a high-yielding oil palm plant comprising:

(i) determining the level of a protein in mesocarp tissue of a fruit of a parental oil palm plant, wherein the protein is selected from the group consisting of 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase 2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde-3-phosphate-dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog;

(ii) determining whether there is a difference between the level of the protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant; and

(iii) selecting progeny of the parental oil palm plant based on the difference to obtain the high-yielding oil palm plant.

2. The method of claim 1, wherein the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase comprises SEQ ID NO: 1, the abscisic stress ripening protein comprises SEQ ID NO: 2, the actin 6 comprises SEQ ID NO: 3, the actin E comprises SEQ ID NO: 4, the biotin-carboxylase precursor comprises SEQ ID NO: 5, the caffeic acid O-methyltransferase comprises SEQ ID NO: 6, the catalase 2 comprises SEQ ID NO: 7, the conserved-hypothetical-protein-of-Ricinus-communis ortholog comprises SEQ ID NO: 8, the fibrillin-like protein comprises SEQ ID NO: 9, the flavodoxin-like quinone reductase 1 comprises SEQ ID NO: 10, the fructose-bisphosphate aldolase comprises SEQ ID NO: 11, the glyceraldehyde 3-phosphate dehydrogenase comprises SEQ ID NO: 12, the H0825G02.11 ortholog comprises SEQ ID NO: 13, the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase comprises SEQ ID NO: 14, the Lea1P comprises SEQ ID NO: 15, the methionine synthase protein comprises SEQ ID NO: 16, the mitochondrial peroxiredoxin comprises SEQ ID NO: 17, the Os02g0753300 ortholog comprises SEQ ID NO: 18, the Os05g0482700 ortholog comprises SEQ ID NO: 19, the Os12g0163700 ortholog comprises SEQ ID NO: 20, the OSJNBb0085F13.17 ortholog comprises SEQ ID NO: 21, the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog comprises SEQ ID NO: 22, the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog comprises SEQ ID NO: 23, the predicted-protein-of-Populus-trichocarpa ortholog

comprises SEQ ID NO: 24, the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog comprises SEQ ID NO: 25, the nascent polypeptide associated complex alpha comprises SEQ ID NO: 26, the proline iminopeptidase comprises SEQ ID NO: 27, the protein transporter comprises SEQ ID NO: 28, the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog comprises SEQ ID NO: 29, the Ran GTPase binding protein comprises SEQ ID NO: 30, the chloroplastic triosephosphate isomerase comprises SEQ ID NO: 31, the V-type proton ATPase catalytic subunit A comprises SEQ ID NO: 32, the regulator of ribonuclease activity A comprises SEQ ID NO: 33, the retroelement pol polyprotein-like ortholog comprises ~~SEQ ID NO: 34, the ribosomal protein L10 comprises SEQ ID NO: 35, the short chain type~~ dehydrogenase comprises SEQ ID NO: 36, the temperature-induced lipocalin comprises SEQ ID NO: 37, and the unknown-protein-of-Picea-sitchensis ortholog comprises SEQ ID NO: 38.

3. The method of claims 1 or 2, wherein the difference is that the level of the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

4. The method of claims 1 or 2, wherein the difference is that the level of the abscisic stress ripening protein in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the abscisic stress ripening protein in the

mesocarp tissue of the fruit of the reference oil palm plant 15 to 19 weeks after pollination thereof.

5. The method of claims 1 or 2, wherein the difference is that the level of the actin 6 in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the actin 6 in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

~~6. The method of claims 1 or 2, wherein the difference is that the level of the actin E in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the actin E in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.~~

7. The method of claims 1 or 2, wherein the difference is that the level of the biotin carboxylase precursor in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the biotin carboxylase precursor in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

8. The method of claims 1 or 2, wherein the difference is that the level of caffeic acid O-methyltransferase in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 17 weeks after pollination thereof is lower than the level of caffeic acid O-methyltransferase in the

mesocarp tissue of the fruit of the reference oil palm plant 11 to 17 weeks after pollination thereof.

9. The method of claims 1 or 2, wherein the difference is that the level of the catalase 2 in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 19 weeks after pollination thereof is higher than the level of the catalase 2 in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 19 weeks after pollination thereof.

10. The method of claims 1 or 2, wherein the difference is that the level of the conserved-hypothetical-protein-of-Ricinus-communis ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the conserved-hypothetical-protein-of-Ricinus-communis ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

11. The method of claims 1 or 2, wherein the difference is that the level of the fibrillin-like protein in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the fibrillin-like protein in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

12. The method of claims 1 or 2, wherein the difference is that the level of the flavodoxin-like quinone reductase 1 in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 19 weeks after pollination thereof is lower than the level of the flavodoxin-like quinone reductase 1

in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 19 weeks after pollination thereof.

13. The method of claims 1 or 2, wherein the difference is that the level of the fructose-bisphosphate aldolase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the fructose-bisphosphate aldolase in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

14. The method of claims 1 or 2, wherein the difference is that the level of the glyceraldehyde 3-phosphate dehydrogenase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the glyceraldehyde 3-phosphate dehydrogenase in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

15. The method of claims 1 or 2, wherein the difference is that the level of the H0825G02.11 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the H0825G02.11 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

16. The method of claims 1 or 2, wherein the difference is that the level of the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase in the mesocarp tissue of the fruit of the parental oil palm plant 17 to 19 weeks after pollination thereof is higher than the level of the

large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase in the mesocarp tissue of the fruit of the reference oil palm plant 17 to 19 weeks after pollination thereof.

17. The method of claims 1 or 2, wherein the difference is that the level of the Lea1P in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the Lea1P in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

~~18. The method of claims 1 or 2, wherein the difference is that the level of the methionine synthase protein in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the methionine synthase protein in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.~~

19. The method of claims 1 or 2, wherein the difference is that the level of the mitochondrial peroxiredoxin in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 17 weeks after pollination thereof is higher than the level of the mitochondrial peroxiredoxin in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 17 weeks after pollination thereof.

20. The method of claims 1 or 2, wherein the difference is that the level of the Os02g0753300 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the Os02g0753300 ortholog in the

mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

21. The method of claims 1 or 2, wherein the difference is that the level of the Os05g0482700 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the Os05g0482700 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

22. The method of claims 1 or 2, wherein the difference is that the level of the Os12g0163700 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the Os12g0163700 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

23. The method of claims 1 or 2, wherein the difference is that the level of the OSJNBb0085F13.17 ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the OSJNBb0085F13.17 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

24. The method of claims 1 or 2, wherein the difference is that the level of the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog in the mesocarp tissue of the fruit of the

parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

25. The method of claims 1 or 2, wherein the difference is that the level of the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is lower than the level of the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

26. The method of claims 1 or 2, wherein the difference is that the level of the predicted-protein-of-Populus-trichocarpa ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 17 weeks after pollination thereof is lower than the level of the predicted-protein-of-Populus-trichocarpa ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 17 weeks after pollination thereof.

27. The method of claims 1 or 2, wherein the difference is that the level of the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

28. The method of claims 1 or 2, wherein the difference is that the level of the nascent polypeptide associated complex alpha in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 19 weeks after pollination thereof is higher than the level of the nascent polypeptide associated complex alpha in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 19 weeks after pollination thereof.

29. The method of claims 1 or 2, wherein the difference is that the level of the proline iminopeptidase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the proline iminopeptidase in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 19 weeks after pollination thereof.

30. The method of claims 1 or 2, wherein the difference is that the level of the protein transporter in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is lower than the level of the protein transporter in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

31. The method of claims 1 or 2, wherein the difference is that the level of the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

32. The method of claims 1 or 2, wherein the difference is that the level of the Ran GTPase binding protein in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is higher than the level of the Ran GTPase binding protein in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

33. The method of claims 1 or 2, wherein the difference is that the level of the chloroplastic triosephosphate isomerase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the chloroplastic triosephosphate isomerase in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

34. The method of claims 1 or 2, wherein the difference is that the level of the V-type proton ATPase catalytic subunit A in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is lower than the level of the V-type proton ATPase catalytic subunit A in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

35. The method of claims 1 or 2, wherein the difference is that the level of the regulator of ribonuclease activity A in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the regulator of ribonuclease activity A in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

36. The method of claims 1 or 2, wherein the difference is that the level of the retroelement pol polyprotein-like ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is lower than the level of the retroelement pol polyprotein-like ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

37. The method of claims 1 or 2, wherein the difference is that the level of the ribosomal protein L10 in the mesocarp tissue of the fruit of the parental oil palm plant 11 to 13 weeks after pollination thereof is lower than the level of the ribosomal protein L10 in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

38. The method of claims 1 or 2, wherein the difference is that the level of the short chain type dehydrogenase in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 19 weeks after pollination thereof is higher than the level of the short chain type dehydrogenase in the mesocarp tissue of the fruit of the reference oil palm plant 11 to 13 weeks after pollination thereof.

39. The method of claims 1 or 2, wherein the difference is that the level of the temperature-induced lipocalin in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the temperature-induced lipocalin in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

40. The method of claims 1 or 2, wherein the difference is that the level of the unknown-protein-of-Picea-sitchensis ortholog in the mesocarp tissue of the fruit of the parental oil palm plant 15 to 17 weeks after pollination thereof is higher than the level of the unknown-protein-of-Picea-sitchensis ortholog in the mesocarp tissue of the fruit of the reference oil palm plant 15 to 17 weeks after pollination thereof.

41. The method of claims 1 or 2, further comprising:

~~(i) determining the level of at least another of the proteins in the mesocarp tissue of the~~ fruit of the parental oil palm plant;

(ii) determining whether there is a difference between the level of the other protein in the mesocarp tissue of the fruit of the parental oil palm plant and the level of the other protein in the mesocarp tissue of the fruit of the reference oil palm plant; and

(iii) selecting the progeny of the parental oil palm plant based also on the difference with respect to the levels of the other protein to obtain the high-yielding oil palm plant.

42. The method of claim 1 or 2, wherein the difference is determined by a technique selected from the group consisting of two-dimensional fluorescence difference gel electrophoresis, antibody-based detection, immunoblot detection, and dot-blot detection.

43. The method of any one of claims 1 to 42, wherein:

the parental oil palm plant is a *dura* breeding stock plant;

the progeny comprises an oil palm plant selected from the group consisting of a *dura* breeding stock plant and a *tenera* agricultural production plant; and

the high-yielding oil palm plant is selected from the group consisting of a *dura* breeding stock plant and a *tenera* agricultural production plant.

44. The method of any one of claims 1 to 42, wherein:

the parental oil palm plant is a *tenera* breeding stock plant;

the progeny comprises an oil palm plant selected from the group consisting of a *tenera* breeding stock plant, a *pisifera* breeding stock plant, and a *tenera* agricultural production plant; and

the high-yielding oil palm plant is selected from the group consisting of a *tenera* breeding stock plant and a *tenera* agricultural production plant.

45. A method for obtaining palm oil from a high-yielding oil palm plant comprising:

(i) obtaining the high-yielding oil palm plant by the method of any one of claims 1 to 44; and

(ii) isolating palm oil from a fruit of the high-yielding oil palm plant.

46. A method for predicting oil yield of a test oil palm plant comprising:

(i) determining the level of a protein in mesocarp tissue of a fruit of the test oil palm plant, wherein the protein is selected from the group consisting of 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase

2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde 3-phosphate dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog;

(ii) determining whether there is a difference between the level of the protein in the mesocarp tissue of the fruit of the test oil palm plant and the level of the protein in mesocarp tissue of a fruit of a reference oil palm plant; and

(iii) predicting the oil yield of the test oil palm plant based on the difference.

47. The method of claim 46, wherein the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase comprises SEQ ID NO: 1, the abscisic stress ripening protein comprises SEQ ID NO: 2, the actin 6 comprises SEQ ID NO: 3, the actin E comprises SEQ ID NO: 4, the biotin carboxylase precursor comprises SEQ ID NO: 5, the caffeic acid O-

methyltransferase comprises SEQ ID NO: 6, the catalase 2 comprises SEQ ID NO: 7, the conserved-hypothetical-protein-of-Ricinus-communis ortholog comprises SEQ ID NO: 8, the fibrillin-like protein comprises SEQ ID NO: 9, the flavodoxin-like quinone reductase 1 comprises SEQ ID NO: 10, the fructose-bisphosphate aldolase comprises SEQ ID NO: 11, the glyceraldehyde 3-phosphate dehydrogenase comprises SEQ ID NO: 12, the H0825G02.11 ortholog comprises SEQ ID NO: 13, the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase comprises SEQ ID NO: 14, the Lea1P comprises SEQ ID NO: 15, the methionine synthase protein comprises SEQ ID NO: 16, the mitochondrial peroxiredoxin comprises SEQ ID NO: 17, the Os02g0753300 ortholog comprises SEQ ID NO: 18, the Os05g0482700 ortholog comprises SEQ ID NO: 19, the Os12g0163700 ortholog comprises SEQ ID NO: 20, the OSJNBb0085F13.17 ortholog comprises SEQ ID NO: 21, the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog comprises SEQ ID NO: 22, the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog comprises SEQ ID NO: 23, the predicted-protein-of-Populus-trichocarpa ortholog comprises SEQ ID NO: 24, the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog comprises SEQ ID NO: 25, the nascent polypeptide associated complex alpha comprises SEQ ID NO: 26, the proline iminopeptidase comprises SEQ ID NO: 27, the protein transporter comprises SEQ ID NO: 28, the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog comprises SEQ ID NO: 29, the Ran GTPase binding protein comprises SEQ ID NO: 30, the chloroplastic triosephosphate isomerase comprises SEQ ID NO: 31, the V-type proton ATPase catalytic subunit A comprises SEQ ID NO: 32, the regulator of ribonuclease activity A comprises SEQ ID NO: 33, the retroelement pol polyprotein-like ortholog comprises SEQ ID NO: 34, the ribosomal protein L10 comprises SEQ ID NO: 35, the short chain type dehydrogenase comprises SEQ ID

NO: 36, the temperature-induced lipocalin comprises SEQ ID NO: 37, and the unknown-protein-of-Picea-sitchensis ortholog comprises SEQ ID NO: 38.

48. The method of claims 46 or 47, further comprising:

(i) determining the level of at least another of the proteins in the mesocarp tissue of the fruit of the test oil palm plant;

(ii) determining whether there is a difference between the level of the other protein in the mesocarp tissue of the test oil palm plant and the level of the other protein in the mesocarp tissue of the fruit of the reference oil palm plant; and

(iii) predicting the oil yield of the test oil palm plant based also on the difference with respect to the levels of the other protein.

49. A kit for obtaining a high-yielding oil palm plant comprising:

an antibody for detection of a protein selected from the group consisting of 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase, abscisic stress ripening protein, actin 6, actin E, biotin carboxylase precursor, caffeic acid O-methyltransferase, catalase 2, conserved-hypothetical-protein-of-Ricinus-communis ortholog, fibrillin-like protein, flavodoxin-like quinone reductase 1, fructose-bisphosphate aldolase, glyceraldehyde 3-phosphate dehydrogenase, H0825G02.11 ortholog, large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase, Lea1P, methionine synthase protein, mitochondrial peroxiredoxin, Os02g0753300 ortholog, Os05g0482700 ortholog, Os12g0163700 ortholog, OSJNBb0085F13.17 ortholog, predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog, predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog, predicted-protein-

of-Populus-trichocarpa ortholog, hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog, nascent polypeptide associated complex alpha, proline iminopeptidase, protein transporter, putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog, Ran GTPase binding protein, chloroplastic triosephosphate isomerase, V-type proton ATPase catalytic subunit A, regulator of ribonuclease activity A, retroelement pol polyprotein-like ortholog, ribosomal protein L10, short chain type dehydrogenase, temperature-induced lipocalin, and unknown-protein-of-Picea-sitchensis ortholog; and

an extract of a mesocarp tissue of a fruit of a reference oil palm plant.

50. The kit of claim 49, wherein the 5-methyltetrahydropteroyltriglutamate-homocysteine methyltransferase comprises SEQ ID NO: 1, the abscisic stress ripening protein comprises SEQ ID NO: 2, the actin 6 comprises SEQ ID NO: 3, the actin E comprises SEQ ID NO: 4, the biotin carboxylase precursor comprises SEQ ID NO: 5, the caffeic acid O-methyltransferase comprises SEQ ID NO: 6, the catalase 2 comprises SEQ ID NO: 7, the conserved-hypothetical-protein-of-Ricinus-communis ortholog comprises SEQ ID NO: 8, the fibrillin-like protein comprises SEQ ID NO: 9, the flavodoxin-like quinone reductase 1 comprises SEQ ID NO: 10, the fructose-bisphosphate aldolase comprises SEQ ID NO: 11, the glyceraldehyde 3-phosphate dehydrogenase comprises SEQ ID NO: 12, the H0825G02.11 ortholog comprises SEQ ID NO: 13, the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase comprises SEQ ID NO: 14, the Lea1P comprises SEQ ID NO: 15, the methionine synthase protein comprises SEQ ID NO: 16, the mitochondrial peroxiredoxin comprises SEQ ID NO: 17, the Os02g0753300 ortholog comprises SEQ ID NO: 18, the Os05g0482700 ortholog comprises SEQ ID NO: 19, the Os12g0163700 ortholog comprises SEQ ID NO: 20, the OSJNBb0085F13.17 ortholog comprises

SEQ ID NO: 21, the predicted-protein-of-Ostreococcus-lucimarinus-CCE9901 ortholog comprises SEQ ID NO: 22, the predicted-protein-of-Physcomitrella patens-subsp.-patens ortholog comprises SEQ ID NO: 23, the predicted-protein-of-Populus-trichocarpa ortholog comprises SEQ ID NO: 24, the hypothetical-protein-isoform-1-of-Vitis-vinifera ortholog comprises SEQ ID NO: 25, the nascent polypeptide associated complex alpha comprises SEQ ID NO: 26, the proline iminopeptidase comprises SEQ ID NO: 27, the protein transporter comprises SEQ ID NO: 28, the putative-NBS-LRR-disease-resistance-protein-homologue-of-Oryza-sativa-Japonica-Group ortholog comprises SEQ ID NO: 29, the Ran GTPase binding protein comprises ~~SEQ ID NO: 30, the chloroplastic triosephosphate isomerase comprises SEQ ID NO: 31, the V-~~ type proton ATPase catalytic subunit A comprises SEQ ID NO: 32, the regulator of ribonuclease activity A comprises SEQ ID NO: 33, the retroelement pol polyprotein-like ortholog comprises SEQ ID NO: 34, the ribosomal protein L10 comprises SEQ ID NO: 35, the short chain type dehydrogenase comprises SEQ ID NO: 36, the temperature-induced lipocalin comprises SEQ ID NO: 37, and the unknown-protein-of-Picea-sitchensis ortholog comprises SEQ ID NO: 38.

51. The kit of claims 49 or 50, wherein the kit further comprises instructions indicating use of the antibody for determining whether there is a difference between the level of the protein in mesocarp tissue of a fruit of a parental oil palm plant and the level of the protein in the extract of the mesocarp tissue of the fruit of the reference oil palm plant.

52. The kit of claim 51, wherein the kit further comprises instructions indicating selection of progeny of the parental oil palm plant based on the difference to obtain the high-yielding oil palm plant.

53. The kit of claims 49 or 50, further comprising at least another antibody for detection of at least another of the proteins.