

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44bis)

Applicant's or agent's file reference 1014081	FOR FURTHER ACTION	See item 4 below
International application No. PCT/US2016/037429	International filing date (<i>day/month/year</i>) 14 June 2016 (14.06.2016)	Priority date (<i>day/month/year</i>) 15 June 2015 (15.06.2015)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant MALAYSIAN PALM OIL BOARD		

1.	This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 bis.1(a).																								
2.	This REPORT consists of a total of 10 sheets, including this cover sheet.																								
	In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.																								
3.	This report contains indications relating to the following items: <table style="width: 100%;"> <tr> <td style="width: 5%; text-align: center;">☒</td> <td style="width: 25%;">Box No. I</td> <td style="width: 70%;">Basis of the report</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table>	☒	Box No. I	Basis of the report	☐	Box No. II	Priority	☒	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	☒	Box No. IV	Lack of unity of invention	☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	☐	Box No. VI	Certain documents cited	☐	Box No. VII	Certain defects in the international application	☐	Box No. VIII	Certain observations on the international application
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4.	The International Bureau will communicate this report to designated Offices in accordance with Rules 44bis.3(c) and 93bis.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44bis .2).																								

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Date of issuance of this report 19 December 2017 (19.12.2017) Authorized officer Agnès Wittmann-Regis e-mail: pct.team6@wipo.int
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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

13 MAR 2017

Applicant's or agent's file reference
1014081

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US2016/037429

International filing date (day/month/year)

14 June 2016

Priority date (day/month/year)

15 June 2015

International Patent Classification (IPC) or both national classification and IPC

IPC(8) - C07K 14/415; C12N 15/82; C12Q 1/68 (2017.01)

CPC - C07K 14/415; C12N 15/821; C12Q 1/6895 (2017.02)

Applicant MALAYSIAN PALM OIL BOARD

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion

22 February 2017

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2016/037429

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - ☒ the international application in the language in which it was filed.
 - ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).
3. ☒ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☒ forming part of the international application as filed:
 - ☒ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
 - ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).
4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:
SEQ ID NO:12 was searched.

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INTERNATIONAL SEARCHING AUTHORITY**

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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 4-32, 54, 68-70

because:

☐ the said international application, or the said claims Nos. _____ relate to the following subject matter which does not require an international search (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 4-32, 54, 68-70 are so unclear that no meaningful opinion could be formed (*specify*):

Claims 4-32, 54, and 68-70 are multiple dependent claims not drafted in accordance with the second and third sentences of Rule 6.4(a).

☐ the claims, or said claims Nos. _____ are so inadequately supported by the description that no meaningful opinion could be formed (*specify*):

☒ no international search report has been established for said claims Nos. 4-32, 54, 68-70

☐ a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

☐ furnish a sequence listing in the form of an Annex C/ST.25 text file, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

☐ furnish a sequence listing on paper or in the form of an image file complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

☐ pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13^{ter}.1(a) or (b).

☐ See Supplemental Box for further details.

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Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:
- ☐ paid additional fees.
 - ☐ paid additional fees under protest and, where applicable, the protest fee.
 - ☐ paid additional fees under protest but the applicable protest fee was not paid.
 - ☒ not paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with.
 - ☒ not complied with for the following reasons:

see first Supplemental Box(es).

4. Consequently, this opinion has been established in respect of the following parts of the international application:

- ☐ all parts.
- ☒ the parts relating to claims Nos. 1-3 and 50-53 restricted to a polymorphic marker for shell phenotype of SEQ ID NO:12.

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-3, 50-53	YES
	Claims	None	NO
Inventive step (IS)	Claims	1-3, 50-53	YES
	Claims	None	NO
Industrial applicability (IA)	Claims	1-3, 50-53	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-3 and 50-53 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 1, the prior art of record, individually or in combination, does not teach or fairly suggest a method for predicting the shell phenotype of a palm plant or seed, the method comprising: (a) determining from a nucleic acid sample from the palm plant or seed the presence, absence, or number of pisifera or dura alleles by detecting a genotype of a polymorphic marker of SEQ ID NO:12 to thereby predict the genotype of a SHELL gene; and (b) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles.

Regarding claim 2, the prior art of record, individually or in combination, does not teach or fairly suggest a method for segregating a plurality of palm plants into different categories based on predicted shell phenotype, the method comprising: (a) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles by detecting a genotype of a linked marker in SEQ ID NO:12 to thereby predict the genotype of a SHELL gene; and (c) segregating the plants into groups based on the genotype of the polymorphic marker, wherein at least one group only contains one of (i) plants predicted to have the tenera shell phenotype, (ii) plants predicted to have the dura shell phenotype, or (iii) plants predicted to have the pisifera shell phenotype.

Claim 3 depends from claim 1 or claim 2, and therefore meets the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 1 and claim 2.

Regarding claim 50, the prior art of record, individually or in combination, does not teach or fairly suggest a kit for determining the shell phenotype of a palm plant the kit comprising an oligonucleotide primer or probe that comprises a sequence complementary to SEQ ID NO:12 wherein the primer or probe independently hybridizes to SEQ ID NO: 12.

Claims 51-53 depend from claim 50, and therefore meet the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 50.

The following prior art is made of record to further support and define the reason why claims 1-3 and 50-53 meet the criteria set out in PCT Article 33(2)-(3).

(i) US 2013/0247249 A1 to Malaysian Palm Oil Board discloses a method for predicting the shell phenotype of a palm plant or seed (Nucleic acid sequences for predicting and controlling shell phenotype in palm, Abstract; methods for determining the shell phenotype of a palm (e.g., oil palm) plant (including but not limited to a whole palm plant or palm seed) are provided, Para. [0009]), the method comprising: (a) determining from a nucleic acid sample from the palm plant or seed the presence, absence, or number of pisifera or dura alleles by (i) detecting a genotype of at least one polymorphic marker (the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]) b) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles (SEQ ID NO: 1 represents a SNP that is accurate in predicting shell phenotype 83% of the time. Said another way, using the SNP of SEQ ID NO: 1 as a genetic marker, one can correctly predict shell phenotype of palm plants, Para. [0067]), but fails to explicitly disclose SEQ ID NO: 12.

(ii) US 2015/0024388 A1 to Malaysian Palm Oil Board discloses methods and compositions for optimizing fruit morphology (Abstract) using a method for sorting palm seeds, seed embryos, germinated seeds and plants by predicted shell thickness and/or oil yield, the method comprising obtaining a sample from a plurality of oil palm seeds or plants, thereby providing a plurality of samples; detecting expression or genotype of a SEP-like gene in the samples; and sorting the plurality of seeds or plants based on the seed's or plant's predicted shell thickness and/or oil yield, wherein the thickness of the shell is correlated to an expression level or mutation in the SEP-like gene (Para. [0014]), but fails to explicitly disclose SEQ ID NO: 12.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: *Box IV, Lack of Unity of Invention*

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees need to be paid.

Group I+: claims 1-3, 33-53, and 55-67 are drawn to polymorphic markers for shell phenotype, methods, kits, nucleic acids, and plants comprising the same.

The first invention of Group I+ is restricted to a polymorphic marker for shell phenotype, methods, kits, nucleic acids, and plants comprising the same, wherein the polymorphic marker is selected to be SEQ ID NO:12. It is believed that claims 1-3 and 50-53 read on this first named invention and thus these claims will be searched without fee to the extent that they read on a polymorphic marker for shell phenotype of SEQ ID NO:12.

Applicant is invited to elect additional polymorphic markers with specified SEQ ID NO to be searched in a specific combination by paying additional fee for each set of election. An exemplary election would be a polymorphic marker for shell phenotype, methods, kits, nucleic acids, and plants comprising the same, wherein the polymorphic marker is selected to be SEQ ID NO:3. Additional polymorphic markers with specified SEQ ID NO will be searched upon the payment of additional fees. Applicants must specify the claims that read on any additional elected inventions. Applicants must further indicate, if applicable, the claims which read on the first named invention if different than what was indicated above for this group. Failure to clearly identify how any paid additional invention fees are to be applied to the "+" group(s) will result in only the first claimed invention to be searched/examined.

The inventions listed in Groups I+ do not relate to a single general inventive concept under PCT Rule 13.1, because under PCT Rule 13.2 they lack the same or corresponding special technical features for the following reasons:

The Groups I+ formulas do not share a significant structural element responsible for predicting the shell phenotype of a palm plant or seed, requiring the selection of alternatives for the polymorphic marker, where "a polymorphic marker selected from the group consisting of those depicted in SEQ ID NOs: 12 and 29-8245" and "at least one polymorphic marker corresponding to nucleotide 7, 8, 9, 13, 14, 15, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 87, 88, 89, 90, 91, 92, 109, 110, 111, 114, 1211, 122, or 123 of exon 1 of a SHELL gene" and "at least one polymorphic marker encoding one or more amino acids selected from the group consisting of amino acids 3, 5, 8, 9, 10, 11, 12, 21, 22, 23, 24, 25, 26, 27, 28, 30, 37, and 41 of a SHELL polypeptide" and "a polynucleotide encoding a polypeptide comprising a sequence substantially (e.g., a least 80, 85, 90, 95, 97, 3 98, 99%) identical or identical to SEQ ID NO: 3, 4, 5, 6, 7, 8, 9, or 10".

The Groups I+ share the technical features of a method for predicting the shell phenotype of a palm plant or seed, the method comprising: (a) determining from a nucleic acid sample from the palm plant or seed the presence, absence, or number of pisifera or dura alleles by (i) detecting a genotype of at least one polymorphic marker b) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles; a method for segregating a plurality of palm plants into different categories based on predicted shell phenotype, the method comprising: (a) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles by: (i) detecting a genotype of at least one polymorphic marker (c) segregating the plants into groups based on the genotype of the polymorphic marker, wherein at least one group only contains one of (i) plants predicted to have the tenera shell phenotype, (i) plants predicted to have the dura shell phenotype, or (iii) plants predicted to have the pisifera shell phenotype; a method for predicting the shell phenotype of a palm plant or seed, the method comprising, (a) determining from a nucleic acid sample from the palm plant or seed the presence, absence, or number of pisifera or dura alleles by detecting the genotype of at least one polymorphic marker encoding one or more amino acids of a SHELL polypeptide; and (b) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles; a method for segregating a plurality of palm plants into different categories based on predicted shell phenotype, the method comprising, (a) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles by detecting the genotype of at least one polymorphic marker encoding one or more amino acids of a SHELL polypeptide; and (b) segregating the plants into groups based on the genotype of the polymorphic marker, wherein at least one group only contains one of (i) plants predicted to have the tenera shell phenotype, (i) plants predicted to have the dura shell phenotype, or (iii) plants predicted to have the pisifera shell phenotype; a kit for determining the shell phenotype of a palm plant, the kit comprising, one or more oligonucleotide primer or probe that comprises a sequence wherein the one or more primers or probes independently hybridize to a sequence of a position in exon 1 of the SHELL gene; an isolated nucleic acid comprising a polynucleotide encoding a polypeptide comprising a sequence, wherein the polynucleotide comprises a mutation relative to a wild-type, shAVROS, and shMPOB SHELL gene; an expression cassette comprising a heterologous promoter operably linked to a polynucleotide encoding a polypeptide comprising a sequence wherein the polynucleotide comprises a mutation relative to a wild-type, shAVROS, and shMBOP SHELL gene; a plant comprising a heterologous expression cassette, the expression cassette comprising a heterologous promoter operably linked to a polynucleotide encoding a polypeptide, wherein the polynucleotide comprises a mutation relative to a wild-type, shAVROS, and shMPOB SHELL; a plant comprising a heterologous expression cassette, the expression cassette comprising a promoter operably linked to a polynucleotide, which polynucleotide, when expressed in the plant, reduces the amount of a SHELL polypeptide in a nucleus of the plant (compared to a control plant lacking the expression cassette), wherein reduced amount of nuclear SHELL polypeptide results reduced shell thickness in the plant. However, these shared technical features do not represent a contribution over the prior art.

Specifically, US 2013/0247249 A1 to Malaysian Palm Oil Board discloses a method for predicting the shell phenotype of a palm plant or seed (Nucleic acid sequences for predicting and controlling shell phenotype in palm, Abstract; methods for determining the shell phenotype of a palm (e.g., oil palm) plant (including but not limited to a whole palm plant or palm seed) are provided., Para. [0009]), the method comprising: (a) determining from a nucleic acid sample from the palm plant or seed the presence, absence, or number of pisifera or dura alleles by (i) detecting a genotype of at least one polymorphic marker (the method comprises, providing a sample from the plant

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INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2016/037429

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: *Box IV, Lack of Unity of Invention*

or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]; b) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles (SEQ ID NO: 1 represents a SNP that is accurate in predicting shell phenotype 83% of the time. Said another way, using the SNP of SEQ ID NO: 1 as a genetic marker, one can correctly predict shell phenotype of palm plants, Para. [0067]); a method for segregating a plurality of palm plants into different categories based on predicted shell phenotype (Alternatively, one can identify and segregate plants based on their predicted shell genotype, allowing for selection and cultivation of fields of pure pisifera and dura trees, if desired, e.g., for later breeding purposes., Para. [0073]), the method comprising: (a) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles (Also provided is a method for segregating a plurality of palm (e.g., oil palm) plants into different categories based on predicted shell phenotype, Para. [0013]; the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]; The marker or the alleles of the gene responsible for the trait can be used to separate the dura, tenera and pisifera plants in the nursery, Para. [0054]) by: (i) detecting a genotype of at least one polymorphic marker (the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]) (c) segregating the plants into groups based on the genotype of the polymorphic marker (Alternatively, one can identify and segregate plants based on their predicted shell genotype, allowing for selection and cultivation of fields of pure pisifera and dura trees, if desired, e.g., for later breeding purposes., Para. [0073]), wherein at least one group only contains one of (i) plants predicted to have the tenera shell phenotype, (i) plants predicted to have the dura shell phenotype, or (iii) plants predicted to have the pisifera shell phenotype (Also provided is a method for segregating a plurality of palm (e.g., oil palm) plants into different categories based on predicted shell phenotype, Para. [0013]; the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]; The marker or the alleles of the gene responsible for the trait can be used to separate the dura, tenera and pisifera plants in the nursery, Para. [0054]); a method for predicting the shell phenotype of a palm plant or seed (Nucleic acid sequences for predicting and controlling shell phenotype in palm, Abstract; methods for determining the shell phenotype of a palm (e.g., oil palm) plant (including but not limited to a whole palm plant or palm seed) are provided., Para. [0009]), the method comprising, (a) determining from a nucleic acid sample from the palm plant or seed the presence, absence, or number of pisifera or dura alleles (The marker or the alleles of the gene responsible for the trait can be used to separate the dura, tenera and pisifera plants in the nursery, Para. [0054]); by detecting the genotype of at least one polymorphic marker encoding one or more amino acids of a SHELL polypeptide (Also provided is a method for segregating a plurality of palm (e.g., oil palm) plants into different categories based on predicted shell phenotype, Para. [0013]; the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]; and (b) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles (the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]); a method for segregating a plurality of palm plants into different categories based on predicted shell phenotype (Alternatively, one can identify and segregate plants based on their predicted shell genotype, allowing for selection and cultivation of fields of pure pisifera and dura trees, if desired, e.g., for later breeding purposes., Para. [0073]), the method comprising, (a) predicting the shell phenotype of the palm plant based on the presence, absence, or number of pisifera or dura alleles (Also provided is a method for segregating a plurality of palm (e.g., oil palm) plants into different categories based on predicted shell phenotype, Para. [0013]; the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]; The marker or the alleles of the gene responsible for the trait can be used to separate the dura, tenera and pisifera plants in the nursery, Para. [0054]); by detecting the genotype of at least one polymorphic marker encoding one or more amino acids of a SHELL polypeptide (the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]; SEQ ID NO:8222 represents the predicted amino acid sequence of the N-terminal 181 amino acids of the protein expressed in oil palm of the pisifera fruit type that is derived from the Nigerian line, Para. [0059]); and (b) segregating the plants into groups based on the genotype of the polymorphic marker (Alternatively, one can identify and segregate plants based on their predicted shell genotype, allowing for selection and cultivation of fields of pure pisifera and dura trees, if desired, e.g., for later breeding purposes., Para. [0073]), wherein at least one group only contains one of (i) plants predicted to have the tenera shell phenotype, (i) plants predicted to have the dura shell phenotype, or (iii) plants predicted to have the pisifera shell phenotype (Also provided is a method for segregating a plurality of palm (e.g., oil palm) plants into different categories based on predicted shell phenotype, Para. [0013]; the method comprises, providing a sample from the plant or seed; and determining from the sample the genotype of at least one polymorphic marker in the genomic region corresponding to SEQ ID NO:8218, wherein heterozygosity within the region indicates the presence of the tenera shell phenotype, Para. [0010]; The marker or the alleles of the gene responsible for the trait can be used to separate the dura, tenera and pisifera plants in the nursery, Para. [0054]); a kit for determining the shell phenotype of a palm plant (Also provided are kits for determining the shell phenotype of a palm seed or plant., Para. [0014]), the kit comprising, one or more oligonucleotide primer or probe that comprises a sequence wherein the one or more primers or probes independently hybridize to a sequence of a position in exon 1 of the SHELL gene (kit comprises, one or more oligonucleotide primer or probe that comprises:, Para. [0014]; a sequence of at least, e.g., 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, or 18 (or 20, 22, 24, or more) nucleotides of SEQ ID NO:8218, Para. [0015]; Primer sequences were confirmed to be unique in the reference pisifera genome, and to avoid any identified polymorphic nucleotides. A 5' M13 forward sequence tag was added to the Exon 1 forward PCR primer...SHELL exon 1, Para. [0146]); an isolated nucleic acid comprising a polynucleotide encoding a polypeptide comprising a sequence (An isolated nucleic acid comprising a polynucleotide encoding a polypeptide, Para. [0023]), wherein the polynucleotide comprises a mutation relative to a wild-type, shAVROS, and shMPOB SHELL gene (The DNA sequence change associated with the pisifera fruit form in shMFOB results in a leucine to proline amino acid change in the conserved DNA binding and dimerization domain, while the DNA sequence change associated with the pisifera fruit form in >shAvRos results in a lysine to asparagine amino acid change

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: *Box IV, Lack of Unity of Invention*

only two amino acids removed, Para. [0142]); an expression cassette (expression cassettes, Para. [0095]) comprising a heterologous promoter operably linked to a polynucleotide encoding a polypeptide comprising a sequence wherein the polynucleotide comprises a mutation relative to a wild-type, shAVROS, and shMBOP SHELL gene (under control of a heterologous promoter in the plant, Para. [0077]; The DNA sequence change associated with the pisifera fruit form in shMFOB results in a leucine to praline amino acid change in the conserved DNA binding and dimerization domain, while the DNA sequence change associated with the pisifera fruit form in >shAvRos results in a lysine to asparagine amino acid change only two amino acids removed, Para. [0142]; carried either the ShDeliDura, shAvRos or shMPOB alleles in exon 1, Para. [0144]); a plant comprising a heterologous expression cassette (Also provided is a cell or seed or plant comprising a heterologous expression cassette, the expression cassette comprising a heterologous promoter operably linked to a polynucleotide encoding a polypeptide comprising a sequence substantially (e.g., a least 80, 85, 90, 95, 97, 98, 99%) identical or identical to SEQ ID NO:8220, 8221, or 8222., Para. [0024]), the expression cassette comprising a heterologous promoter operably linked to a polynucleotide encoding a polypeptide (Also provided is a cell or seed or plant comprising a heterologous expression cassette, the expression cassette comprising a heterologous promoter operably linked to a polynucleotide encoding a polypeptide comprising a sequence substantially (e.g., a least 80, 85, 90, 95, 97, 98, 99%) identical or identical to SEQ ID NO:8220, 8221, or 8222, Para. [0024]), wherein the polynucleotide comprises a mutation relative to a wild-type, shAVROS, and shMPOB SHELL (under control of a heterologous promoter in the plant, Para. [0077]; The DNA sequence change associated with the pisifera fruit form in shMFOB results in a leucine to praline amino acid change in the conserved DNA binding and dimerization domain, while the DNA sequence change associated with the pisifera fruit form in >shAvRos results in a lysine to asparagine amino acid change only two amino acids removed, Para. [0142]; carried either the ShDeliDura, shAvRos or shMPOB alleles in exon 1, Para. [0144]); a plant comprising a heterologous expression cassette (Also provided is a cell or seed or plant comprising a heterologous expression cassette, the expression cassette comprising a heterologous promoter operably linked to a polynucleotide encoding a polypeptide comprising a sequence substantially (e.g., a least 80, 85, 90, 95, 97, 98, 99%) identical or identical to SEQ ID NO:8220, 8221, or 8222., Para. [0024]), the expression cassette comprising a promoter operably linked to a polynucleotide (Also provided is a cell or seed or plant comprising a heterologous expression cassette, the expression cassette comprising a heterologous promoter operably linked to a polynucleotide encoding a polypeptide comprising a sequence substantially (e.g., a least 80, 85, 90, 95, 97, 98, 99%) identical or identical to SEQ ID NO:8220, 8221, or 8222., Para. [0024]), which polynucleotide, when expressed in the plant, reduces the amount of a SHELL polypeptide in a nucleus of the plant compared to a control plant lacking the expression cassette, wherein reduced amount of nuclear SHELL polypeptide results reduced shell thickness in the plant (Also provided is a cell or seed or plant comprising a heterologous expression cassette, the expression cassette comprising a promoter operably linked to a polynucleotide, which polynucleotide, when expressed in the seed or plant, reduces expression of a SHELL polypeptide in the seed or plant (compared to a control plant lacking the expression cassette), wherein reduced expression of the SHELL polypeptide results in reduced shell thickness of the future seeds produced by the plant, Para. [0025]).

The inventions listed in Groups I+ therefore lack unity under Rule 13 because they do not share a same or corresponding special technical features.

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Continuation of: *Box V, part 2*

(iii) WO 2015/010008 A1 to Malaysian Palm Oil Board discloses methods, compositions, and kits for determining SHELL genotype and predicting shell fruit form of oil palm plants (Abstract) by testing the shell fruit form of a plant which can be accurately predicted by assaying for the presence of the three naturally occurring SHELL alleles (Para. [0046]) because the reagents that distinguish between SHELL genotypes are oligonucleotides (rather than proteins as described above) that are specific for one or more SHELL alleles, or specific for a polymorphism that is linked to one or more SHELL alleles (Para. [0058]), but fails to explicitly disclose SEQ ID NO: 12.

Claims 1-3 and 50-53 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.