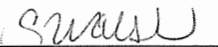


I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being transmitted via the Office electronic filing system in accordance with 37 CFR § 1.6(a)(4).

Dated: 9/8/16 Signature: 
(Sarah Walsh)

Docket No.: 091876-0014

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:	:	Customer Number: 23630
Willem Hendrik Lindhout, et al.	:	
	:	
Application No.: 13/504,156	:	Confirmation No.: 6337
	:	
Filed: July 10, 2012	:	Art Unit: 1663
	:	
For: Hybrid Seed Potato Breeding	:	Examiner: Russell T. Boggs

Mail Stop – Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT IN RESPONSE TO NON-FINAL OFFICE ACTION UNDER 37 C.F.R. 1.111

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

INTRODUCTORY COMMENTS

In response to the Office Action dated March 8, 2016, please amend the above-identified U.S. as directed herein. A Petition for Extension of Time (3 months), a Statement relating to deposited biological material, a Declaration under 37 CFR 1.132, a response to information requested under 37 CFR 1.105 and an Information Disclosure Statement are concurrently filed herewith. Reconsideration and further examination of the present application is requested in light of the following:

Amendments to the Abstract begin on Page 2.

Amendments to the Specification begin on Page 3.

Amendments to the Claims begin on Page 6.

Remarks/Arguments begin on Page 16.

AMENDMENTS TO THE ABSTRACT

In the following amendment to the abstract, ~~deletions are shown with strike through~~, and additions are underlined.

Please amend the abstract as follows:

The present invention relates to diploid, fertile, self-compatible and essentially homozygous potato lines, wherein said lines comprise an agronomically desirable trait such as vigour. The invention further relates to methods for producing such plants and to hybrid seeds obtained by crossing such homozygous potato lines and to potato plants grown from said ~~see~~ seed.

AMENDMENTS TO THE SPECIFICATION

In the following amendment to the specification, ~~deletions are shown with strike through~~, and additions are underlined.

Please amend the paragraph at page 52, lines 19-23 as follows:

All markers showed a high frequency of occurrence in the diploid potato germplasm used in this experiment (Figure 9). The heterozygote frequency in the germplasm by ~~using~~ using these 100 markers ranged from 26% to 77%, while the *Sli* gene donor was 100% homozygous as is in accordance with expectations (Phumichai et al. 2005 Genome 48: 977-984).

Please amend the paragraph at page 37, lines 5-19 as follows:

The present inventors used the strategy of repeated selfing, backcrossing and crossing of potato germ plasm of a single self-compatible potato line and one or more self-incompatible potato lines harbouring agronomic traits. The homozygous plants of the present invention were obtained by continuous selfing of diploid potato plants and selection for fertile offspring (besides the inherent selection for self-compatibility). This is an entirely new approach, as in the prior art methods, plants are obtained by selection for agronomical traits, such as tuber formation or general growth characteristics of the offspring plants, not by selection for fertile offspring from selfings. Moreover, and unlike the prior art methods the procedures are performed using diploid plant lines, instead ~~to~~ of tetraploid plants. Unexpectedly, this radically new approach proved successful for obtaining increasingly homozygous, diploid offspring plants, that were ~~self-compatible~~ self-compatible and fertile. In addition, when (out)crossed with plants of diploid lines harbouring beneficial traits, such as resistance or white tuber color, these traits could be introduced into the essentially homozygous germ plasm without loss of self-compatibility and fertility.

Please amend the paragraph at page 33, lines 11-22 as follows:

Plants according to the present invention include the line with breeders reference AGVD1, representative seeds of said line having been deposited on 23 October 2009 with the NCIMB, Ferguson Building, Craibstone Estate, Bucksburn, Aberdeen, AB219YA, Scotland under accession

number NCIMB 41663 and breeders reference AGVD1, which plant represents an F2 obtained by crossing a plant of parent IVP07-1001/4 (see Example 1), which is an essentially homozygous, diploid, fertile and self-compatible but non-vigorous potato line with a plant of parent D1, which is an elite diploid breeding clone that is essentially non-homozygous, and is not self-compatible, but which has the desirable agronomic trait of yellow flesh color and exhibits good cooking quality in that the flesh is not greying after cooking, and selfing the resulting F1 offspring plants. It is estimated that AGVD1 is about 50% homozygous, meaning that about 50% of the loci for which the parents differ are homozygous.

Please amend the paragraph at page 33, lines 23-31 as follows:

Plants according to the present invention also include the line with breeders reference AGVD2, representative seeds of said line having been deposited on 23 October 2009 with the NCIMB, Ferguson Building, Craibstone Estate, Bucksburn, Aberdeen, AB219YA, Scotland under accession number NCIMB 41664 and under breeders reference AGVD2, which line represents an (F1 x F1) line (or pseudo F2) obtained by crossing a plant of parent IVP07-1001/4 as indicated above with a plant of parent D1 as indicated above, and mutually crossing individual F1 offspring plants, that share the IVP07-1001/4 parent but have different individuals of the D1 parent. It is estimated that AGVD2 is about 25% homozygous for the loci for which the parents differ.

Please amend the paragraph bridging pages 33 and 34 as follows:

Plants according to the present invention also include the line with breeders reference AGVD3, representative seeds of said line having been deposited on 23 October 2009 with the NCIMB, Ferguson Building, Craibstone Estate, Bucksburn, Aberdeen, AB219YA, Scotland under accession number NCIMB 41665 and under breeders reference AGVD3, which line represents a BC1 population obtained by crossing a plant of parent IVP07-1001/4 as indicated above with a plant of parent D 1 as indicated above, and backcrossing the resulting F1 offspring plants with the IVP07-1001/4 parent. It is estimated that AGVD3 is about 75% homozygous for the loci for which the parents differ.

Please amend the paragraph at page 34, lines 7-14 as follows:

Plants according to the present invention also include the line with breeders reference AGVD17, representative seeds of said line having been deposited on 5 October 2010 with the NCIMB, Ferguson Building, Craibstone Estate, Bucksburn, Aberdeen, AB219YA, Scotland under accession number NCIMB 41765 and under breeders reference AGVD17, which line represents an F3 population obtained by crossing a plant of parent IVP07-1001/4 as indicated above with a plant of parent D2 as indicated above, and backcrossing the resulting F1 offspring plants with the IVP07-1001/4 parent, followed by two steps of selfing. It is estimated that AGVD17 is > 80% homozygous for the loci for which the parents differ.

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A diploid, fertile, self-compatible and essentially homozygous potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber bearing ~~Solanum~~ Solanum species crossable to *Solanum tuberosum*, said potato line comprising a plant[[s]] having ~~an average~~ a tuber yield expressed in grams of fresh weight of at least 200 grams ~~per plant~~; wherein at least 50% of [[the]] loci in said plant[[s]] are homozygous, wherein said self-compatibility originating from *Solanum chacoense* as present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively, ~~wherein self-compatibility in said potato line is introduced from tuber-bearing self-compatible *Solanum* species crossable to *S. tuberosum*,~~ and wherein at least 25% of the plants of said line produce seed-carrying berries.
2. (Cancelled)
3. (Currently Amended) The potato line of claim 1, wherein said plant of said line, in addition to said tuber yield, comprises at least one agronomically desirable trait [[is]] selected from the group consisting of insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color [[or]] and cold-sweetening resistance.
4. (Currently Amended) The potato line of claim 1, wherein said plant[[s]] of said line, when mature, attains ~~an average~~ a fresh weight of the foliage and shoots of at least 500 grams ~~per plant~~.
5. (Currently Amended) A plant of [[a]] the line according to claim 1.
6. (Currently Amended) ~~Seeds~~ A seed or tuber[[s]] of a plant according to claim 5.

7. (Cancelled)

8. (Currently Amended) A method for producing a diploid, fertile, self-compatible and essentially homozygous potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line comprising a plant[[s]] having ~~an average~~ a tuber yield expressed in grams of fresh weight of at least 200 grams ~~per plant~~, comprising:

(a) providing a first potato plant, which first potato plant is a plant of a diploid, fertile, self-compatible and essentially homozygous potato line ~~of the species *Solanum tuberosum* or *Solanum tuberosum*~~ comprising introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*, ~~wherein self-compatibility in said *Solanum tuberosum* potato line is introduced from tuber bearing self-compatible *Solanum* species crossable to *S. tuberosum*, obtained by selfing said a plant of diploid, self-compatible~~ plant of said diploid, self-compatible potato line for at least 3 times while selecting for plants that produce fertile offspring, wherein said self-compatibility originates from *Solanum chacoense* as present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively, to thereby provide a first potato plant of a first diploid, self-compatible, fertile and essentially homozygous potato line,

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid ~~or tetraploid~~ potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line which may have any level of homozygosity, said line of said second potato plant comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant;

(c) cross pollinating said first and second potato plant to provide a seed[[s]] and collecting said seed[[s]] to thereby provide a hybrid offspring seed;

(d) growing said hybrid offspring seed into a population of hybrid offspring potato plants and selecting from said population plants producing tubers at a yield expressed in grams of fresh weight of at least 200 grams per plant, and

(e) selfing said hybrid offspring potato plants or backcrossing said hybrid offspring potato plant to a potato plant of said line of said first potato plant, for between 1 to 8 selfings or backcrosses, and selecting for plants that produce fertile offspring, to thereby provide a diploid, fertile, self-compatible and essentially homozygous potato breeding line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line comprising a plant[[s]] having an average a tuber yield expressed in grams of fresh weight of at least 200 grams ~~per plant~~;

and wherein at least 50% of [[the]] loci in the plant[[s]] provided in step (e) are homozygous.

9. (Currently Amended) The method of claim 8, ~~wherein said steps (a)-(e) are repeated and~~ wherein step (b) comprises the provision of a second potato plant, wherein said second potato plant is a donor for an additional agronomically desirable trait, wherein said trait is insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color or cold-sweetening resistance.

10. (Cancelled)

11. (Currently Amended) The method of claim 8, wherein said first potato plant is a plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said line having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively.

12. (Currently Amended) The method of claim 8, wherein said second potato plant is ~~[[a]]~~ the plant of a second diploid, fertile, self-compatible and essentially homozygous potato line.

13. (Currently Amended) The method of claim 8, wherein said second potato plant is ~~[[a]]~~ the plant of a second diploid, fertile, self-incompatible potato line.

14-15. (Cancelled)

16. (Currently Amended) A method for producing a uniform hybrid potato seed, comprising:

(a) providing a first potato plant, which first potato plant is a plant of a first diploid, fertile, self-compatible and essentially homozygous potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said first potato plant having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant; wherein at least 50% of ~~[[the]]~~ loci in said first potato plant are homozygous; and wherein said self-compatibility originates from *Solanum chacoense* as present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively, and wherein self-compatibility in said potato line is introduced from tuber-bearing self-compatible *Solanum* species crossable to *S. tuberosum*,

(b) providing a second potato plant, wherein said second potato plant is a plant of a second diploid or tetraploid, fertile, self-compatible and essentially homozygous potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said second potato plant having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant; wherein at least 50% of ~~[[the]]~~ loci in said second potato plant are homozygous; and wherein said self-compatibility originates from *Solanum chacoense* as present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or

NCIMB accession number 41765, representative seeds of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively, and wherein self-compatibility in said potato line is introduced from tuber-bearing self-compatible *Solanum* species crossable to *S. tuberosum*, and wherein said first and second plant contain at least 20 % contrasting homozygous loci as determined by molecular marker analysis, and

(c) cross pollinating said first and second potato plant and allowing one of said parent plants to produce berries with seeds and collecting said seeds from said berries to provide a hybrid offspring seed.

17. (Cancelled)

18. (Previously Presented) Method according to claim 16, wherein at least one of said first and second potato plants comprises at least one agronomically desirable trait selected from the group consisting of insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color and cold-sweetening resistance.

19. (Currently Amended) The method of claim 16, wherein said first potato plant is a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said lines having been deposited with the NCIMB, Aberdeen, Scotland, ~~or a diploid, self-compatible and essentially homozygous offspring potato plant thereof, wherein said diploid, self-compatible and essentially homozygous offspring plant is of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*.~~

20. (Currently Amended) The method of claim 16, wherein said second potato plant is a plant of a second diploid or tetraploid, self-compatible and essentially homozygous potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said second potato line comprising

an additional agronomically desirable trait; and wherein said trait is insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color or cold-sweetening resistance.

21. (Currently Amended) A seed of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said line having been deposited with the NCIMB, Aberdeen, Scotland.
22. (Previously Presented) A seed produced by the method of claim 16.
23. (Currently Amended) A hybrid potato plant, or part thereof, produced by growing the seed of claim [[16]] 22.
24. (Previously Presented) Pollen or an ovule of the plant of claim 23.
25. (Previously Presented) A tuber from the plant of claim 23.
26. (Previously Presented) A potato plant having all of the physiological and morphological characteristics of the plant of claim 23.
27. (Previously Presented) A tissue culture of the plant of claim 23.
28. (Previously Presented) A potato plant regenerated from the tissue culture of claim 27.
29. (Currently Amended) A method for producing a hybrid potato seed wherein the method comprises crossing a first potato plant with a second potato plant and harvesting a hybrid potato seed resulting from said crossing, wherein said first or second parent potato plant is the potato plant of claim 5 or claim 38, wherein said first and second parent potato have at least 20 % contrasting homozygous loci as determined by molecular genetic marker analysis.

30. (Previously Presented) A method of producing a hybrid potato plant, said method comprising producing a seed according to a method of claim 16 and growing said seed into a potato plant.
31. (Previously Presented) A potato plant produced by the method of claim 30, or a tuber thereof.
32. (Currently Amended) A set of 2 homozygous diploid, fertile, self-compatible and essentially homozygous potato lines of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum* according to claim 1 for intercrossing, wherein each of said lines differ from another line in said set by having at least 20 % contrasting homozygous loci as determined by molecular genetic marker analysis; and wherein at least 50% of [[the]] loci in said plants are homozygous.
33. (Cancelled)
34. (Currently Amended) A hybrid potato seed which seed, when sown produces a diploid, fertile, self-compatible and essentially heterozygous potato plant of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, said plant being obtained by:
- (a) providing a first diploid, fertile, self-compatible and essentially homozygous potato line comprising plants of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, wherein at least 50% of [[the]] loci in a plant of said first potato line are homozygous; wherein said self-compatibility originates from *Solanum chacoense* as present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB

accession number 41665, or NCIMB accession number 41765, representative seeds of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively ~~and wherein self-compatibility in said first potato line is introduced from tuber-bearing self-compatible *Solanum* species crossable to *S. tuberosum*;~~

(b) providing a second diploid, fertile, self-compatible and essentially homozygous potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, wherein said first and second plant contain at least 20 % contrasting homozygous loci as determined by molecular marker analysis, and wherein at least 50% of [[the]] loci in a plant of said second potato line are homozygous; wherein said self-compatibility originates from *Solanum chacoense* as present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds, of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively, ~~and wherein self-compatibility in said second potato line is introduced from tuber-bearing self-compatible *Solanum* species crossable to *S. tuberosum* and~~

(c) cross pollinating said first and second potato plant and allowing at least one of said parent plants to produce berries with seeds and collecting said seeds from said berries to provide a hybrid offspring seed.

35. (Currently Amended) A method for producing a diploid, fertile, self-compatible and essentially homozygous potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, comprising:

(a) providing a first potato plant, which first potato plant is a plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said line having been deposited with the

NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively;

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid or tetraploid potato line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line which may have any level of homozygosity, said line of said second potato plant comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant;

(c) cross pollinating said first and second potato plant to provide seeds and collecting said seeds to thereby provide a hybrid offspring seed;

(d) growing said hybrid offspring seed into a population of hybrid offspring potato plant and selecting from said population plants producing tubers at a yield expressed in grams of fresh weight of at least 200 grams per plant, and

(e) selfing said hybrid offspring potato plant or backcrossing said hybrid offspring potato plant to a potato plant of said line of said first potato plant, for between 1 to 8 selfings or backcrosses, to thereby provide a diploid, fertile, self-compatible and essentially homozygous potato breeding line of the species *Solanum tuberosum* or *Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*, said potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant;

and wherein at least 50% of [[the]] loci in a plant provided in step (e) are homozygous.

36. (Currently Amended) Starch, potato chips, or French fries produced from the tuber of any of claims [[5]] 6, 25 or 31.

37. (New) A tetraploid potato line produced by doubling the genome of a plant of claim 5.

38. (New) A plant of a tetraploid potato line according to claim 37.

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39. (New) The potato line according to claim 1, wherein at least 75% of loci in said plant of said line are homozygous.

REMARKS/ARGUMENTS

Status of Claims

Claims 1, 3-9, 11-16, 18-32 and 34-36 were pending in this application. Claims 1, 3-6, 8, 9, 11-13, 16, 19-21, 23, 29, 32 and 34-36 have been amended. Claims 7, 14 and 15 are canceled without prejudice. Claims 37-39 are newly added.

Basis for this amendment is present throughout the application as filed. For example, support for the amendment to claims 1, 8, 16, and 34 is found at page 6, lines 5-7, at page 10, lines 26-32, at page 32, lines 24-28, at page 37, lines 21-24, at page 46, lines 32 to page 47, line 2 and at Table 6).

Claims 1, 3-6, 8, 9, 11-13, 16, 19-21, 23, 29, 32 and 34-36 have been amended to correct informalities. No new matter is believed to be added herein.

Support for new claim 37 can be found *inter alia* at page 31, lines 6-15 and at page 40, lines 31 to page 41, line 3.

Abstract

The abstract has been amended to correct a spelling error. The amendments do not add new matter.

Specification

The specification has been amended to correct informalities. Spelling and typographical errors have been corrected and address of NCIMB regarding the deposits is included. The amendments do not add new matter.

Claim Objections

Claims 1, 4-9, 11-13, 19, 21 and 35 are objected to because of informalities.

A. Claim 1 is objected to for the following reasons: (1) “plants” referred in plural rather than reading on a single plant, (2) *S. tuberosum* is not italicized, (3) *Solanum* is not italicized and (4) the recitation of the word “species”

Claim 1 is amended to correct the informalities.

B. Claim 4 is objected to because it refers to the “plants” in plural.

Claim 4 is amended to recite the word “plant” in singular.

C. Claim 5 is objected to because of recitation of the phrase “a line according to claim 1”.

Claim 5 is amended to recite the phrase “the line...” instead of “a line....”.

D. Claim 7 is objected to because it refers to the “seeds” in plural.

Claim 7 is cancelled.

E. Claim 8 is objected to for the following reasons: (1) recites in plural “seeds” rather than a singular composition, (2) the phrase “said hybrid offspring potato plant” lacks antecedent basis, (3) the recitation of the phrase “the plants”, (4) the recitation of the phrase “tuber-bearing” and (5) the recitation of the phrase “a first potato plant”.

Claim 8 is amended to correct the informalities.

F. Claim 9 is objected to because of recitation of the phrase “wherein said steps (a)-(e) are repeated”.

Claim 9 is amended to delete the phrase “wherein said steps (a)-(e) are repeated”.

G. Claim 11 is objected to because the word “accession number” is missing.

Claim 11 is amended to include the word “accession number” between “NCIMB” and each of “41663”, “41664”, “41665” and “41765”.

H. Claims 12 and 13 are objected to because of the recitation of the phrase “a second diploid”.

Claims 12 and 13 are amended to replace the phrase “a second diploid” with the phrase “the second diploid”.

I. Claim 19 is objected to because the word “accession number” is missing.

Claim 19 is amended to include the word “accession number” between “NCIMB” and each of “41663”, “41664”, “41665” and “41765”.

J. Claim 21 is objected to because the word “accession number” is missing.

Claim 21 is amended to include the word “accession number” between “NCIMB” and each of “41663”, “41664”, “41665” and “41765”.

K. Claim 35 is objected to because the word “accession number” is missing.

Claim 35 is amended to include the word “accession number” between “NCIMB” and each of “41663”, “41664”, “41665” and “41765”.

Reconsideration and withdrawal of objection are respectfully requested.

Rejections under 35 U.S.C. § 112, second paragraph

Claims 1, 3-9, 11-16, 18-20, 22-32 and 34-36 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite, for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

A. According to the Examiner, claims 1, 8, 14, 15, 16, 19, 20, 32, 34 and 35 are indefinite in their recitation of “*Solanum tuberosum* comprising introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*”, since it appears to require that the plant have some relationship to *Solanum tuberosum* but the extent of that relationship is indefinite.

Claims 14 and 15 have been cancelled. Claims 1, 8, 16, 19, 20, 32, 34 and 35 are amended for clarity purposes.

B. According to the Examiner, claims 1, 8, 16, 32, 34 and 35 are indefinite in the recitation of “the loci”, as there is insufficient antecedent basis.

For clarity purposes, the phrase “the loci” is amended to “loci” in claims 1, 8, 16, 32, 34 and 35.

C. According to the Examiner, claim 3 is indefinite in the recitation of “said at least one agronomically desirable trait”, as there is insufficient antecedent basis.

For clarity purposes, the phrase “said at least one agronomically desirable trait” in claim 3 is replaced with “said plant of said line, in addition to said tuber yield, comprises at least one agronomically desirable trait”. Support for the basis of amendment to claim 3 can be found *inter alia* in the originally filed PCT claim 2.

D. According to the Examiner, claim 7 is indefinite in the recitation of “uniform hybrid potato seed”, as the specification fails to define the term and the term lacks a meaning in the art.

Claim 7 is cancelled.

E. According to the Examiner, claim 8 is indefinite in the recitation of “said hybrid offspring potato plant” and “said potato line”, as it lacks antecedent basis.

For clarity purposes, claim 8 is amended. Support for the basis of amendment to claim 8 can be found in the specification at page 37, lines 11-14 and 30-32.

F. According to the Examiner, claim 36 is indefinite in the recitation of “the tuber of any of claims 5, 25 or 31”, as there is no reference to a tuber in claim 5.

The phrase “the tuber of any of claims 5, 25 or 31” in claim 36 is amended to “the tuber of any of claims 6, 25 or 31”.

Reconsideration and withdrawal of rejection are respectfully requested.

Rejections under 35 U.S.C. § 112, first paragraph

A. Claims 1, 3-9, 11-16, 18-20, 22-32 and 34-36 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement.

According to the Examiner, the claims are broadly drawn to a diploid, fertile, self-compatible and essentially homozygous potato line, or a seed thereof, comprising plants that have an average tuber yield of at least 200 g/plant. Independent method claims 8, 16, 34 and 35 are drawn to a method to produce such a line and a method for producing a uniform hybrid potato seed. Dependent claims relate to, e.g., crosses made, adding agronomically desirable traits, and potato lines deposited with the NCIMB in Aberdeen, Scotland. According to the Examiner, the Applicant claims a large genus, whereas the instant application describes only four potato lines to use in the claimed methods that were created from the same line, the IVP07-1001/4 line.

Claims 7, 14 and 15 are cancelled. Claims 1, 3-6, 8, 9, 11, 16, 19, 20, 23, 29, 32 and 34-36 have been amended and limited to the species *S. tuberosum*.

The claimed self-compatible *S. tuberosum* lines originates from *Solanum chacoense* as present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds, of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively.

AGVD1, AGVD2, AGVD3 and AGVD17 represent four examples of *S. tuberosum* having various levels of homozygosity. It is clear from the application as filed that the Applicant has demonstrated the methods that can be used to produce (1) a diploid potato breeding line, (2) hybrid potato seed and (3) an offspring of a diploid potato breeding line of the species of *Solanum tuberosum*.

Reconsideration and withdrawal of rejection are respectfully requested.

B. Claims 1-32 are rejected under 35 U.S. C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the enablement requirement.

According to the Examiner, the specification does not disclose a repeatable process to obtain the plant and thus it is not apparent if the plant is readily available to the public.

Applicant asserts that the deposit of seeds was made under the Budapest Treaty. A Statement is submitted concurrently herewith by the Attorney of record stating that the instant invention will be readily available to the public upon the issuance of a patent.

Reconsideration and withdrawal of rejection are respectfully requested.

Rejections under 35 U.S.C. § 103

A. Claims 1, 3-9, 12-16, 18, 20, 22-26 and 29-34 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Jansky (“Breeding, Genetics, and Cultivar Development”, *Advances in Potato Chemistry and Technology*, ed. J. Singh & L. Kaur, pp. 27-62, June, 2009) in view of Phumichai et al. (*Genome* 48:977-84, 2005), in further view of Maris (*Euphytica* 46:15-33, 1990), Simmonds, (*Potato Res* 40:191-214, 1997), and in further view of Watanabe et al. (*Breed Sci* 46:329-36, 1996).

B. Claims 27 and 28 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Jansky, (“Breeding, Genetics, and Cultivar Development”, *Advances in Potato Chemistry and Technology*, ed. J. Singh & L. Kaur, pp. 27-62 , June, 2009) in view of Phumichai et al. (*Genome* 48:977-84, 2005), in further view of Maris (*Euphytica* 46:15-33, 1990), and in further view of Wang & Ran (*NZ J Crop Hart Sci* 28:1-8 , 2000).

The Examiner has concluded that it would have been obvious to a person of ordinary skill in the art to modify the teachings of the said prior art references to arrive at the claimed invention.

The rejection is principally based on the prior art disclosure (Jansky and Phumichai) that *Sli* gene originating from *Solanum chacoense* can be used to attain high levels of homozygosity in potato plants and the inbred plants can be used in heterosis breeding and to produce true potato seed and from Simmonds disclosure that diploid potato plants were at that time underutilized, therefore providing motivation to cultivate them and that heterosis produces a “spectacular” increase in yield. The Examiner has cited Maris and Watanabe as allegedly disclosing the claimed agronomically desirable traits.

Applicant respectfully disagrees. Without acquiescing to the merits of the rejection and solely to expedite prosecution, claims 1, 3-6, 8, 9, 12, 13, 16, 20, 23, 29, 32 and 34 have been amended and claims 7, 14 and 15 have been cancelled.

The Scope And Content Of The Prior Art

Prior art potato breeding methods:

The applicant herewith provides an overview of the prior art of potato breeding up to the priority date of the present application. In this, it will be emphasized that the skilled person would not arrive at the claimed subject-matter and that the steps of obtaining such a plant are not common in the breeding of cultivated or commercial potatoes of the species *Solanum tuberosum*.

Plant breeding can be divided into the “classical” methods of slowly enriching plant populations with beneficial characteristics and “hybrid” breeding, wherein homozygous parental inbred lines are developed and crossed to produce a commercial (F1) hybrid variety. In order to improve the F1 hybrid, the essentially homozygous parental lines may be improved by deliberate interbreeding (crossing) of closely or distantly related individuals to produce new germplasm whereby traits or genes from a donor line are introduced into the genetic background of a favored line with high agronomical or horticultural value.

Although hybrid breeding procedures are suitable and presently used for many crop species, for *Solanum tuberosum*, the current breeding process is not a hybrid breeding process, but a process of crossing highly heterozygous tetraploid parental lines and selecting from tens or hundreds of thousands of offspring plants the new and improved germplasm. This process is excessively labor intensive and time consuming as explained in the introductory part of the description of the application as filed. Still, potato breeding on a commercial level occurs in this way, primarily because hybrid breeding methods have proven unsuccessful (see below). Although a large number of new varieties have been developed, today's potato industry is still dominated by two potato varieties that were developed a century ago: Bintje (1904) in (parts of) Europe and Russet Burbank (1876) in North America. Methods of potato breeding have not changed much in the 20th century.

Hybrid breeding in *Solanum tuberosum* has not been possible up to the present invention. While at the tetraploid level the provision of homozygous inbred lines is prevented due to inbreeding depression (*see* introduction of Uijtewaal, Euphytica, 36: 745-753, 1987, IDS filed concurrently), homozygous inbred lines have not been obtained at the diploid level due to both inbreeding depression and self-incompatibility (*see* Watanabe at introduction). However such essentially homozygous lines are pivotal in allowing the introduction of new traits into *S. tuberosum* germplasm. There are presently a large number of traits available for potato breeding, for instance for resistance to phytophthora, but such traits cannot be included in the present commercial germplasms.

Hence, there is a long felt need for improved methods of breeding *S. tuberosum*. One of the preferred, but unavailable, methods is that of hybrid breeding using essentially homozygous parental lines of *S. tuberosum*, also evidenced by the wish expressed in Jansky's publication, which was quickly downplayed as commercially unfeasible due to "dramatic reductions in fertility and vigor", while referring to Phumichai, both publications currently being used by the Examiner in the obviousness rejection. Jansky refers to sibling mating as an attractive alternative to hybrid breeding, thereby suggesting – and further establishing the prejudice argued herein below – to stay clear of hybrid breeding in *S. tuberosum*.

Inbreeding:

Apart from exhibiting the complex tetrasomic inheritance, *S. tuberosum* breeding also suffers from the inbreeding depression. One of the earliest publications on potato breeding is by Krantz (*see* Krantz, Technical Bulletin 25, Dec 1924, IDS filed concurrently). This reference advocates the use of self-fertilization or inbreeding that is successfully used in other crops. Krantz summarizes as follows:

"Inbreeding studies on maize by East (5) and Shull (41, 42, 43, 44) suggested to these investigators the value of selection in self-fertilized lines of normally cross-pollinated crop as a means for their improvement. [...]. In a vegetatively propagated crop such as the potato, in which the resultant heterozygous F1 individuals can be propagated indefinitely, the method would appear to be particularly appropriate. Furthermore, the almost total absence of desirable parents among our present potato varieties which produce viable pollen, makes it imperative to utilize some method to secure the parents necessary for a basis for potato breeding work."
[emphasis added, *see* Krantz at pages 23-24 under the section titled "Selection in self-fertilized lines"].

It is thus clear that in 1924, some 90 years ago, inbreeding in *S. tuberosum* was advocated as a valuable and necessary course, but that there were problems with producing fertile offspring. This is just one indication of the presence of a long felt need. In consecutive sections of his book chapter, Krantz describes the effect of the inbreeding strategy on heterozygosity, vigor and fertility, and discloses the following:

"Improved varieties that are dependable as pollen parents are a necessary requisite to any great improvement in the potato varieties of this country. Selection in self-fertilized lines is the best method of obtaining such varieties." [emphasis added, see Krantz at page 29 under the section titled "Conclusions"].

Thus, in 1924 there was already a strong scientific motivation to use inbreeding in potato breeding methods. However, 60 years onward, Jackson et al. in 1984 were not able to report more than that "inbreeding in potatoes presents a considerable challenge, but one for which the potential rewards are great." (see Jackson, 1984, Report of the XXVIII Planning Conference, IDS filed concurrently). Hence, despite the rewards and the suggestion of inbreeding strategies 60 years earlier, there were no such breeding results to report in 1984 due, at large, to inbreeding depression.

Tetraploid *S. tuberosum* is a natural reservoir for deleterious and lethal alleles. Although tolerated in tetraploids via dominance and epistatic interactions, this genetic burden causes inbreeding depression when homozygosity is increased (see Birhman, Genome, 43, 495-502, 2000, IDS filed concurrently). The exact mechanism of this phenomenon is not known, but it is considered that homozygous expression of deleterious genes upon inbreeding is the cause of the very weak and infertile plants of which the seedlings are addressed as "... having small, gnarly, absolutely worthless tubers" (see Krantz at page 24 under the section titled "Effect of inbreeding on heterozygosity").

Diploids:

Following the first description of genetically less complex diploid wild *Solanum* species (*S. chacoense*, *S. phureja*, *S. stenotomum*, etc.) and even diploid *S. tuberosum* clones in the late fifties (see Hougas, Am. Potato Journal, 35: 701-707, 1958, IDS filed concurrently) the use of cultivated

diploid *Solanum* species was implemented in potato breeding (*see* Haynes, Symposium, 1972, IDS filed concurrently).

Initially, potato dihaploids ($2n = 2x = 24$ = diploid *S. tuberosum*) were envisioned as a tool to simplify the breeding of *S. tuberosum* cultivar production by reducing tetraploid germplasm to a diploid breeding level. Hougas already indicated in 1958 that such diploids are of interest to plant breeders primarily because they would present a rapid method for obtaining a high degree of homozygosity, and that the use of chromosome doubling in monoploids (haploids derived from diploid species) would result in completely homozygous individuals.

One should bear in mind, however, that, although not as a result from self-fertilization, these diploid *S. tuberosum* clones also suffer from inbreeding depression, due to the reduction of the tetraploid genome to the diploid level via haploidization (*see* Uijtewaal at pages 745-746 under the section titled "Introduction" and at pages 750-752, under the section titled "Discussion"). Such diploid *S. tuberosum* clones are weak and feeble plants, produce hardly any tubers (*see* Uijtewaal at page 750, Fig. 1) and cannot be selfed (*see* Uijtewaal at page 752, fourth paragraph), i.e., such dihaploids are self-incompatible. This self-incompatibility means that selfed plants do not form berries upon self-fertilization, or that berries do not contain viable seeds after selfing. Despite the fact that these diploid *S. tuberosum* breeding programs were proposed some 55 years ago by Hougas, they have never resulted in vigorous fertile homozygous diploid *S. tuberosum* lines before the present invention due to self-incompatibility and inbreeding depression.

A second motive for the production of diploids was to acquire a 'genetic bridge' between the genomes of the various *Solanaceae* species. By this technique, ploidy barriers between cultivated *S. tuberosum* and wild *Solanum* species could be circumvented by reducing tetraploid *S. tuberosum* to the diploid level and crossing the resultant dihaploids to the wild diploid *Solanum* spp. In the background of this wild diploid *Solanum* spp material, the *S. tuberosum* genes can be recombined to a beneficial constitution. Novel germplasm is then incorporated back into tetraploid *S. tuberosum* breeding programs via sexual crosses between tetraploid *S. tuberosum* and colchicine-doubled *S. tuberosum* diploids, or through $4x-2x$ crosses utilizing unreduced gamete formation. This breeding strategy is indicated as "germplasm enhancement", which is basically a diploid breeding scheme

using wild *Solanum* relatives to prepare a desired combination of genes, and then to elevate this back to the tetraploid level of cultivated *S. tuberosum*. This breeding strategy is also described by Maris, Hermundstad and Watanabe.

Watanabe is an example of such a potato breeding scheme through germplasm enhancement. The aim of the scientific research described in Watanabe is to use potato diploids as a genetic bridge to transfer resistance genes to tetraploid *S. tuberosum*. This is a two-step process whereby in the first step resistance genes are transferred from the wild donor species into diploid *S. tuberosum* by crossing and selections of the resistant diploid *S. tuberosum* in the progenies of such crosses. In the second step the resistance is transferred from resistant diploid *S. tuberosum* genotypes into tetraploid *S. tuberosum* by crossings via the production of unreduced gametes (2n) in the diploids. The resulting tetraploid plants can be further crossed with commercial tetraploid breeding germplasm to combine favourable agricultural traits from the tetraploids with the resistance gene originating from the wild *Solanum* species. Watanabe is not the first publication wherein germplasm enhancement is described. Hougas already expressed this idea in 1958 and combining useful genes for classic potato breeding through germplasm enhancement is a major line of research ever since, as indicated by Maris and Hermundstad. However, these *S. tuberosum* diploids are not essentially homozygous.

Homozygous diploids:

As indicated above under the section titled 'Diploids', one of the foreseen advantages of diploids (or dihaploids as they are also called for *S. tuberosum*) was that they could rapidly provide for a high degree of homozygosity.

Homozygous diploids of potato can in principle be obtained by one of two ways:

1. Doubling haploids (*see* Uijtewaal), wherein the haploids are for instance obtained by ovule culture or anther culture (*see* Jacobsen, Theor. Appl. Genet, 52: 119-123, 1978, IDS filed concurrently), or
2. Repeated selfings using the *S. chacoense Sli* gene (*see* Phumichai).

Of the 2 methods above, only doubling of haploids (1) has successfully resulted in the production of homozygous diploids of *S. tuberosum*. As noted earlier, although some improvement in tuber yield could be obtained in the case of using doubled haploids (*see* Uijtewaal at page 750, Fig. 1 and page 746, Table 1), this is not nearly the 200 g/plant as present in a plant obtained by the method of claim 8, and, furthermore, these plants were essentially infertile (*see* Uijtewaal at page 752, third paragraph).

In contrast, the inbreeding technique reported by Phumichai for obtaining homozygous potatoes is NOT performed with *S. tuberosum*. The plants of Phumichai are not *S. tuberosum* plants but a mixture of the genomes of three wild relatives *S. chacoense*, *S. phureja*, and *S. stenotomum*. The *Sli* gene donor, clone F1-1, is also not an *S. tuberosum* plant but an interspecific hybrid between a highly inbred clone (S7) of *S. chacoense* and a cultivated diploid *S. phureja* clone (*see* Birhman). The F1 (S0) clone 94H87 is a cross between the *Sli* gene donor clone F1-1, and “cultivated diploid” 93H100 (*see* Phumichai at page 979, Fig. 1). Birhman discloses the following:

“The family 93H100 consisted of plants raised from a mixture of seeds obtained by bulk-pollen pollinations among the cultivated diploid potatoes (the *S. stenotomum* – *S. phureja* mixed population).” [emphasis added, *see* Birhman at page 426, column 2].

Hence, clone 93H100 is *S. stenotomum*/*S. phureja*, while clone F1-1 is *S. chacoense*/*S. phureja*.

The schematic figure herein below summarizes the *Sli* gene ancestry, and position of the 93H100 family described by Phumichai.

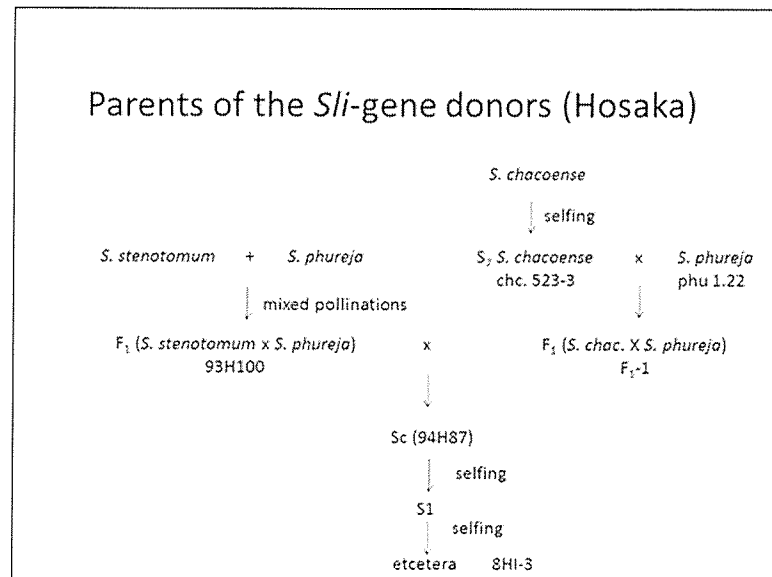


Fig. 1: Indication of the ancestry of the clones 93H100 (left), 94H87 (center) and F1-1 (right) (based on Birhman).

It should be noted that the term “Cultivated diploid potatoes” in Phumichai refers to *S. stenotomum*/*S. phureja* germplasm, and not to *S. tuberosum*. The term “cultivated diploid potatoes” must be understood in the light of Haynes, as follows:

“To date, consideration of breeding at the diploid level has always involved the derived diploids from Group Tuberosum. Other diploids have entered the picture primarily as sources of disease and insect resistance to be transferred largely through back cross programs. No systematic effort has been made to improve the diploid cultivars themselves through breeding.” [see Haynes at page 102, second paragraph].

The authors of Phumichai progress on that route, in an attempt to improve the germplasm of the diploid cultivated potatoes *S. stenotomum*, *S. chacoense* and *S. phureja*. Essentially, therefore, Phumichai is directed to enhancement of wild potato germplasm.

Differences Between the Prior Art and the Claimed Invention

The problem that the present inventors aimed to solve was to produce an essentially homozygous diploid potato plant (in the present case of the species *S. tuberosum*) that could be used as a true breeding parent for producing uniform hybrid potato seed. For that, the plant must show to be fertile, self-compatible and vigorous in that it produces more than 200 gram tubers.

Phumichai is directed to the same problem of attempting to produce highly homozygous diploid potato plants for producing TPS. This reference also uses the same method, namely inbreeding while overcoming the self-incompatibility problem using the *Sli gene*. The same problem is mentioned in Jansky (*see* Jansky at page 46, third paragraph), which for that matter explicitly refers back to Phumichai.

The difference between the present invention and Phumichai, or Jansky for that matter, is that the potato plant is a *Solanum tuberosum* plant, that is also vigorous in that it has a high (>200 gr/plant) tuber yield.

The present inventors arrived at such a plant by a method as presently claimed, in the first culturing steps encountering frail and weak plants with very few flowers and very few berries after self-pollination, and many berries without seed.

This phenomenon was already observed by Phumichai for the wild diploid cultivars when crossing a self-compatible potato plant having the *Sli gene* with cultivated plants raised from a mixture of seeds obtained by bulk-pollen pollinations among the cultivated diploid potatoes *S. stenotomum* and *S. phureja*.

Phumichai discloses that only 1 of 7 cross combinations reached S5 generation indicating serious loss of fertility and inbreeding depression reduced pollen viability and tuber yield (*see* Phumichai at page 982, second and third paragraphs).

Thus a skilled person would not be inclined to perform such a crossing with diploid plants of *Solanum tuberosum* since these tetraploid-derived diploids suffer from even more inbreeding depression.

Surprisingly, the inventors found that, successive rounds of selfing while selecting for plants that produce fertile offspring eventually resulted in plants with progressively improved fertility and vigour. Without wishing to be bound by theory, the inventors believe that this manner of selection indeed allowed the removal of a sufficient amount of deleterious genes from the *Solanum tuberosum* germplasm.

This result was fully unexpected, since selection for fertile plants has usually been associated with selecting for heterozygosity, not homozygosity.

"The slower than expected decline in heterozygosity has been reported by Brouwer and Osborn (1997) with inbreeding diploid alfalfa and by Scotti et al. (2000) with inbreeding tetraploid alfalfa. Consequential selection for vigor and fertility during selfing has been suggested as the cause (Brouwer and Osborn 1997). We previously suggested that reproductive traits, such as flowering versus nonflowering and the degree of pollen production, were strongly correlated with heterozygosity, and selection for fertility favored the more heterozygous plants." [see Phumichai at page 982).

The present inventors were the first to follow the strategy that during the inbreeding process, the selection process of suitable offspring plants having an increased level of homozygosity should not be based on selecting vigorous plants having high tuber yields, but on selecting self-compatible plants having the highest level of fertility. For any potato breeder, this is a fully counterintuitive process. After all, potato breeders attempt to maximize the vigor of the plant and in particular the tuber yield while minimizing the amount of flowers and berries produced. After all, and in contrast to for instance tomato, the berries have no agronomic value, and cultivation of flowering and berries-producing potato plants may result in segregated seeds being shed that may grow into undesirable plants in commercial production fields. Hence, flowers, berries and viable seeds are not considered valuable and are selected against, while strong plants with high tuber yields are selected for further rounds of breeding.

The present inventors showed for the first time that an increase in vigor is possible when a sufficient level of fertility is attained, and that any premature selection for vigor results in ushering or selection for deleterious genes. Hence the inventors made a first cross between a diploid self-compatible potato line having the *Sli* gene and a diploid vigorous line of *S. tuberosum*, optionally backcrossed against the *Sli* donor, and continued the selfing process to increase the homozygosity while again selecting for fertility. In this manner, the inventors were surprisingly able to produce essentially homozygous inbred and diploid *S. tuberosum* plants that were fertile and vigorous.

Applicant wishes to provide further citations regarding no expectation of success, contrary to the Examiner's assertion.

Bachem (Unravelling the Potato Genome, 2008, IDS filed concurrently) reported in 2008 on the perspectives of unraveling the potato genome on the FAO website dedicated to the International year of the Potato comments the following.

"Cultivated potato is what we call a highly heterozygous, self-incompatible outbreeder - in practice that makes it impossible to produce true breeding lines and so genetic improvement is a complex and lengthy process." [emphasis added, see first paragraph of <http://www.fao.org/potato-2008/en/perspectives/bachem.html>]

Simko (Genetics, 173: 2237-2245, 2006, IDS filed concurrently) recites Simmonds and classify potato as an outcrosser because it suffers from severe inbreeding depression that prevents development of homozygous lines. (see Simko at page 2237, right column).

Veilleux (Solcapnews 3(2): 4-5, 2011) discloses the following:

"[...], the plant breeding community was captivated by the new opportunities to derive haploid and doubled haploid lines of commercial crops. Our intentions for applying the technique to the Haynes adapted phureja population of potato were motivated by the possibility of deriving homozygous lines as building blocks for hybrid true potato seed. My dissertation research at the University of Minnesota under the direction of Florian Lauer involved selecting 2n pollen producing clones from the adapted phureja population, crossing them to potato cultivars and evaluating the resulting tetraploid 4x-2x hybrids in the field. The high yield and cultivar like appearance of these 4x-2x hybrids was remarkable, despite the lack of selection on the phureja population for any traits except 2n pollen. Their heterogeneity could be attributed to genetic segregation expected to occur both during the formation of megasporocytes in the tetraploid cultivars as well as the formation of 2n pollen in the diploid phureja selections. We knew from the work of Wenzel in Germany and Uijtewaal in Holland that inbreeding depression in potato cultivars or (di)haploid breeding lines was severe, so that even if plants could be obtained, they were too weak to be of much use. However they had established a protocol for anther culture of potato. We hoped that the adapted phureja population would have greater tolerance to inbreeding". [emphasis added; see Veilleux at page 4, first paragraph]

The above mentioned additional references also suggest that there was no expectation of success for inbreeding of *S. tuberosum* diploid material.

The general prejudice that production of homozygous true breeding lines of potato would not be possible is also indicated and supported with references on page 5, lines 1-28 of the application as filed.

Level Of Ordinary Skill In The Art

The person of ordinary skill in the art would have a background in potato breeding and crossing. The person of ordinary skill would be aware of the disclosures of the prior art documents discussed in this Amendment.

Objective Evidence Of Non-Obviousness

A Declaration by Willem Hendrik Lindhout under 37 CFR 1.132 on the newly developed diploid potato inbreds providing additional information regarding the claimed invention that is probative of non-obviousness is submitted herewith. Testimonies from the following experts in the field of potato breeding are provided herewith.

1. Ir. Jan van Loon, a Dutch Potato Breeder since 1973, subsequently at Cebeco, Hettema and HZPC.
2. Prof. Dr. Ir. Evert Jacobsen, Professor of Plant Breeding, Wageningen University, Netherlands since 1988; Max-Planck and successor to Hermsen in Wageningen.
3. Prof. Dr. Jonathan D. G. Jones, Laboratory Head, The Sainsbury Laboratory, John Innes Centre, and Professor at East Anglia University, UK.
4. Prof. Dr. Ir. Maarten Koornneef, Director at the Max Planck Institute for Plant Breeding Research and Part-time professor of Plant Genetics at Wageningen University, The Netherlands.
5. Prof. Dr. Sanwen Huang, PhD, Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences, Beijing, China.

The above experts testify that:

- (a) it was impossible to produce commercial potato varieties [*S. tuberosum*] from seed and that it would be very difficult, if not impossible to produce homozygous inbred lines as parents for a variety from true potato seeds (*see* testimony from van Loon),
- (b) inbreeding depression and self-incompatibility at the diploid level justified the traditional way of breeding and that the approach by the inventors was considered unrealistic and unfeasible for the development of commercial cultivars (*see* testimony from Jacobsen),

- (c) attempts to produce hybrid potato at the diploid level using the *S. chacoense Sli gene* in *Solanum phureja* and selfing the lines that carry the *Sli gene*, were never successful in developing any promising material in the form of fertile homozygotes that could be useful for hybrid breeding and that could tolerate recurrent selfing (*see* testimony from Jones),
- (d) development of diploid, homozygous inbreds in potato was a daring undertaking with very little chance of success and that the success in challenging this dogma is a positive surprise (*see* testimony from Koornneef), and
- (e) the progress made by the inventors on developing self-compatible homozygous diploid potato with good agronomic performance was surprising that, this result was the breakthrough that the experts have been waiting for since nearly a century and is crucial for the potato breeding worldwide and especially for the food security in, for instance, China (*see* testimony from Huang).

Commercial Importance of the invention

Applicant also wishes to bring the commercial and societal impact of the present invention, in establishing the background for non-obviousness. The Dutch company Solynta, which exploits the subject-matter of the present US patent application, had the honor to receive from the Dutch government the title of “National Icon 2014”, for its groundbreaking technology in the field of potato breeding.

“For crops, the potato is fourth in terms of revenue in the world. Yet innovation in this crop has been silent for about 60 years. The variety 'bintje' is still the biggest variety in Europe. Solynta comes with a new breeding technique with potato seed instead of potatoes. The genetic material of the potato can be enhanced and so varied.” [emphasis added, *see* <http://www.rvo.nl/nationaal-icoon-2014-hybride-aardappels>].

“This groundbreaking technology makes it possible to increase the nutritional value of potatoes and to grow different types of potatoes”. This means more efficient storage and transport and less disease. “Solynta underlines with this project the major Dutch contribution to the global world food supply.” [see <http://www.rvo.nl/nationaal-icoon-2014-hybride-aardappels>].

The Claimed Invention is Non-Obvious

The present invention solves the problem of producing diploid, homozygous inbred potato plants that are self-compatible, fertile and vigorous. The question to be answered is whether a skilled person would arrive at the claimed solution because of prior art teachings.

Applicant respectfully submits that this is not the case. If one would endeavor on a quest to find a vigorous homozygous *Solanum tuberosum*, this is not an endeavor one would engage on with any expectation of success.

If one of skill would choose to select the *Sli* gene donor F1-1 as taught by Phumichai and cross it with a cultivated diploid variety such as *S. phureja* or *S. stenotomum*, as described in Phumichai or Birhman, one would recognize that although some level of vigor may be obtained, it would not result in a fertile homozygote due to inbreeding depression, as clearly stated in Phumichai as follows:

“However, the fact that only 1 of 7 cross combinations reached S5 generation indicates that serious loss of fertility is typical in most families. Thus, inbreeding depression, typically expressed as reduced pollen viability and tuber yield ([...]), will certainly limit continued selfing of the present diploid inbreds.” [emphasis added; see Phumichai at page 982, left column, second paragraph].

Moreover, this line of development would result in a homozygous wild potato cultivar, not an *S. tuberosum* cultivar. The skilled person is also aware of the results of doubled haploid *S. tuberosum* experiments, and is aware that such breeding routes result in plants “too weak to be of much use” as stated herein above. Hence, the only experiment that resulted in essentially homozygous inbred potatoes with some tuber yield (not reported as being commercially relevant as the >200 gr/plant as presently claimed) were not obtained with dihaploids obtained from tetraploid *S. tuberosum*, but with naturally occurring diploid potato lines of the species *S. phureja* and *S. stenotomum*. Hence, if one would cross the *Sli* gene donor F1-1 from Phumichai or Birhman with a plant of a diploid *S. tuberosum* line, all one would expect is that this would not work.

Hence, performing a cross between a plant derived from *Sli* gene donor F1-1 from Phumichai or Birhman with a plant of a diploid *S. tuberosum* line with intent to produce a fertile and vigorous homozygous *S. tuberosum* plant will not lead to successful results and therefore not obvious to try, as results in that direction predicted failure.

Further, the Applicant notes that the combination of teachings of Phumichai and/or Jansky with Maris clearly reflects the hindsight that taints the present obviousness rejection. As argued hereinbefore, the main problem that underlies the invention is that it was hitherto impossible to produce essentially homozygous *Solanum tuberosum* plants that are vigorous in the sense as presently claimed. The features of tuber yield and the level of homozygosity are therefore the essential elements that together define the invention.

In the context of obviousness, one cannot simply mosaic features together, especially not if a disclosure that is used to mosaic the invention expressly states its unsuitability for the purpose of the invention and the problem it solves.

In that context, Applicant refers to their arguments and citations from Maris that were filed in response to the non-final Office Action dated October 14, 2014, wherein *inter alia* passages from Maris such as “continued use of *S. tuberosum* dihaploids in potato breeding needs to be dissuaded” were cited.

In this context, one cannot counter-argue that “Maris is only relied upon for its disclosure of the claimed tuber yield”, as, if that rationale is followed, no single invention would be patentable anymore because every claimed feature has already been described in isolation somewhere in the art.

In view of the foregoing, the claims are non-obvious. Reconsideration and withdrawal of the rejection are respectfully requested.

CONCLUSION

Should the Examiner be of the view that an interview would expedite consideration of the application, request is made that the Examiner telephone the applicant’s attorney at (617) 535 4453 in order that any outstanding issues be resolved.

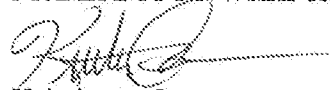
Applicant has included the fee for three-month extension of time fee. The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit

Application No.: 13/504,156
Attorney Docket No.: 091876-0014

Account No. 50-1133, under Order No. 091876-0014 from which the undersigned is authorized to draw.

Respectfully submitted,

McDERMOTT WILL & EMERY LLP



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Date: September 8, 2016

**Please recognize our Customer No. 23630 as our
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