The Art

The art generally teaches this breeding strategy, or similar strategies. For example, Jansky teaches first obtaining homozygous diploids using a self-incompatibility inhibitor. J Jansky, "Breeding, Genetics, and Cultivar Development," Advances in Potato Chemistry and Technology, ed. J. Singh & L. Kaur, pp. 27-62 (June, 2009), p. 46. Jansky teaches that "[h]ighly homozygous inbreds could be also be used for heterosis breeding. Jansky, p. 46. Jansky teaches that such an approach would be difficult. *Id*.

Phumichai et al. confirms the approach of Jansky, and documents the use of the *Sli* gene in the approach. Phumichai et al., Genome 48:977-84 (2005), abstract.

> Potato . . . is an auto- or segmental allo-tetraploid showing tetrasomic inheritance, which results in complicated genetic segregation. Since potatoes are propagated vegetatively, highly heterotic genotypes can be maintained, which facilitates the use of heterosis, an essential factor in potato breeding, particularly for tuber yield. Alternatively, open-pollinated true potato seed (TPS) can be used as a low-cost planting material for potato production.
>
> Highly homozygous inbreds, once amply produced, would be highly useful for the development of TPS varieties with genetic uniformity, as well as for the investigation of heterosis.
>
> A scheme for hybrid breeding using homozygous diploids and subsequent somatic hybridization has been proposed, for which the availability of highly homozygous diploid (or pure) lines is a key for success. In considering the use of pure lines for the development of genetically uniform [true potato seed] varieties, self-fertile, seed-propagated lines are highly desirable, and simple techniques to develop such lines are necessary.

Id., pp. 977-78 (citations omitted).

Teachings on the Record and by the Inventors

In the response filed on 14 September 2016, Applicant traverses the rejection previously made under 35 USC § 103, now withdrawn, and argues that one of skill in the art would not have a reasonable expectation of success in attempted to develop the potato lines necessary for the instant invention. Response, pp. 21-35. As part of the argument, Applicant reviews the scope and content of the prior art, including, *inter alia*, the Phumichai et al. reference. *Id.*, pp. 27-28. Applicant argues that Watanabe et al. (Breed Sci 46:329-36 (1996)) teaches "homozygous inbred lines have not been obtained at the diploid level due to both inbreeding depression and self-incompatibility." *Id.*, p. 23. Applicant also cites to Jansky as downplaying the possibility of hybrid breeding as 'commercially unfeasible due to "dramatic reductions in fertility and vigor.'" *Id.*, (quoting Jansky, p. 46). Applicant argues that Uijtewaal et al. (Euphytica, 36: 745-53 (1987)) confirms this teaching. *Id.*, p. 23 & p. 25. Applicant concludes the argument with citation of additional material supporting their position that one of skill in the art would not have a reasonable expectation of success in combining the art cited in the rejection under 35 USC 103.

In support of the argument, Applicant also filed a declaration under 37 CFR 1.132 by Dr. Lindhout with supporting letters. The supporting letters were initially filed in European Application EP2699684 (04 June 2014) and appear to be copies therefrom. The letters teach that the success of Applicant's invention, as broadly as encompassed by the pending claims, was unpredictable. For example, on page 2 of his letter, Dr. Koornneef states that

> Ever since Lindhout and his co-workers published their results in Potato Research volume 54 of 2011, showing high yielding hybrids from 87% homozygous F3 inbreds, I have been positively surprised that Solynta has managed to challenge this dogma. Solynta could successfully obtain essentially homozygous inbred lines by making use of genotypes that are selfcompatible and by choosing the right starting material that apparently is heterozygous for a lower number of deleterious alleles. This provides the basis of generating useful inbred lines that can become parents of F1 hybrids.

Letter from Koornneef (2012) p. 2 (underlining added). Earlier, Dr. Koornneef also states that "to start a project aiming at developing a good performing homozygous potato plant for the purpose of hybrid production is a daring undertaking with very little chance of success. *Id.*

In another letter supplied in support of Dr. Lindhout's declaration, Dr. J.D.G. Jones states that

> "[I]n the mid 2000s we attempted to produce hybrid potato ourselves. . . . However, we never succeeded in developing any promising material in the form of fertile homozygotes that could be useful for hybrid breeding and that could tolerate recurrent selfing. . . . We considered that this was due to our inability to cross the Sli- self-compatibility locus into good enough or diverse enough diploid *Solanum* germplasm.

Letter from Dr. Jonathan D.G. Jones (2012), p. 1 (underlining added).

Furthermore, on 15 December 2011, over two years after the filing date of the instant application, Lindhout et al. published a paper in the Potato Research journal which appears to correspond to the experiments set forth in the instant examples (all five inventors are among the six authors on the paper). Lindhout et al., Potato Res 54:301-12 (2011). The discussion in the paper is instructive. For example, Lindhout et al. describes that

> As a consequence of the high level of unfavourable alleles, techniques aimed at developing homozygotes in one step, although successful as a technology in various crops, certainly do not generate vigorous homozygous potatoes. For instance, if 20 of the 39,000 protein-encoding genes (PGSC 2011) on the potato genome harbor alleles causing severe fitness reduction, the chance to generate vigorous diploid selfed progenies without homozygous unfavourable loci from a parent genotype, that is heterozygous for these 20 loci, is only 0.3%.

Id., p. 303. Lindhout et al. concludes that "inbred lines were developed that combined self-compatibility with good agronomic performance. Although the number of such plants is still low, the progress made in this breeding programme is significant." *Id.*, p. 304. As a possible reason for success, *Id.* offers "lethal alleles do not occur at high frequency in our diploid potato germplasm. Lindhout et al., pp. 308-09. The authors continue that

> there are many loci with minor effects involved in these traits (Quantitative Trait Locus, QTL). Our current research focuses on identifying the crucial QTLs for these traits. The results will be applied in breeding and allow to increase efficiencies by using diagnostic markers for these traits.

Id., p. 309.

Revisiting the Scope of the Claims

Applicant claims a large genus of *S. tuberosum* plants. Both Jansky and Spooner et al. describes the breadth of the of the claimed genus as extremely large. *See*, e.g., Jansky, "Breeding, Genetics, and Cultivar Development," Advances in Potato Chemistry and Technology, ed. J. Singh & L. Kaur, pp. 27-62 (June, 2009), pp. 27-29; Spooner et al., Bot Rev 80:283-383 (2014), Table 1, pp. 286-94. Applicant's invention in claim 1, for example, reads on any potential potato line that is a "diploid, fertile, self-compatible and essentially homozygous potato line" where the self-compatibility is "as

present" in the deposited samples and where the potato line has a yield of 200 g per plant.

In view of Applicant's arguments in response to the rejection under 35 USC § 103 and Dr. Lindhout's declaration with its supporting letters, success in practicing Applicant's claimed invention is unpredictable and depends on the genotype of the potato lines. Therefore, extensive guidance would be required to enable the invention as broadly as claimed. Such guidance is not provided, or at least the claims encompass a broad, unpredictable genus.

The specification therefore does not enable one skilled in the art to make and use members of the species of the claimed genus other than the deposited lines. See, for example, MPEP 2164.06(a)(II), citing to *Ex parte Jackson*, 217 USPQ 804, 806 (Bd. App. 1982). The issue before the Board in *Ex parte Jackson* was:

> The issue squarely raised by this rejection is whether or not a description of several newly discovered strains of bacteria having one particularly desirable metabolic property in terms of the conventionally measured culture characteristics and a number of metabolic and physiological properties would enable one of ordinary skill in the relevant art to independently discover additional strains having the same specific, desirable metabolic property, i.e., the production of a particular antibiotic.
>
> To state the issue somewhat differently, it is whether a verbal description of a new species would enable one of ordinary skill in the relevant art to obtain strains of that species over and above the specific strains made available through deposit in one of the recognized culture depositories.

Ex parte Jackson, 217 USPQ 804, 806 (Bd. App. 1982). In the instant application, the issue is similar to the one before the Board in that Applicant made deposits with unique characteristics but not taught how to make and use other lines similar to the deposited lines. In *Ex parte Jackson*, the Board held that the deposit, without a detailed

explanation of how to obtain more species, did not enable the generic claims. *Id.*, p. 808. The board found that "the degree of experimentation involved in locating new [organisms] apart from deposited cultures is undue in light of the enablement requirement of 35 U.S.C. 112." *Id.* The *Jackson* decision was considered and distinguished by the Federal Circuit in the *Wands* decision in view of the routine experimentation required to obtain hybridomas that were before the bar in the Wands application. *In re Wands*, pp. 1403-04. Therefore, in particular in view of the *Ex parte Jackson* decision, the generic scope of claims 1, 8, 16 and 34, reading on the genus as set forth above, is not enabled. Obtaining further species falling within the scope of the generic claims would require undue experimentation.

Furthermore, Applicant provides minimal teachings and/or guidance regarding the Sli gene, which appears to be an essential part of the claimed invention.

Dependent claims are included in this rejection because none provide further limitations obviating this rejection.

Applicant's Arguments

Applicant traverses the rejection on page 14 of the response filed on 19 May 2017. Applicant cites to the Declaration of Dr. Lindhout under 37 CFR 1.132 dated 08 May 2017. *Id.*

Response to Applicant's Arguments

Applicant's arguments fail to address the rejection of record concerning the scope of enablement other than by citing to Dr. Lindhout's declaration dated 8 May 2017. The declaration under 37 CFR 1.132 filed 8 May 2017, however, is insufficient to

overcome the rejections of the above claims as set forth in the last Office action and as set forth above due to the following reasons.

After introductory remarks, Dr. Lindhout begins the argument in paragraph 12. Dr. Lindhout disputes Dr. Jones' understanding of the "gist" of the invention. However, Dr. Lindhout submitted the letter in support of Dr. Lindhout's previous declaration. It is disingenuous to now assert that Dr. Jones does not understand the "gist" of the instant invention. Furthermore, Dr. Lindhout fails to address Dr. Koornneef's letter.

Dr. Lindhout states that the Office is interpreting the invention too narrowly. para. 12, 1st line. The Examiner disagrees, the invention is not being interpreted. At issue are the pending claims and the claims being examined are extremely broad. The scope of the claims, not the scope of the invention, is the issue in the instant rejection.

Dr. Lindhout then sets forth how the lines represented by D1, D2 and D3 were not selected. *Id*. But, in view of *Ex parte Jackson*, neither the specification nor Dr. Lindhout teaches how to obtain more such lines.

Dr. Lindhout then states that "other factors [are] at play to arrive at a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* plant." With all due respect to Dr. Lindhout, the pending claims are being examined. There is no limitation directed at "other factors." "It is improper to import claim limitations from the specification" into the claims. MPEP § 2111.01(II). "Though understanding the claim language may be aided by explanations contained in the written description [the specification], it is important not to import into a claim limitations that are not part of the claim. For example, a particular embodiment appearing in the written description may

not be read into a claim when the claim language is broader than the embodiment." *Id.*, (quoting *Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875, 69 USPQ2d 1865, 1868 (Fed. Cir. 2004)).

Furthermore, on 8 September 2016, Dr. Lindhout submitted a declaration traversing the rejection under 35 USC 103 that stated, *inter alia*, that

> That the chance of obtaining a progeny plant, by crossing different genotypes, which is not suffering from inbreeding depression in potato is infinitesimally small, and that starting from a heterozygous diploid potato genotypes, the chance of identifying a plant without homozygous deleterious alleles is, in practice, impossible . . .

Decl. (2016), para. 12, p. 4. In the declaration signed 8 May 2017, Dr. Lindhout now states that "I am convinced that the invention can also be practiced by introgressing the self-compatibility originating from *Solanum chacoense* into *Solanum tuberosum* parent lines other than D1 – D3." Decl. (2017), para. 12 (sub-para. 2), p. 3. Dr. Lindhout does not explain the apparent difference in his opinion between 2016 and 2017. Therefore Dr. Lindhout's 2017 declaration fails to persuade regarding the above rejection of the pending claims.

Further, regarding Dr. Lindhout's assertion about "luck" and "unpredictability" (para. 12) the word "luck" does not appear in the Office action mailed on 21 February 2017. Unpredictability is an issue under the instant enablement rejection. However, the teachings of the art, Applicant's cited experts, and the inventors themselves as set forth above establish that obtaining *S. tuberosum* lines that would function in the instant invention is unpredictable. Applicant fails to provide sufficient guidance as to how to

enable the genus of plants as broadly as claimed. Therefore the rejection is maintained.

In 1966, the Supreme Court held that "[t]he basic quid pro quo contemplated by the Constitution and the Congress for granting a patent monopoly is the benefit derived by the public from an invention with substantial utility. Unless and until a process is refined and developed to this point-where specific benefit exists in currently available form, there is insufficient justification for permitting an application to engross what may prove to be a broad field. *Brenner v. Manson*, 383 U.S. 519, 534-35, 148 USPQ 689, 695 (1966). The full scope of Applicant's claimed invention is not enabled.

Finally, in 2016 Jansky et al. published an "Opinion & Policy" article calling for "Reinventing Potato as a Diploid Inbred Line-Based Crop." Jansky et al., Crop Sci. 56:1412-22 (2016). In approximately the same generalized viewpoint as adopted by Dr. Lindhout in the 2017 declaration, the authors call for the creation of "diploid inbred lines" (*Id.*, p. 1413) with improved, e.g. tuber yield (*Id.*, 1414) for use in creating inbred pools for use in heterosis. *Id.* The authors devoted almost a page to the challenges faced. *Id.*, p. 1415. Then the authors addressed questions that must still be answered. *Id.* pp. 1415-18. They cite to Dr. Lindhout's work on page 1417 and page 1418 as ongoing testing. Neither Jansky et al. in this article nor Dr. Lindhout in his declaration specifically address the 200 g tuber-yield per plant limitation. Therefore, approximately seven years after the filing date of the instant application, the problem of creating vigorous inbred diploid *S. tuberosum* plants apparently still exits.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

11 Claim 36 is rejected under 35 U.S.C. 102(b) as being anticipated by Mullins et al., Trends Plant Sci 11(5):254-60 (2006).

Mullins et al. teaches that, for example, processed start, was known in the art at least by 2006, over a year before the filing date of the instant application. Mullins et al., p. 256. No limitation in claim 36 distinguishes claimed starch from the starch of the prior art. Thus the claim is interpreted as a product-by-process claim with the implicit method steps required to produce the processed starch. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." MPEP § 2113 (quoting *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985) (citations omitted)). Therefore Mullins et al. anticipates claim 36.

Conclusion

12 Claim 21 is allowed.

Allowable Subject Matter

13 Claims 11, 19 and 35 are rejected under 35 USC 112(a) because they depend on a claim that contains new matter. Other than the new matter rejection, claims 11, 19 and 35 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RUSSELL T BOGGS whose telephone number is (571)272-2805. The examiner can normally be reached on Monday - Friday, 0800 to 1830 Mtn.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amjad Abraham, can be reached at 571-270-7058. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/RUSSELL T BOGGS/
Examiner, Art Unit 1663

Doc code: IDS
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

Receipt date: 01/13/2017

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	Willem Hendrik LINDHOUT
	Art Unit	1663
	Examiner Name	Russell T BOGGS
	Attorney Docket Number	091876-0014

/R.T.B/	1	Trofimov et al., Translated Title: "Utilizing Diploid Varieties and Dihaploids to Intensify Potato Selection and How to Better Preserve The Viability of The Pollen of Various Species of Gourds", Translated Journal Title: Potatoes and Vegetables 6 (2007) (English translation)	☐
/R.T.B/	2	Trofimov et al., "Ispol'zovaniye Diploidnykh Vidov I Digaploidov Dlya Intensifikatsii Selektsii Kartofelya And Kak Lushche Sokhranit' Zhiznesposobnost' Pylytsy Raznykh Vidov Tykvy", Kartofel' I Ovoshchi 6 (2007) (Russian)	☐

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EXAMINER SIGNATURE

Examiner Signature	/RUSSELL T BOGGS/	Date Considered	08/26/2017

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13504156
	Filing Date	2012-07-10
	First Named Inventor	Willem Hendrik LINDHOUT
	Art Unit	1663
	Examiner Name	Russell T BOGGS
	Attorney Docket Number	091876-0014

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kristin A Connarn/	Date (YYYY-MM-DD)	2017-01-13
Name/Print	Kristin A Connarn	Registration Number	57,025

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	22791	inbred near line	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:37
L2	77785	potato.ab. or tuberosum.ab.	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:37
L3	61	L2 and L1	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:37
L4	47	L3 and @ad<="20091026"	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:37
L5	11076	potato.clm. or tuberosum.clm.	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:39
L6	492	L1 and L5	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:39
L7	20	L4 and L6	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:39
L8	0	L7 not L4	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:40
L9	86919	L2 or L5	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:41
L10	47	L9 and L4	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:42
L11	0	L10 not L4	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:44
L12	27	L10 not L7	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:44
L13	20	L5 and L4	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:45
L14	3	L9 and sli	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2017/08/25 15:46

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     FILE 'MEDLINE, CROPU, AGRICOLA, CABA, CAPLUS, BIOSIS' ENTERED AT 17:54:11
     ON 25 AUG 2017
L1           31 S (POTATO OR TUBEROSUM)/AB AND (SLI (S) GENE)
L2           11 DUPLICATE REMOVE L1 (20 DUPLICATES REMOVED)

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	Art Unit
	RUSSELL T BOGGS	1663

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
STIC search of STN	8/12/14	/RTB/
STN, EAST and Google search as per attached	9/28/14	/RTB/
STIC search	9/23/14	/RTB/
EAST search as per attached	5/11/15	/RTB/
discuss claims and rejections with A.M. Grunberg	5/8/15	/RTB/
EAST search as per attached	1/31/16	/RTB/
extensive literature search by cross-referencing, Google Scholar & PubMed	1/19 to 2/2/16	/RTB/
EAST search as per attached	1/6/17	/RTB/
discuss objection because amendment cannot be ORCed w/ A. Kubelik	08/23/2017	/RTB/
Google Scholar search up to	08/25/2017	/RTB/
EAST & STN search as per attached	08/25/2017	/RTB/
discuss rejections w. C. Worley	09/02/2017	/RTB/

	/RUSSELL BOGGS/ Examiner.Art Unit 1638

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
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	RUSSELL T BOGGS	1663

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

	/RUSSELL BOGGS/ Examiner.Art Unit 1638

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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: 12/27/2017 Signature: Kirsten Book
(Kirsten Book)

Docket No.: 091876-0014 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Willem Hendrik Lindhout, et al.	:	Customer Number: 23630
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

Sir:

In response to the non-final Office Action dated September 7, 2017, please amend the above-identified U.S. as directed herein. A Petition for Extension of Time (1 month) 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 Claims begin on Page 2.

Remarks/Arguments begin on Page 12.

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A diploid, fertile[[,]] and self-compatible ~~and essentially homozygous~~ *Solanum tuberosum* potato line, ~~said potato line may comprise minor introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*,~~ said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams; wherein at least 50% of genomic loci in said plant are homozygous[[,]];

wherein said self-compatibility originating from *Solanum chacoense* and is referred to as S-locus inhibitor (*Sli*) gene, [[as]] a copy of said gene is 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 at least 25% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds.

2. (Cancelled)

3. (Previously Presented) 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 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.

4. (Previously Presented) The potato line of claim 1, wherein said plant of said line, when mature, attains a fresh weight of the foliage and shoots of at least 500 grams.

5. (Previously Presented) A plant of the line according to claim 1.

6. (Previously Presented) A seed or tuber of the plant according to claim 5.

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7. (Cancelled)

8. (Currently Amended) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, ~~said potato line may comprise minor introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*,~~ said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams, 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 according to claim 1, ~~obtained by selfing a plant of a 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* and is referred to as S-locus inhibitor (*Sli*) gene, 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,~~

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, ~~said potato line may comprise minor 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 potato plant and said second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(d) growing a multiplicity of 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 plants of said line of said first potato plant, for between 1 to 8 selfings or

backcrosses, and selecting for plants that produce fertile offspring, wherein at least 25% of the plants produce seed-carrying berries, each carrying at least 5 seeds, to thereby provide a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato breeding line, ~~said potato breeding line may comprise minor introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*,~~ said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams;

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

9. (Previously Presented) The method of claim 8, 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. (Previously Presented) 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. (Previously Presented) The method of claim 8, wherein said second potato plant is the plant of a second diploid, fertile, self-compatible and essentially homozygous potato line.

13. (Previously Presented) The method of claim 8, wherein said second potato plant is 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 *Solanum tuberosum* potato line according to claim 1, ~~said potato line may comprise minor 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 loci in said first potato plant are homozygous; and wherein said self-compatibility originates from *Solanum chacoense* and is referred to as S-locus inhibitor (*Sli*) gene, 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,~~

(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 *Solanum tuberosum* potato line according to claim 1, ~~said potato line may comprise minor 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 loci in said second potato plant are homozygous; and wherein said self-compatibility originates from *Solanum chacoense* and is referred to as S-locus inhibitor (*Sli*) gene, 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 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. (Previously Presented) 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.

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 *Solanum tuberosum* potato line, ~~said potato line may comprise minor 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. (Previously Presented) 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.

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23. (Previously Presented) A hybrid potato plant, or part thereof, produced by growing the seed of claim 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. (Cancelled)

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. (Previously Presented) 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. (Currently Amended) A part of a hybrid potato plant ~~produced by the method of claim 30, or~~ according to claim 23, which is a tuber ~~thereof~~.

32. (Currently Amended) A set of 2 homozygous diploid, fertile, self-compatible and essentially homozygous potato lines 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 loci in said plants are homozygous.

33-34. (Cancelled)

35. (Currently Amended) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, ~~said potato line may comprise minor 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 *Solanum tuberosum* potato line, ~~said potato line may comprise minor introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*,~~ said potato line of said second potato plant having 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

Solanum tuberosum potato breeding line, ~~said potato breeding line may comprise minor introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*,~~ said potato breeeding 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 loci in a plant provided in step (e) are homozygous.

36. (Cancelled)

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

38. (Previously Presented) A plant of the tetraploid potato line according to claim 37.

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

40. (New) The diploid, fertile, and self-compatible *Solanum tuberosum* potato line according to claim 1, which is a progeny line of a potato line with NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and/or NCIMB accession number 41765.

41. (New) The diploid, fertile, and self-compatible *Solanum tuberosum* potato line according to claim 1, wherein at least 90% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds.

42. (New) A method for producing a uniform hybrid potato seed, comprising:

(a) providing a first potato 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,

(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 *Solanum tuberosum* potato line according to claim 1, 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.

43. (New) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams, comprising:

(a) providing a first potato 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,

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, 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 potato plant and said second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(d) growing a multiplicity of 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 plants 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 wherein at least 90% of the plants

produce seed-carrying berries, each carrying 5-500 seeds, to thereby provide a diploid, fertile, self-compatible and essentially homozygous Solanum tuberosum potato breeding line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 gram and wherein at least 50% of loci in the plant are homozygous.

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REMARKS/ARGUMENTS

Status of Claims

Claims 1, 3-6, 8, 9, 11-13, 16, 18-25, 27-32 and 34-39 were pending in this application. Claims 1, 8, 16, 20, 31, 32 and 35 have been amended. Claims 34 and 36 have been cancelled without prejudice. New claims 40-43 are added.

Claims have been amended for clarity purposes and to correct certain informalities. Basis for amendments to claims can be found throughout the application as filed. For example, support for the amendment to claims 1 and 8 can be found at page 28, lines 7-10.

Support for new claim 40 can be found in claim 1. Support for new claim 41 can be found at page 28, lines 7-14. Support for new claim 42 can be found in claims 8 and 11. Support for new claim 43 can be found in claims 16 and 19.

No new matter is believed to be added herein.

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

Claims 1, 3-6, 8-9, 11-13, 16, 18-20, 23-25, 27-32 and 34-39 are rejected under 35 U.S.C. § 112(a) or 35 U.S.C. § 112 (pre-AIA), second paragraph, as being indefinite, for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

According to the Examiner, claims 1, 8, 16, 20 and 34-35 are indefinite in their recitation of "minor introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*", since what constitutes "minor" introgression segments is indefinite.

Claims 1, 8, 16, 20 and 35 are amended to delete the phrase "minor introgression segments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum*".

Reconsideration and withdrawal of the rejection are respectfully requested.

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

A. Claims 1, 3-6, 8-9, 11-13, 16, 18-20, 22-25, 27-32 and 34-39 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 addition of the word "minor" to modify "introgression segments" comprises new matter.

Claims 1, 8, 16, 20 and 35 are amended to delete the word "minor".

Reconsideration and withdrawal of the rejection are respectfully requested.

B. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 34 and 36-39 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. 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.

Applicant respectfully disagrees. Claims 1, 8, 16, 20, 31 and 32 have been amended and commensurate with the specification as filed. Applicant has disclosed that the source of self-compatibility is the *Sli* gene and that the invention is specifically drawn to *Solanum tuberosum* potato lines and plants.

The claims do not represent broad genera of potato plants. The reason being that the claims (a) do not disclose the presence of minor introgression fragments of other tuber-bearing *Solanum* species crossable to *Solanum tuberosum* and (b) disclose that the self-compatibility is the same self-compatibility gene that is found in the deposited lines, thereby providing the specific structure associated with the claimed self-compatibility.

Thus, one of skill in the art would appreciate that the Applicant was in possession of the genus as claimed.

Reconsideration and withdrawal of rejection are respectfully requested.

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C. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 34 and 36-39 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 while being enabling for the deposited cell lines, does not reasonably provide enablement for forms of self-compatibility as claimed.

Applicant respectfully disagrees. The application as filed discloses that the *Sli* gene donor 07-1004-1, as used in the experiments, is a progeny of the *Sli*-donor F1-1 as described in Phumichai et al. (2005, Genome 48:977-984), Phumichai and Hosaka (2006, Euphytica 149:251-258) and Phumichai et al. (2006, Euphytica 148:227-234) (*see* specification as page 57, Table 6). The disclosure of the application combined with the teachings of the prior art references therefore enable a person skilled in the art to introgress the *Sli* gene from a donor plant into a *Solanum tuberosum* potato plant.

The diploid, fertile, self-compatible and essential homozygous potato plants according to the invention were obtained by using a novel approach.

> *"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 tetraploid plants. Unexpectedly, this radically new approach proved successful for obtaining increasingly homozygous, diploid offspring plants, that were 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 germplasm without loss of self-compatibility and fertility."* (see specification at page 374, lines 5-19).

By crossing diploid potato plants, and by selecting the progeny from each cross for fertile offspring, plants that have a tuber yield expressed in grams of fresh weight of at least 200 grams and of which at least 25% of the plants were obtained, preferably at least 90% of the plants, produce seed-carrying berries, each carrying at least 5 seeds. Such plants have not been disclosed in the art

before, and are also acknowledged by renowned experts in the field (*see* Declaration by Willem Hendrik Lindhout under 37 CFR 1.132, filed previously on May 19, 2017).

As previously disclosed in the Declaration of Lindhout, this selection procedure resulted in plants according to the invention for two of three starting *Solanum tuberosum* parent lines (potato lines **D1** (IVP97-079-9) and **D2** (IVPAA-096-18). The *Solanum tuberosum* parent lines **D1**, **D2** and **D3** were selected without any specific preselection for fertility, tuber yield, or combining ability with a *Sli* gene donor. Hence, it is credible that the applied selection procedure, rather than the starting parent lines, resulted in the generation of the novel diploid, fertile, self-compatible and essential homozygous potato plants according to the invention.

As disclosed in Figure 2, the invention is not limited to the deposited plants. Rather, these plants were used to generate further diploid, fertile, self-compatible and essential homozygous potato plants according to the invention by backcrossing (BC) and crossing with other potato plants.

In view of the foregoing, the invention can be practiced over the whole scope of the claims and does not require undue experimentation.

Reconsideration and withdrawal of rejection are respectfully requested.

Rejections under 35 U.S.C. § 102

Claim 36 is rejected under 35 U.S.C. 102(b) as being anticipated by Mullins et al., (2006, Trends Plant Sci. 11(5):254-260).

Without acquiescing to the merits of the rejection, claim 36 is cancelled solely to expedite prosecution.

Reconsideration and withdrawal of rejection are respectfully requested.

Allowable Subject Matter

Applicant would like to thank the Examiner for the indication that claims 11, 19 and 35 contain allowable subject matter, and would be allowable if rewritten in independent form.

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Please note that the new claims 42 and 43 are presented as independent claims and includes the subject matter of claims 11 and 19 respectively.

Applicant wishes to bring to the attention of the Office that claim 35 was already presented as an independent claim.

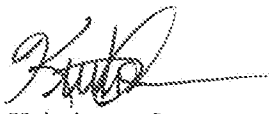
CONCLUSION

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.

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 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: December 27, 2017

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

U.S.PATENTS

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13504156
	Filing Date	2012-07-10
	First Named Inventor	Willem Hendrik LINDHOUT
	Art Unit	1663
	Examiner Name	Russell T BOGGS
	Attorney Docket Number	091876-0014

	1	International Search Report relating to PCT/NL2012/050269, issued September 19, 2012.	☐
	2	Johnstone, Jr., Francis E. "Chromosome Doubling in Potatoes Induced by Colchicine Treatment," American Journal of Potato Research, Vol. 16, No. 11, pages 288-304, November 1, 1939.	☐
	3	Ramulu, K. Sree, H. A. Verhoeven, and P. Dijkhuis. "Mitotic blocking, micronucleation, and chromosome doubling by oryzalin, amiprophos-methyl, and colchicine in potato." Protoplasma, Vol. 160, No. 2-3, pages 65-71, June 1, 1991.	☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kristin A Connarn/	Date (YYYY-MM-DD)	2017-12-27
Name/Print	Kristin A Connarn	Registration Number	57,025

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
P94557PC00		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/NL2012/050269	20/04/2012	21/04/2011
Applicant		
AGVENTURE B.V		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 5 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language,** the international search was carried out on the basis of:
      [X] 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))
   b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. [X] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**
   a. the figure of the **drawings** to be published with the abstract is Figure No. _____
      [ ] as suggested by the applicant
      [ ] as selected by this Authority, because the applicant failed to suggest a figure
      [ ] as selected by this Authority, because this figure better characterizes the invention
   b. [X] none of the figures is to be published with the abstract

Agventure B.V. Ex. 2009
IPR2025-00136
Page 865

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NL2012/050269

Box No. I Nucleotide and/or amino acid sequence(s) (Continuation of item 1.c of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, the international search was carried out on the basis of:

   a. (means)

   ☐ on paper

   ☒ in electronic form

   b. (time)

   ☐ in the international application as filed

   ☐ together with the international application in electronic form

   ☒ subsequently to this Authority for the purpose of search

2. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

3. Additional comments:

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2012/050269

A. CLASSIFICATION OF SUBJECT MATTER
INV. C12N15/82 A01H1/04 A01H4/00 A01H5/04
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C12N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CHALERMPOL PHUMICHAI ET AL: "Cryptic improvement for fertility by continuous selfing of diploid potatoes using Sli gene", EUPHYTICA, KLUWER ACADEMIC PUBLISHERS, DO, vol. 149, no. 1-2, 2 June 2006 (2006-06-02), pages 251-258, XP019395452, ISSN: 1573-5060, DOI: 10.1007/S10681-005-9072-5 abstract page 251, right-hand column, line 8 - page 252, left-hand column, line 2 figure 1 Plant material; page 252, right-hand column ----- -/--	1-18

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 September 2012	19/09/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Mundel, Christophe

1

Agventure B.V. Ex. 2009
IPR2025-00136

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CHALERMPOL PHUMICHAI ET AL: "Expression of S-locus inhibitor gene (Sli) in various diploid potatoes", EUPHYTICA, KLUWER ACADEMIC PUBLISHERS, DO, vol. 148, no. 3, 28 April 2006 (2006-04-28), pages 227-234, XP019395412, ISSN: 1573-5060, DOI: 10.1007/S10681-005-9004-4 abstract page 227, left-hand column, line 4 - page 228, left-hand column, line 3 Plant material; page 228 figure 1 table 1 page 233, left-hand column, line 26 - line 36	1-18
Y	PHUMICHAI CHALERMPOL ET AL: "Toward the development of highly homozygous diploid potato lines using the self-compatibility controlling Sli gene", GENOME, OTTAWA, CA, vol. 48, no. 6, 1 December 2005 (2005-12-01), pages 977-984, XP002577501, ISSN: 0831-2796, DOI: 10.1139/G05-066 abstract page 978, left-hand column, line 39 - right-hand column, line 7 Plant material; page 978 figure 1 tables 1, 2 page 982, left-hand column, line 1 - line 21	1-18
Y	MARIS B: "COMPARISON OF DIPLOID AND TETRAPLOID POTATO FAMILIES DERIVED FROM SOLANUM-PHUREJA X DIHAPLOID SOLANUM-TUBEROSUM HYBRIDS AND THEIR VEGETATIVELY DOUBLED COUNTERPARTS", EUPHYTICA, KLUWER ACADEMIC PUBLISHERS, NL, vol. 46, no. 1, 1 March 1990 (1990-03-01), pages 15-33, XP008132658, ISSN: 0014-2336, DOI: 10.1007/BF00057615 page 16 - page 17	1-18

-/--

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SHELLEY HERMUNDSTAD ET AL: "Tuber yield and tuber traits of haploid-wild species F1 hybrids", POTATO RESEARCH, ASSOCIATION FOR POTATO RESEARCH, WAGENINGEN, NL, vol. 29, 1 September 1986 (1986-09-01), pages 289-297, XP008132723, ISSN: 0014-3065, DOI: 10.1007/BF02359958 Material and methods; page 290 Results; page 290 figure 1 -----	1-18

Electronic Patent Application Fee Transmittal

Application Number:	13504156
Filing Date:	10-Jul-2012
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Filer:	Kristin Anne Connarn/Kirsten Book
Attorney Docket Number:	091876-0014

Filed as Small Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	2251	1	100	100
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	90	90
		Total in USD ($)		**190**

Electronic Acknowledgement Receipt

EFS ID:	31342557
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
Filer:	Kristin Anne Connarn/Kirsten Book
Filer Authorized By:	Kristin Anne Connarn
Attorney Docket Number:	091876-0014
Receipt Date:	27-DEC-2017
Filing Date:	10-JUL-2012
Time Stamp:	14:25:12
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$190
RAM confirmation Number	122817INTEFSW00000424501133
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Extension of Time	ExtensionofTime.pdf	592923 60b9b936d4092801911785eadf1159ffcf8e31bf	no	1
Warnings:					
Information:					
2	Amendment/Req. Reconsideration-After Non-Final Reject	ResponsetoNFOA.pdf	1154317 b809722efac7441fbde90ff7f0932f84bf31b5df	no	16
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	SB08a.pdf	734463 5ce6cb4184b3574d9723a1cf026ab0620cea3035	no	4
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
4	Non Patent Literature	NPL1_ISR-PCTNL2012050269.pdf	150446 52b9776084621da2d5542c251c5d430acd0b0e54	no	5
Warnings:					
Information:					
5	Non Patent Literature	NPL2_Johnstone_AmerPotatoJ-1939.pdf	1729289 3432031bed4b25f8b177410b70c4a34bf3be80fa	no	17
Warnings:					
Information:					
6	Non Patent Literature	NPL3_Ramulu_Protoplasma-1991.pdf	1255664 46f3070741fb6dfc6247026ae011a4814e88f410	no	7
Warnings:					

Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	32731 c454f618e757e16f03bd8a7aa772f8210d6a3639	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	5649833	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/22 (03-13)
Approved for use through 7/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 091876-0014
Application Number 13/504,156 Conf # 6337	Filed July 10, 2012
For HYBRID SEED POTATO BREEDING	
Art Unit 1663	Examiner BOGGS, Russell T

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	Micro Entity Fee	
[X] One month (37 CFR 1.17(a)(1))	$200	$100	$50	$ 100
[ ] Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$
[ ] Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$
[ ] Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
[ ] Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$

[ ] Applicant asserts small entity status. See 37 CFR 1.27.

[ ] Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

[ ] A check in the amount of the fee is enclosed.

[ ] Payment by credit card. Form PTO-2038 is attached.

[ ] The Director has already been authorized to charge fees in this application to a Deposit Account.

[X] The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 50-1133 .

[X] Payment made via EFS-Web.

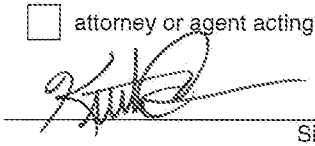
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

[ ] applicant.

[X] attorney or agent of record. Registration number 57,025 .

[ ] attorney or agent acting under 37 CFR 1.34. Registration number _____ .



Signature

December 27, 2011
Date

Kristin A. Connarn
Typed or printed name

(617) 535-4453
Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

[X] * Total of 1 forms are submitted.

DM_US 75981159-1.091876.0014

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: _____ Electronic Signature for Kirsten Book _____

PTO/SB/06 (09-11)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/504,156	Filing Date 07/10/2012	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT **12/27/2017**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 33	Minus	** 34	= 0	X $40 =	0
Independent (37 CFR 1.16(h))	* 7	Minus	***7	= 0	X $210 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
KIM P. DOZIER

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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EXAMINER	
BOGGS, RUSSELL T	

ART UNIT	PAPER NUMBER
1663	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 13/504,156	Applicant(s) Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	AIA Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 27 December 2017.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1,3-6,8-9,11-13,16,18-25,27-32,35 and 37-43 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☑ Claim(s) 21,35 and 42-43 is/are allowed.

7) ☑ Claim(s) 1,3-6,8-9,12-13,16,18,20,22-25,27-32 and 37-41 is/are rejected.

8) ☑ Claim(s) 11 and 19 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first-to-invent provisions.

Status

1. Claims 1-34 were examined on the merits in the Office action mailed 14 October 2014 and rejected. Applicant responded on 14 January 2015 amending several claims and cancelling claims 2, 10 and 17. Claims 1, 3-9, 11-16 and 18-34 were examined and rejected in the final rejection mailed 18 May 2015.

Applicant filed an RCE on 18 November 2015. Claims 1, 3-9, 11-16, 18-32 and 34-36 were examined and rejected on 8 March 2016. Applicant responded on 8 September 2016 cancelling claims 14-15 and adding claims 37-39. Claims 1, 3-9, 11-13, 16, 18-32 and 34-39 were examined and rejected in an Office action mailed 21 February 2017.

Applicant filed a second RCE on 19 May 2017. Applicant amended claims and cancelled claim 26. Claims 1, 3-6, 8-9, 11-13, 16, 18-25, 27-32 and 34-39 were examined on 7 September 2017; most claims were rejected. Applicant responded on 27 December 2017, cancelling claims 34 and 36 and adding claims 40-43.

Claims 1, 3-6, 8-9, 11-13, 16, 18-25, 27-32, 35, 37-39 and 40-43 are examined herein.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one

or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Withdrawal of Objections and Rejections

2. The rejection of claims 1, 3-6, 8-9, 11-13, 16, 18-20, 23-25, 27-32, 35 and 37-39 under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite, is withdrawn in view of Applicant's amendments to the claims.

3. The rejection of claims 1, 3-6, 8-9, 11-13, 16, 18-20, 22-25, 27-32, 35 and 37-39 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 because they contained new matter is withdrawn in view of Applicant's amendments to the claims.

4. Any objections to and rejections of cancelled claims are rendered moot.

Examiner's Note

5. Citations to Applicant's specification are abbreviated herein "Spec."

Claim Objections

6. Claim 35 is objected to because of the following informalities. In the third to last line, the misspelling "breeeding" occurs.

Claim Rejections - 35 USC § 112(a) / written description

7. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39 and 40-41 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. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention.

Due to Applicant's amendments to the claims, the rejection is modified from the rejection set forth in the Office action mailed 7 September 2017 as applied to the above-referenced claims. Applicant traverses the rejection in the paper filed U27 December 2017. Applicant's arguments have been fully considered but are not persuasive.

The Claims

Claim 1 is drawn to a diploid, fertile, self-compatible *S. tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams; wherein at least 50% of genomic loci in said plant are homozygous, wherein self-compatibility originating from *S. chacoense* and is referred to as a S-locus inhibitor (Sli) gene, a copy of said gene is present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, and wherein at least 25% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds.

Dependent claims are drawn to properties of the potato line (claims 3 and 4); and a plant line of claim 1, or a seed or tuber of the plant (claims 5 and 6). Claim 39

requires that the plant of claim 1 has at least 75% homozygous loci. New claim 40 is drawn to a progeny line of one or more of the lines of claim 1. New claim 41 requires that at least 90% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds.

New dependent claim 42, not rejected under 35 USC 112(a), is drawn to a method for producing a uniform hybrid potato seed comprising the steps of

(1) providing a first potato plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765;

(2) providing a second potato plant that is from another diploid or tetraploid, fertile, self-compatible and essentially homozygous *S. tuberosum* line according to claim 1, wherein said the two plants contain at least 20% contrasting homozygous loci as determined by molecular marker analysis; and

(3) cross-pollinating them to produce berries with seeds and then collecting the seeds.

Claim 16 is a method claim drawn to producing a uniform hybrid potato seed starting with a first plant from a diploid, fertile, self-compatible and essentially homozygous *S. tuberosum* potato line according to claim 1 and crossing the first plant with a second plant according to claim 1.

Dependent claims are drawn to properties of the potato line (claims 18 and 20); where the method uses as a first potato plant one of four deposited lines (claim 19 (not included in this rejection); a seed produced by the claimed method (claim 22); and a plant or part thereof produced from the seed of claim 22 (claims 23-25); a tissue culture

of the plant of claim 23 and a plant or a plant part produced from this tissue culture (claims 27-28 and 31); and a method using the seed to produce a plant (claim 30).

Claim 32 reads on a set of two homozygous diploid, fertile, self-compatible and essentially homozygous potato lines according to claim 1 wherein each of said lines differ from the other line in the set by having at least 20% contrasting homozygous loci as determined by molecular genetic marker analysis; and wherein at least 50% of loci in said plants are homozygous. Claim 37 reads on a tetraploid line derived from the plant of claim 5 and claim 38 reads on a plant of the line of claim 37. Claim 29 is drawn to a method using either the plant of claim 5 (a diploid plant) or the plant of claim 38 (a tetraploid plant).

Claim 8 is a method claim drawn to producing a diploid, fertile, self-compatible and essentially homozygous *S. tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams, comprising:

(a) providing a first potato plant of a diploid, fertile, self-compatible and essentially homozygous potato line according to claim 1;

(b) providing a second potato plant, 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 potato plant and second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(d) growing a multiplicity of 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, wherein at least 25% of the plants produce seed-carrying berries, each carrying at least 5 seeds, to thereby provide a diploid, fertile, self-compatible and essentially homozygous S. tuberosum potato breeding line, said potato line comprising plant having a tuber yield expressed in grams of fresh weight of at least 200 grams;

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

Dependent claims are drawn to properties of the potato line (claims 9 and 12-13); and where the method uses as a first potato plant one of four deposited lines (claim 11) (not included in this rejection).

Claim 35, an independent claim, reads on a method for producing a diploid, fertile, self-compatible and essentially homozygous potato line using a method similar to, e.g. claim 16, with one of the deposited lines used as the first plant; claim 35 is not included in this rejection.

Claim 36 depends from one of claims 6, 25 or 31 and reads on, e.g., a food product.

Claim 21, not rejected under 35 USC 112(a), is an independent claim drawn to a seed of one of the deposited lines.

New claim 43, not rejected under 35 USC 112(a), is drawn to a method for producing a diploid, fertile, self-compatible and essentially homozygous *S. tuberosum* line, said line comprising a plant having a tuber yield of at least 200 grams, comprising the steps of:

(1) providing a first potato plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765;

(2) providing a second potato plant which is a plant of a diploid *S. tuberosum* line with any level of homozygosity but comprising plants having an average tuber yield at least 200 grams per plant;

(3) cross pollinating the two to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(4) growing a multiplicity of the hybrid offspring seed and selecting plants with a tuber yield at least 200 grams per plant;

(5) selfing or backcrossing the hybrid offspring; and

(6) selecting for plants that produce fertile offspring wherein at least 90% of the plants produce seed-carrying berries, each carrying 5-500 seeds.

Applicant's Description

Applicant describes the deposited lines by breeders reference: AGVD1 (NCIMB 41663), AGVD2 (NCIMB 41664), AGVD3 (NCIMB 41665) and AGVD17 (NCIMB 41765). Spec., pp. 33-34.

In the specification, Applicant describes a breeding process according to the instant invention starting with a self-compatible line, e.g. AGVD1-3 or AGVD17. *Id.*, p.

37. Applicant states that "[n]o or at least little, attention is paid to the agronomical appearance of the plants at this stage." *Id.* One aspect of the recited breeding steps includes the possibility of adding a desired trait, such as vigor. *Id.*, p. 38. Continuing this aspect, after adding the trait, the hybrid is backcrossed to the self-compatible line while selecting for, e.g. vigor. *Id.* After adding numerous traits, and performing test crosses, inbred elite diploid breeding lines can be obtained which can be used to produce commercially valuable hybrids. *Id.* Applicant reviews the steps: develop a "a vigorous fertile homozygous self-compatible diploid potato line;" "a diploid breeding line;" and then an "elite diploid potato breeding line." *Id.*, p. 40. On page 43, Applicant concludes that "[t]he above method now provides a breeding process for the production of homozygous breeding lines or elite breeding lines based on the background of population AGVD1, AGVD2, AGVD3 or AGVDI7, to which background successively additional alleles are added, thereby providing elite breeding lines wherein desirable traits are stacked." *Id.*, p. 43.

In particular, in Example 1, Applicant describes obtaining the IVP07-1001/4 line from publically available germplasm where the IVP07-1001/4 plants contained the *Sli* gene after repeated selfing. *Id.*, p. 44. Applicant cites to the 2006 Euphytica publication by Phumichai et al. as well as the 2005 Genome publication by Phumichai et al. regarding the source of the *Sli* gene. Id., p. 44 & p. 57 (citing to Phumichai et al., Genome 48:977-94 (2005) and Phumichai et al., Euphytica 148:227-34 (2006)). Applicant describes that these plants are of no commercial value. *Id.* Applicant crossed these plants to three different diploid donor lines, D1-3, in order to acquire commercially valuable traits carried by the donor lines. *Id.*, pp. 44-45. The F1 cross with D1 was

selfed and the progeny deposited as AGVD1, which was estimated as 50% homozygous. *Id.*, p. 45. The F1(D1) was crossed with F1(D2) and the progeny deposited under AGVD2, and this was estimated to be 25% homozygous with respect to alleles originating from IVP07-1001/4. *Id.* The F1(D1) was backcrossed to obtain progeny 25% homozygous with respect to alleles originating from IVP07-1001/4; these were deposited as AGVD3. *Id.*

In Example 2, Applicant describes crossing the *Sli* gene donor with various publically available potato clones designated: IVP97-079-9, IVPAA-096-I8 and SH83-92-488 to generate clones D1, D2 and D3. *Id.*, p. 47. Applicant describes this created a diploid trait donor lines containing the Sli gene with enhanced agricultural quality. *Id.*, pp. 46-50. Applicant provides a more detailed description of the potato lines used in Table 6. *Id.*, pp. 57-58.

Applicant describes creating a molecular marker platform, i.e. SNPs, in Example 3. *Id.*, pp. 50-58.

In Example 4, Applicant describes the development of homozygous diploid potato plants and then F1 hybrid progeny, as well as subsequent generations. *Id.*, pp. 58-62. Applicant describes that it is "often stated" that potatoes are very prone to inbreeding depression. *Id.*, p. 60. A cause of this might be deleterious alleles; Applicant potentially identified a few such deleterious alleles, with one allele that was almost lethal. *Id.*

Applicant concludes, on page 62, that

> It was found that after two generations of selfings homozygous diploid potato plants were obtained comprising alleles from both parents. Not a single marker out of 36 markers tested provided proof for a lethal allele. Furthermore, plants with more than 84% homozygous loci can be

> successfully crossed to obtain hybrid plants with at least five heterozygous chromosome regions. This means that hybrid seeds that are essentially uniform and that represent true potato seed have now been produced.

Id., p. 62.

The Scope of the Claims

In contrast to the limited description – four deposited lines – the claimed genera are quite large. For example, the claimed genera include those set forth in the following exemplary claims:

In claim 1, which is a composition claim drawn to a plant, the genus includes any diploid, fertile, and self-compatible with a tuber yield of at least 200 grams and having at least 50% homozygous loci, wherein the self-compatibility originates from *S. chacoense* and is as present in a plant of potato line deposited with NCIMB accession numbers 41663, 41664, 41665, or 41765. Claims 5-6 and 37-38 read on plants directly derived from claim 1.

In the record, Applicant argues that the plants of the invention are distinguishable from the prior art plants because they have a tuber yield in excess of 200 grams per plant even after inbreeding. Remarks, 14 Jan. 2015, p. 17 and Remarks, 8 Sept. 2016, pp. 28-29. Applicant offers a theory that, in the prior art, inbreeding to diploids was associated with severe inbreeding depression because of the presence of deleterious and lethal alleles. Remarks, 8 Sept. 2016, p. 24. Although Applicant is clearly not bound by this theory, Applicant fails to associate any structure with the phenotype of superior tuber yield (at least 200 g per plant).

The claims require that the self-compatibility gene originates from *S. chacoense* and is as present in a plant of potato line deposited with NCIMB accession numbers

41663, 41664, 41665, or 41765. This, however, does not require that the self-compatibility in the claims is the same self-compatibility gene that is found in one of the deposited lines since Applicant fails to describe the scope of "as present." It is well-accepted that the meaning of "as" includes "for instance" and thus the claims also read on other embodiments of self-compatibility with the deposited lines merely representing particular embodiments. Merriam-Webster, "as", accessed 2 December 2016. Again, Applicant fails to describe any specific structure associated with the claimed self-compatibility, such as the genes required or the sequences of the genes.

Additionally, several other claims represent other broad genera. Claim 22 reads on all seeds produced by the method of claim 16 without further describing the seeds or requiring any specific structure. Claims 23-25 and 31 read on all plants, and parts thereof, produced from the seed of claim 22 without further describing the plants or requiring any specific structure such as the genetic structure described by the deposits. Claim 27 reads on a broad genus of tissue cultures. Claim 28, which reads on a plant produced by the tissue culture, also reads on a broad genus of plants because somaclonal variation of a plant obtained from tissue culture may increase the size of the genus encompassed by claims. See, e.g., Bairu et al., Plant Growth Regul 63:147-73 (2011). None of these claims require any identifying structure, even the *Sli* gene.

To claim a genus under the written description requirement, Applicant is required to describe a representative number of species to reflect the variation within the genus or structures sufficient to define the genus. The factors to be considered include disclosure of complete or partial structure, physical and/or chemical properties,

functional characteristics, structure/function correlation, methods of making the claimed product, or any combination thereof.

Applicant Fails to Describe a Representative Number of Species or Structural Features

Applicant clearly provides written description – by deposit – for the deposited lines. But does Applicant describe a representative number of species in comparison to the size of the all the genera claimed? In the instant application, Applicant only describes by deposit only four potato lines as compositions and for use in the claimed methods. All were created from the same *Sli* donor, the IVP07-1001/4 line, crossed to three diploid donor lines. Spec., p. 44 & pp. 57-58. Applicant cites to Phumichai et al. (2006) as to the source of the *Sli* gene line. Id., p. 44. The IVP07-1001/4 line does not appear to be a *S. tuberosum* line based on a review of the specification and Phumichai et al. (2005) and Phumichai et al. (2006), but its identity is not directly stated. Applicant does not further characterize or describe the *Sli* gene or describe any means to identify it.

The Art

The art describes basic the approach of Applicant's invention. For example, in a 2009 publication, Jansky describes first obtaining homozygous diploids using a self-incompatibility inhibitor. J Jansky, "Breeding, Genetics, and Cultivar Development," Advances in Potato Chemistry and Technology, ed. J. Singh & L. Kaur, pp. 27-62 (June 2009), p. 46. Jansky teaches that "[h]ighly homozygous inbreds could be also be used for heterosis breeding. Jansky, p. 46. Jansky teaches that such an approach would be difficult. *Id.*

Phumichai et al. confirms the approach of Jansky, and documents the use of the *Sli* gene in the approach. Phumichai et al. (2005), abstract.

> Potato . . . is an auto- or segmental allo-tetraploid showing tetrasomic inheritance, which results in complicated genetic segregation. Since potatoes are propagated vegetatively, highly heterotic genotypes can be maintained, which facilitates the use of heterosis, an essential factor in potato breeding, particularly for tuber yield. Alternatively, open-pollinated true potato seed (TPS) can be used as a low-cost planting material for potato production.
>
> Highly homozygous inbreds, once amply produced, would be highly useful for the development of TPS varieties with genetic uniformity, as well as for the investigation of heterosis.
>
> A scheme for hybrid breeding using homozygous diploids and subsequent somatic hybridization has been proposed, for which the availability of highly homozygous diploid (or pure) lines is a key for success. In considering the use of pure lines for the development of genetically uniform [true potato seed] varieties, self-fertile, seed-propagated lines are highly desirable, and simple techniques to develop such lines are necessary.

Id., pp. 977-78 (citations omitted).

Admissions on the Record and by the Inventors

The claims read on broad genera of *S. tuberosum* diploid plants, but would all be active in the instant invention? What distinguishes a *S. tuberosum* diploid plant with a 200 gram tuber yield from one without such a high tuber yield. In the specification, Applicant states that

> It is often stated that repeated selfings in diploid potato will only result in weak plants due to inbreeding depression. This should be due to numerous deleterious alleles that reduce plant fitness, when these alleles are homozygously present. Therefore, we tested the segregation of 36 markers in the six F3 populations mentioned (see Figure 5).

Spec., p. 60. As discussed above, Applicant summarizes the result of the study as identifying some potentially, deleterious alleles, one of which is "very" deleterious, almost lethal. *Id.*

The declaration by Mr. Lindhout dated 15 August 2016 and supporting letters document how unique the potato lines used for the instant invention are. For example, one of the letters supporting Dr. Lindhout's declaration, by Dr. J.D.G. Jones states that

> "[I]n the mid 2000s we attempted to produce hybrid potato ourselves. . . . However, we never succeeded in developing any promising material in the form of fertile homozygotes that could be useful for hybrid breeding and that could tolerate recurrent selfing. . . . We considered that this was due to our inability to cross the Sli- self-compatibility locus into <u>good enough or diverse enough diploid *Solanum* germplasm</u>.

Letter from Dr. Jonathan D.G. Jones (2012), p. 1 (appended to Decl. of Dr. Lindhout 15 August 2016, ("Decl. (2016)")) (underlining added).

In his declaration, Dr. Lindhout summarizes the background art prior to the claimed invention. Decl. (2016), pp. 3-4. In particular, Dr. Lindhout states that

> That as soon as a genotype becomes homozygous for negative alleles of which the negative is not compensated by functional paralogues, such genotypes might show very poor performance and low viability;
> That inbreeding depression is manifested as a reduced fitness with a loss in both yield and fertility;
> That inbreeding depression is mainly due to the presence of many (semi) lethal alleles, and alleles with a deleterious effect, that become visible more frequently at the diploid level when the maximum number of possible alleles is reduced from four to two, resulting in homozygosity of such alleles.
> That the chance of obtaining a progeny plant, by crossing different genotypes, which is not suffering from inbreeding depression in potato is infinitesimally small, and that starting from a heterozygous diploid potato genotypes, the chance of identifying a plant without homozygous deleterious alleles is, in practice, impossible . . .

Decl. (2016), p. 4.

In a similar vein, in a paper filed with the EPO, Applicant also asserts that "every expert in the field can confirm that due to inbreeding depression, the chances of successfully attaining the plant of the invention are close to zero. Hence, the production of such plants is generally considered impossible." EPO Publication No. EP 2 493 286 A2, Remarks to EPO (21 Dec. 2012), p. 8.

Furthermore, on 15 December 2011, approximately two years after the filing date of the instant application, Lindhout et al. published a paper in the Potato Research journal which appears to correspond to the experiments set forth in the instant examples (all five inventors are listed as authors on the paper). Lindhout et al., Potato Res 54:301-12 (2011). The discussion in the paper is instructive. For example, Lindhout et al. describes that

> As a consequence of the high level of unfavourable alleles, techniques aimed at developing homozygotes in one step, although successful as a technology in various crops, certainly do not generate vigorous homozygous potatoes. For instance, if 20 of the 39,000 protein-encoding genes (PGSC 2011) on the potato genome harbor alleles causing severe fitness reduction, the chance to generate vigorous diploid selfed progenies without homozygous unfavourable loci from a parent genotype, that is heterozygous for these 20 loci, is only 0.3%.

Id., p. 303. Lindhout et al. concludes that "inbred lines were developed that combined self-compatibility with good agronomic performance. Although the number of such plants is still low, the progress made in this breeding programme is significant." Id., p. 304. As a possible reason for success, Id. offers "lethal alleles do not occur at high frequency in our diploid potato germplasm. Lindhout et al., pp. 308-09. The authors continue that

> there are many loci with minor effects involved in these traits (Quantitative Trait Locus, QTL). Our current research focuses on identifying the crucial

> QTLs for these traits. The results will be applied in breeding and allow to increase efficiencies by using diagnostic markers for these traits.

Id., p. 309.

Conclusion

Applicant's deposited lines are described and novel. However, in view of the above, especially including Applicant's assertion that "the production of such plants is generally considered impossible," there is nothing in the claims to distinguish Applicant's deposited lines from other *S. tuberosum* lines which fall outside the scope of the claimed tuber yield except for this tuber yield. Yet the claims read on a broad genus *S. tuberosum* lines, provided they have a yield of 200 g per plant and have the *Sli* gene. One of ordinary skill in the art is given no criteria in the claims to distinguish an "impossible" plant from and "possible" plant such as found in Applicant's deposited lines. Applicant fails to describe any distinguishing structure that is necessary and/or sufficient for the instant invention.

Therefore Applicant's invention appears to require both the *Sli* gene as represented by the deposits and other specific *S. tuberosum* diploid plants that are not described except potentially by reference to the deposit. Applicant fails to describe working examples of the broad genus of any other *S. tuberosum* lines, which, if combined with the *Sli* gene, that fall within the scope of the claims. Applicant only describes one *Sli* gene donor line together with only a few diploid donor lines by deposits. Thus, Applicant fails to describe a representative number of species in comparison to the size of the genus claimed. The claims also fail to require any structure / function relationship that may be necessary and/or sufficient for a potato line to successfully be included in the claimed genus.

The specification therefore fails to provide an adequate written description to support the breadth of the claims. Applicant has not demonstrated possession to one of skill in the art of the instant invention as broadly as claimed at the time of filing. Thus one of skill in the art would not believe Applicant to be in possession of the genus as broadly as claimed especially in view of the discussion of the art by, e.g., Applicant before the EPO and the letter of Dr. Jones.

Dependent claims are included in this rejection because none provide further limitations obviating this rejection.

Applicant's Arguments

Applicant traverses the rejection on page 13 of the response filed on 27 December 2017. Applicant points to the amendments. *Id.*

Response to Applicant's Arguments

The rejection stands for the reasons made of record. Applicant only provides written description for the deposited lines.

As an initial matter, Applicant provides no way to determine whether or not the *Sli* gene is present in the compositions encompassed by the pending claims.

As an additional matter, claim 27 reads on a tissue culture of the plant of claim 23; such a tissue culture can be derived from an embryo obtained by an outcross and thus have a significantly reduced relationship to the plants of the line of claim 1. Claim 28 reads on a plant regenerated from the tissue culture which could be, in turn, significantly different from any plant described in the specification.

As an additional example, claim 40 reads on any progeny line, without restriction as to generation, from the line of claim 1.

Claim Rejections - 35 USC § 112 / enablement

8. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39 and 41 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, because the specification, while being enabling for the deposited cell lines, does not reasonably provide enablement for forms of self-compatibility as broadly as claimed. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention commensurate in scope with these claims.

Due to Applicant's amendments to the claims, the rejection is modified from the rejection set forth in the Office action mailed 7 September 2017 as applied to the above-referenced claims. Applicant traverses the rejection in the paper filed U27 December 2017. Applicant's arguments have been fully considered but are not persuasive.

The invention features plants with novel characteristics. Since these plant characteristics are essential to the claimed invention they must be obtainable by a repeatable method set forth in the specification or otherwise be readily available to the public. If such a plant is not so obtainable or available, the requirements of 35 USC § 112 may be satisfied by a deposit of the seeds. Deposits under NCIMB accession numbers 41663, 41664, 41665 and 41765 were made and the deposits were perfected. However the claims are not drawn solely to the deposits.

The Claims

Claim 1 is drawn to a diploid, fertile, self-compatible *S. tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams; wherein at least 50% of genomic loci in said plant are homozygous, wherein self-compatibility originating from *S. chacoense* and is referred to as a S-locus inhibitor (Sli) gene, a copy of said gene is present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, and wherein at least 25% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds.

Dependent claims are drawn to properties of the potato line (claims 3 and 4); and a plant line of claim 1, or a seed or tuber of the plant (claims 5 and 6). Claim 39 requires that the plant of claim 1 has at least 75% homozygous loci. New claim 40 is drawn to a progeny line of one or more of the lines of claim 1; claim 40 is not rejected under the enablement requirement. New claim 41 requires that at least 90% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds.

New dependent claim 42, not rejected under 35 USC 112(a), is drawn to a method for producing a uniform hybrid potato seed comprising the steps of

(1) providing a first potato plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765;

(2) providing a second potato plant that is from another diploid or tetraploid, fertile, self-compatible and essentially homozygous *S. tuberosum* line according to claim 1, wherein said the two plants contain at least 20% contrasting homozygous loci as determined by

molecular marker analysis; and

(3) cross-pollinating them to produce berries with seeds and then collecting the seeds.

Claim 16 is a method claim drawn to producing a uniform hybrid potato seed starting with a first plant from a diploid, fertile, self-compatible and essentially homozygous *S. tuberosum* potato line according to claim 1 and crossing the first plant with a second plant according to claim 1.

Dependent claims are drawn to properties of the potato line (claims 18 and 20); where the method uses as a first potato plant one of four deposited lines (claim 19 (not included in this rejection); a seed produced by the claimed method (claim 22); and a plant or part thereof produced from the seed of claim 22 (claims 23-25); a tissue culture of the plant of claim 23 and a plant or a plant part produced from this tissue culture (claims 27-28 and 31); and a method using the seed to produce a plant (claim 30).

Claim 32 reads on a set of two homozygous diploid, fertile, self-compatible and essentially homozygous potato lines according to claim 1 wherein each of said lines differ from the other line in the set by having at least 20% contrasting homozygous loci as determined by molecular genetic marker analysis; and wherein at least 50% of loci in said plants are homozygous. Claim 37 reads on a tetraploid line derived from the plant of claim 5 and claim 38 reads on a plant of the line of claim 37. Claim 29 is drawn to a method using either the plant of claim 5 (a diploid plant) or the plant of claim 38 (a tetraploid plant).

Claim 8 is a method claim drawn to producing a diploid, fertile, self-compatible and essentially homozygous *S. tuberosum* potato line, said potato line comprising a

plant having a tuber yield expressed in grams of fresh weight of at least 200 grams, comprising:

(a) providing a first potato plant of a diploid, fertile, self-compatible and essentially homozygous potato line according to claim 1;

(b) providing a second potato plant, 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 potato plant and second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(d) growing a multiplicity of 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, wherein at least 25% of the plants produce seed-carrying berries, each carrying at least 5 seeds, to thereby provide a diploid, fertile, self-compatible and essentially homozygous S. tuberosum potato breeding line, said potato line comprising plant having a tuber yield expressed in grams of fresh weight of at least 200 grams;

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

Dependent claims are drawn to properties of the potato line (claims 9 and 12-13); and where the method uses as a first potato plant one of four deposited lines (claim 11) (not included in this rejection).

Claim 35, an independent claim, reads on a method for producing a diploid, fertile, self-compatible and essentially homozygous potato line using a method similar to, e.g. claim 16, with one of the deposited lines used as the first plant; claim 35 is not included in this rejection.

Claim 36 depends from one of claims 6, 25 or 31 and reads on, e.g., a food product.

Claim 21, not rejected under 35 USC 112(a), is an independent claim drawn to a seed of one of the deposited lines.

New claim 43, not rejected under 35 USC 112(a), is drawn to a method for producing a diploid, fertile, self-compatible and essentially homozygous *S. tuberosum* line, said line comprising a plant having a tuber yield of at least 200 grams, comprising the steps of:

(1) providing a first potato plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765;

(2) providing a second potato plant which is a plant of a diploid *S. tuberosum* line with any level of homozygosity but comprising plants having an average tuber yield at least 200 grams per plant;

(3) cross pollinating the two to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(4) growing a multiplicity of the hybrid offspring seed and selecting plants with a tuber yield at least 200 grams per plant;

(5) selfing or backcrossing the hybrid offspring; and

(6) selecting for plants that produce fertile offspring wherein at least 90% of the plants produce seed-carrying berries, each carrying 5-500 seeds.

The Scope of the Claims

As noted above, the rejected claims are not limited to the deposited accessions. In contrast to four deposited lines the claimed genus is quite large. For example, the claims encompass the genus set forth in the following exemplary claims:

In claim 1, which is a composition claim drawn to a plant, the genus includes any diploid, fertile, and self-compatible with a tuber yield of at least 200 grams and having at least 50% homozygous genomic loci, wherein the self-compatibility originates from *S. chacoense* and is as present in a plant of potato line deposited with NCIMB accession numbers 41663, 41664, 41665, or 41765. Claims 5-6 and 37-38 read on plants directly derived from claim 1 and claims 40-41 read on the line itself or progeny thereof.

The Federal Circuit in *In re Wands* lists eight considerations for determining whether or not undue experimentation would be necessary to practice an invention. In re Wands, 858 F2d 731, 8 USPQ2d 1400, 1406 (Fed. Cir. 1988). These factors are: the quantity of experimentation necessary, the amount of direction or guidance presented, the presence or absence of working examples of the invention, the nature of the invention, the state of the prior art, the relative skill of those in the art, the predictability or unpredictability of the art, and the breadth of the claims. *Id.*

Applicant's Teachings

In the specification, Applicant teaches a breeding process according to the instant invention starting with a self-compatible line, e.g. AGVD 1-3 or AGVD17. *Id.*, p. 37. Applicant teaches that "[n]o or at least little, attention is paid to the agronomical appearance of the plants at this stage." *Id.* One aspect of the breeding steps taught by the specification includes the possibility of adding a desired trait, such as vigor. *Id.*, p. 38. After adding such a trait, the hybrid is backcrossed to the self-compatible line while selecting for, e.g. vigor. *Id.* After adding numerous traits, and performing test crosses, inbred elite diploid breeding lines can be obtained which can be used to produce commercially valuable hybrids. *Id.* Applicant reviews the steps: develop a "a vigorous fertile homozygous self-compatible diploid potato line;" "a diploid breeding line;" and then an "elite diploid potato breeding line." *Id.*, p. 40. On page 43, Applicant concludes that "[t]he above method now provides a breeding process for the production of homozygous breeding lines or elite breeding lines based on the background of population AGVD1, AGVD2, AGVD3 or AGVDI7, to which background successively additional alleles are added, thereby providing elite breeding lines wherein desirable traits are stacked." *Id.*, p. 43.

In the experiments that underlie the claimed invention, Applicant teaches obtaining the IVP07-1001/4 line from publically available germplasm where the IVP07-1001/4 plants contained the *Sli* gene after the repeated selfing in Example 1. Spec., p. 44. Applicant cites to the 2006 Euphytica publication by Phumichai et al. (Euphytica 148:227-34 (2006)) as well as the 2005 Genome publication by Phumichai et al. Genome 48:977-94 (2005)) regarding the source of the *Sli* gene. *Id.*, p. 44 & p. 57 Applicant teaches that these plants are of no commercial value. *Id.* Applicant crossed

these plants to three different diploid donor lines, D1-3, in order to acquire commercially valuable traits carried by the donor lines. *Id.*, pp. 44-45. The F1 cross with D1 was selfed and the progeny deposited as AGVD1, which was estimated as 50% homozygous. *Id.*, p. 45. The F1(D1) was crossed with F1(D2) and the progeny deposited under AGVD2, and this was estimated to be 25% homozygous with respect to alleles originating from IVP07-1001/4. *Id.* The F1(D1) was backcrossed to obtain progeny 25% homozygous with respect to alleles originating from IVP07-1001/4; these were deposited as AGVD3. *Id.*

In Example 2, Applicant teaches crossing the *Sli* gene donor with various publically available potato clones designated: IVP97-079-9, IVPAA-096-I8 and SH83-92-488 to generate clones D1, D2 and D3. *Id.*, p. 47. Applicant teaches this created a diploid trait donor lines containing the *Sli* gene with enhanced agricultural quality. *Id.*, pp. 46-50. Applicant provides a more detailed description of the potato lines used in Table 6. *Id.*, pp. 57-58.

Applicant teaches creating a molecular marker platform, i.e. SNPs, in Example 3. *Id.*, pp. 50-58.

In Example 4, Applicant teaches the development of homozygous diploid potato plants and then F1 hybrid progeny, as well as subsequent generations. *Id.*, pp. 58-62. Applicant teaches that it is "often stated" that potatoes are very prone to inbreeding depression. *Id.*, p. 60. A cause of this might be deleterious alleles; Applicant potentially identified a few such deleterious alleles, with one allele almost being lethal. *Id.*

Applicant concludes, on page 62, that

> It was found that after two generations of selfings homozygous diploid potato plants were obtained comprising alleles from both parents. Not a

> single marker out of 36 markers tested provided proof for a lethal allele. Furthermore, plants with more than 84% homozygous loci can be successfully crossed to obtain hybrid plants with at least five heterozygous chromosome regions. This means that hybrid seeds that are essentially uniform and that represent true potato seed have now been produced.

Id., p. 62.

The Art

The art generally teaches this breeding strategy, or similar strategies. For example, Jansky teaches first obtaining homozygous diploids using a self-incompatibility inhibitor. J Jansky, "Breeding, Genetics, and Cultivar Development," Advances in Potato Chemistry and Technology, ed. J. Singh & L. Kaur, pp. 27-62 (June, 2009), p. 46. Jansky teaches that "[h]ighly homozygous inbreds could be also be used for heterosis breeding. *Id.*, p. 46. Jansky teaches that such an approach would be difficult. *Id.*

Phumichai et al. confirms the approach of Jansky, and documents the use of the *Sli* gene in the approach. Phumichai et al., Genome 48:977-84 (2005), abstract.

> Potato . . . is an auto- or segmental allo-tetraploid showing tetrasomic inheritance, which results in complicated genetic segregation. Since potatoes are propagated vegetatively, highly heterotic genotypes can be maintained, which facilitates the use of heterosis, an essential factor in potato breeding, particularly for tuber yield. Alternatively, open-pollinated true potato seed (TPS) can be used as a low-cost planting material for potato production.
>
> Highly homozygous inbreds, once amply produced, would be highly useful for the development of TPS varieties with genetic uniformity, as well as for the investigation of heterosis.
>
> A scheme for hybrid breeding using homozygous diploids and subsequent somatic hybridization has been proposed, for which the availability of highly homozygous diploid (or pure) lines is a key for success. In considering the use of pure lines for the development of genetically uniform [true potato seed] varieties, self-fertile, seed-propagated lines are

> highly desirable, and simple techniques to develop such lines are necessary.

Id., pp. 977-78 (citations omitted).

Teachings on the Record and by the Inventors

In the response filed on 14 September 2016, Applicant traverses the rejection previously made under 35 USC § 103, now withdrawn, and argues that one of skill in the art would not have a reasonable expectation of success in attempted to develop the potato lines necessary for the instant invention. Response, pp. 21-35. As part of the argument, Applicant reviews the scope and content of the prior art, including, *inter alia*, the Phumichai et al. reference. *Id.*, pp. 27-28. Applicant argues that Watanabe et al. (Breed Sci 46:329-36 (1996)) teaches "homozygous inbred lines have not been obtained at the diploid level due to both inbreeding depression and self-incompatibility." *Id.*, p. 23. Applicant also cites to Jansky as downplaying the possibility of hybrid breeding as 'commercially unfeasible due to "dramatic reductions in fertility and vigor.'" *Id.*, (quoting Jansky, p. 46). Applicant argues that Uijtewaal et al. (Euphytica, 36: 745-53 (1987)) confirms this teaching. *Id.*, p. 23 & p. 25. Applicant concludes the argument with citation of additional material supporting their position that one of skill in the art would not have a reasonable expectation of success in combining the art cited in the rejection under 35 USC 103.

In support of the argument, Applicant also filed a declaration under 37 CFR 1.132 by Dr. Lindhout with supporting letters. The supporting letters were initially filed in European Application EP2699684 (04 June 2014) and appear to be copies therefrom. The letters teach that the success of Applicant's invention, as broadly as encompassed

by the pending claims, was unpredictable. For example, on page 2 of his letter, Dr. Koornneef states that

> Ever since Lindhout and his co-workers published their results in Potato Research volume 54 of 2011, showing high yielding hybrids from 87% homozygous F3 inbreds, I have been positively surprised that Solynta has managed to challenge this dogma. Solynta could successfully obtain essentially homozygous inbred lines by making use of genotypes that are selfcompatible and by choosing the right starting material that apparently is heterozygous for a lower number of deleterious alleles. This provides the basis of generating useful inbred lines that can become parents of F1 hybrids.

Letter from Koornneef (2012) p. 2 (underlining added). Earlier, Dr. Koornneef also states that "to start a project aiming at developing a good performing homozygous potato plant for the purpose of hybrid production is a daring undertaking with very little chance of success. *Id.*

In another letter supplied in support of Dr. Lindhout's declaration, Dr. J.D.G. Jones states that

> [I]n the mid 2000s we attempted to produce hybrid potato ourselves. . . . However, we never succeeded in developing any promising material in the form of fertile homozygotes that could be useful for hybrid breeding and that could tolerate recurrent selfing. . . . We considered that this was due to our inability to cross the Sli- self-compatibility locus into good enough or diverse enough diploid Solanum germplasm.

Letter from Dr. Jonathan D.G. Jones (2012), p. 1 (underlining added).

Furthermore, on 15 December 2011, over two years after the filing date of the instant application, Lindhout et al. published a paper in the Potato Research journal which appears to correspond to the experiments set forth in the instant examples (all five inventors are among the six authors on the paper). Lindhout et al., Potato Res 54:301-12 (2011). The discussion in the paper is instructive. For example, Lindhout et al. describes that

> As a consequence of the high level of unfavourable alleles, techniques aimed at developing homozygotes in one step, although successful as a technology in various crops, certainly do not generate vigorous homozygous potatoes. For instance, if 20 of the 39,000 protein-encoding genes (PGSC 2011) on the potato genome harbor alleles causing severe fitness reduction, the chance to generate vigorous diploid selfed progenies without homozygous unfavourable loci from a parent genotype, that is heterozygous for these 20 loci, is only 0.3%.

Id., p. 303. Lindhout et al. concludes that "inbred lines were developed that combined self-compatibility with good agronomic performance. Although the number of such plants is still low, the progress made in this breeding programme is significant." Id., p. 304. As a possible reason for success, Id. offers "lethal alleles do not occur at high frequency in our diploid potato germplasm. Lindhout et al., pp. 308-09. The authors continue that

> there are many loci with minor effects involved in these traits (Quantitative Trait Locus, QTL). Our current research focuses on identifying the crucial QTLs for these traits. The results will be applied in breeding and allow to increase efficiencies by using diagnostic markers for these traits.

Id., p. 309.

Revisiting the Scope of the Claims

Applicant claims a large genus of *S. tuberosum* plants. Both Jansky and Spooner et al. describes the breadth of the of the claimed genus as extremely large. See, e.g., Jansky, "Breeding, Genetics, and Cultivar Development," Advances in Potato Chemistry and Technology, ed. J. Singh & L. Kaur, pp. 27-62 (June, 2009), pp. 27-29; Spooner et al., Bot Rev 80:283-383 (2014), Table 1, pp. 286-94. Applicant's invention in claim 1, for example, reads on any potential potato line that is a "diploid, fertile, self-compatible potato line" where the self-compatibility is the same as the gene present in the deposited samples and where the potato line has a yield of 200 g per plant.

In view of Applicant's arguments in response to the rejection under 35 USC § 103 and Dr. Lindhout's declaration with its supporting letters, success in practicing Applicant's claimed invention is unpredictable and appears to depend on the genotype of the potato lines. Therefore, extensive guidance would be required to enable the invention as broadly as claimed. Such guidance is not provided.

The specification therefore does not enable one skilled in the art to make and use members of the species of the claimed genus other than the deposited lines. See, for example, MPEP 2164.06(a)(II), citing to *Ex parte Jackson*, 217 USPQ 804, 806 (Bd. App. 1982). The issue before the Board in *Ex parte Jackson* was:

> The issue squarely raised by this rejection is whether or not a description of several newly discovered strains of bacteria having one particularly desirable metabolic property in terms of the conventionally measured culture characteristics and a number of metabolic and physiological properties would enable one of ordinary skill in the relevant art to independently discover additional strains having the same specific, desirable metabolic property, i.e., the production of a particular antibiotic.
>
> To state the issue somewhat differently, it is whether a verbal description of a new species would enable one of ordinary skill in the relevant art to obtain strains of that species over and above the specific strains made available through deposit in one of the recognized culture depositories.

Ex parte Jackson, 217 USPQ 804, 806 (Bd. App. 1982). In the instant application, the issue is similar to the one before the Board in that Applicant made deposits with unique characteristics but not taught how to make and use other lines similar to the deposited lines. In *Ex parte Jackson*, the Board held that the deposit, without a detailed explanation of how to obtain more species, did not enable the generic claims. *Id.*, p. 808. The board found that "the degree of experimentation involved in locating new [organisms] apart from deposited cultures is undue in light of the enablement requirement of 35 U.S.C. 112." *Id.* The *Jackson* decision was considered and

distinguished by the Federal Circuit in the Wands decision in view of the routine experimentation required to obtain hybridomas that were before the bar in the Wands application. *In re Wands*, pp. 1403-04. Therefore, in particular in view of the *Ex parte Jackson* decision, the generic scope of claims 1, 8, 16 and 34, reading on the genus as set forth above, is not enabled. Obtaining further species falling within the scope of the generic claims would require undue experimentation.

Furthermore, Applicant provides minimal teachings and/or guidance regarding the *Sli* gene, which appears to be an essential part of the claimed invention.

Dependent claims are included in this rejection because none provide further limitations obviating this rejection.

Applicant's Arguments

Applicant traverses the rejection on pages 14-15 of the response filed on 27 December. Applicant quotes extensively from the specification. Response, p. 14. Applicant also cites to the Declaration of Dr. Lindhout under 37 CFR 1.132 dated 08 May 2017. *Id.*, p. 15.

Response to Applicant's Arguments

Applicant fails to provide a new argument in support of patentability. Applicant quotes from the specification, and Applicant cites to Dr. Lindhout's declaration. Dr. Lindhout's declaration was addressed in the Office action dated 7 September 2017.

Applicant's arguments fail to address the rejection of record concerning the scope of enablement other than by citing to Dr. Lindhout's declaration dated 8 May 2017. The declaration under 37 CFR 1.132 filed 8 May 2017, however, is insufficient to overcome the rejections of the above claims as set forth above. In particular, Applicant

fails to address the teachings of Dr. Koornneef and Dr. Jones. Applicant also fails to address the teachings in the paper by Dr. Lindhout et al. Further, Applicant does not address Jansky's 2016 article providing an overview of the field.

Regarding Dr. Lindhout's declaration, after introductory remarks, Dr. Lindhout begins the argument in paragraph 12. Dr. Lindhout disputes Dr. Jones' understanding of the "gist" of the invention. However, Dr. Lindhout submitted the letter in support of Dr. Lindhout's previous declaration. It is disingenuous to now assert that Dr. Jones does not understand the "gist" of the instant invention. Furthermore, Dr. Lindhout fails to address Dr. Koornneef's letter.

Dr. Lindhout states that the Office is interpreting the invention too narrowly. Decl., para. 12, 1st line. The Examiner disagrees, the invention is not being interpreted. At issue are the pending claims and the claims being examined are extremely broad. The scope of the claims is the issue in the instant rejection. The position of the Office is that the pending claims, except as noted, are too broad.

Dr. Lindhout then sets forth how the lines represented by D1, D2 and D3 were not selected. *Id.* But, in view of *Ex parte Jackson*, neither the specification nor Dr. Lindhout teaches how to obtain more such lines.

Dr. Lindhout then states that "other factors [are] at play to arrive at a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* plant." With all due respect to Dr. Lindhout, the pending claims are being examined. There is no limitation directed at "other factors." "It is improper to import claim limitations from the specification" into the claims. MPEP § 2111.01(II). "Though understanding the claim language may be aided by explanations contained in the written description [the

specification], it is important not to import into a claim limitations that are not part of the claim. For example, a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment." *Id.*, (quoting *Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875, 69 USPQ2d 1865, 1868 (Fed. Cir. 2004)).

Furthermore, on 8 September 2016, Dr. Lindhout submitted a declaration traversing the rejection under 35 USC 103 that stated, *inter alia*, that

> That the chance of obtaining a progeny plant, by crossing different genotypes, which is not suffering from inbreeding depression in potato is infinitesimally small, and that starting from a heterozygous diploid potato genotypes, the chance of identifying a plant without homozygous deleterious alleles is, in practice, impossible . . .

Decl. (2016), para. 12, p. 4. In the declaration signed 8 May 2017, Dr. Lindhout now states that "I am convinced that the invention can also be practiced by introgressing the self-compatibility originating from *Solanum chacoense* into *Solanum tuberosum* parent lines other than D1 – D3." Decl. (2017), para. 12 (sub-para. 2), p. 3. Dr. Lindhout does not explain the apparent difference in his opinion between 2016 and 2017. Therefore Dr. Lindhout's 2017 declaration fails to persuade regarding the above rejection of the pending claims.

Further, regarding Dr. Lindhout's assertion about "luck" and "unpredictability" (para. 12) the word "luck" does not appear in the Office action mailed on 21 February 2017. Unpredictability is an issue under the instant enablement rejection. However, the teachings of the art, Applicant's cited experts, and the inventors themselves as set forth above establish that obtaining *S. tuberosum* lines that would function in the instant invention is unpredictable. Applicant fails to provide sufficient guidance as to how to

enable the genus of plants as broadly as claimed. Therefore the rejection is maintained.

In 1966, the Supreme Court held that

> The basic quid pro quo contemplated by the Constitution and the Congress for granting a patent monopoly is the benefit derived by the public from an invention with substantial utility. Unless and until a process is refined and developed to this point-where specific benefit exists in currently available form, there is insufficient justification for permitting an application to engross what may prove to be a broad field.

Brenner v. Manson, 383 U.S. 519, 534-35, 148 USPQ 689, 695 (1966). The full scope of Applicant's claimed invention is not enabled.

Finally, in 2016 Jansky et al. published an "Opinion & Policy" article calling for "Reinventing Potato as a Diploid Inbred Line-Based Crop." Jansky et al., Crop Sci. 56:1412-22 (2016). In approximately the same generalized viewpoint as adopted by Dr. Lindhout in the 2017 declaration, the authors call for the creation of "diploid inbred lines" (Id., p. 1413) with improved, e.g. tuber yield (Id., 1414) for use in creating inbred pools for use in heterosis. *Id.* The authors devoted almost a page to the challenges faced. *Id.*, p. 1415. Then the authors addressed questions that must still be answered. *Id.* pp. 1415-18. They cite to Dr. Lindhout's work on page 1417 and page 1418 as ongoing testing. Neither Jansky et al. in this article nor Dr. Lindhout in his declaration specifically address the 200 g tuber-yield per plant limitation. Therefore, approximately seven years after the filing date of the instant application, the problem of creating vigorous inbred diploid *S. tuberosum* plants apparently still exits.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25 29, 31-32, 37-39 and 41 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Phumichai et al., Euphytica 148:227-34 (2006) in view of Maris, Euphytica 46:15-33 (1990); in view of Hosaka & Hanneman, Jr., Euphytica 99:191-97 (1998); in view of Lippman & Zamir, Trends Genet 23(2):61-66 (2006); and in further view of Bradshaw et al., Potato Res 49:49-65 (2006).

This is a new rejection necessitated by Applicant's amendments to the claims.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

a. Determining the scope and contents of the prior art.

b. Ascertaining the differences between the prior art and the claims at issue.

c. Resolving the level of ordinary skill in the pertinent art.

d. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Phumichai et al. (2006) teaches inbred potato plants comprising the *Sli* gene from *S. chacoense* that are fertile. Phumichai et al. (2006), pp. 228-29. Phumichai et al. teaches that the aim of their research is heterosis in potatoes. *Id.*, p. 227. Phumichai et al. also teaches that as of writing the 2006 publication, "use of [the] *Sli* gene has been very much limited to only our laboratory." *Id.*

The benefits of using heterosis from the cross of two inbred homozygous lines is well known in the art. See, e.g., Lippman & Zamir, p. 62 (Box 2).

Phumichai et al. does not specifically address the percentage of the plants that produce seed-carrying berries with five seeds, but, for example, line 1 produced 387 plants with 212 pollinated plants producing 4266 flowers which thus appears to fall within the scope of lines 12-13 of claim 1. Furthermore, 5 berries is routine in the art. Hosaka & Hanneman, Jr., e.g., Table 1. Hosaka & Hanneman also teaches plants with berries set up to 100% in self-pollinations. *Id.*, p. 193.

Phumichai et al. does not mention crossing to *S. tuberosum*. Bradshaw et al. however, teaches the value of obtaining genes from *S. chacoense* and crossing such genes into *S. tuberosum*. Bradshaw et al., p. 56.

Maris discloses plants that have an average tuber yield of at least 200 g/plant. See, e.g., Maris, Table 8, pp. 26-28.

In any case, breeding a potato line for a high yield of tubers per plant , or with 90% of the plants in a line produce seed-carrying berries, is an obvious step. In the *KSR* decision, the Supreme Court held that:

> When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

KSR Int'l Co. v. Teleflex Inc., 550 US 398, 417, 82 USPQ2d 1385, 1396 (2007).

Therefore the phenotypes that are claimed in claim 1 are known in the art. Phumichai et al. teaches the development of lines for the use of heterosis in potato

breeding but does not teach S. *tuberosum* lines. Bradshaw et al. teaches using *S. tuberosum* lines. Therefore It would have been *prima facie* obvious to one of ordinary skill in the art at the time of Applicant's invention to use the *Sli* gene of Phumichai et al. to develop *S. tuberosum* lines with the robust phenotypes required by claim 1. (Also note that the 5-seed-per-plant value is the lowest taught by the specification on page 28.) All steps required to produce the claimed potato line were routine in the art at the time of Applicant's invention. Therefore claim 1 is obvious.

Claims 8, and 22-25 merely recite routine breeding steps and components (*see* e.g., *supra*) and thus are obvious. Using diploid, fertile and either self-compatible or self-incompatible lines are obvious in view of, e.g. Bradshaw et al., p. 50, and thus claims 12-13 are obvious.

n view of the teachings of Phumichai et al. regarding the heterozygosity of two lines (see, e.g., page 978), two breeding lines that comprise at least 20% contrasting homozygous loci are obvious in view of the lines of, e.g., Maris, and thus claims 16 and 29-30 are obvious. Potato plants and tubers of the line are obvious in view of the line and thus claims 5-6 and 31 are obvious.

Bradshaw et al. teaches introgressing disease resistance genes (p. 6) and thus claims 3, 9, 18, and 20 are obvious.

Maris does not teach potato plants having an average fresh weight of at least 500 grams as recited in claim 4. Maris, however, does teach potato plants having a dry matter yield in a range of approximately 111 g per plant to 158 g per plant. *Id.*, Table 8, p. 28. Thus, for example, a plant with an average fresh weight which only displays a 316% increase with respect to its dry weight is obvious in view of the plants of Table 8

of Maris, and furthermore, obtaining a larger plant is obviously a beneficial phenotype, and thus claim 4 is obvious. Similarly, lines with plants producing up to 90% with berries is obviously advantageous (see, also Hosaka & Hanneman, p. 193) and thus claim 41 is obvious.

It is well known that most commercial potato lines are tetraploid (Bradshaw et al., p. 50) and thus claims 37-38 are obvious.

Creating a plant line that is, e.g., 50% or 75% homozygous, is routine the agricultural art (see, e.g., Lippman & Zamir, entire article), and thus claims 32 and 39 are obvious.

Claims 27 and 28 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Phumichai et al., Euphytica 148:227-34 (2006)) in view of Maris, Euphytica 46:15-33 (1990); in view of Hosaka & Hanneman, Jr., Euphytica 99:191-97 (1998); in view of Bradshaw et al., Potato Res 49:49-65 (2006); and in further view of Wang & Ran (NZ J Crop Hort Sci 28:1-8 (2000)).

Claims 1, 16 and 23 are obvious as set forth *supra*. The above references do not teach the use of tissue culture. Wang & Ran teach the value of using tissue culture to improve agronomically desirable traits of potatoes.

It would have been *prima facie* obvious to one of ordinary skill in the art at the time of Applicants' invention to follow the teachings of Wang & Ran to create tissue cultures from the potato plants regenerate plants therefrom. Given the level of skill in

the art at the time of Applicants' invention, one of ordinary skill in the art would have had a reasonable expectation of success. Therefore claims 27 and 28 are obvious.

Conclusion

10. Claims 21, 35 and 42-43 are allowed.

Allowable Subject Matter

11. Claims 11 and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RUSSELL T BOGGS whose telephone number is (571)272-2805. The examiner can normally be reached on Monday - Friday, 0800 to 1830 Mtn.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amjad Abraham can be reached on 571-270-0708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/RUSSELL T BOGGS/
Examiner, Art Unit 1663

/Amjad Abraham/
Supervisory Patent Examiner, Art Unit 1663

Notice of References Cited	Application/Control No. 13/504,156	Applicant(s)/Patent Under Reexamination Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
	A					
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	K					
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FOREIGN PATENT DOCUMENTS

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	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
*	U	Wang & Ran (NZ J Crop Hort Sci 28:1-8 (2000))
*	V	Phumichai et al., Euphytica 148:227-34 (2006)
*	W	Maris, Euphytica 46:15-33 (1990)
*	X	Hosaka & Hanneman, Jr., Euphytica 99:191-97 (1998)

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 13/504,156	Applicant(s)/Patent Under Reexamination Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
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	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Bradshaw et al., Potato Res 49:49-65 (2006)
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	Art Unit
	RUSSELL T BOGGS	1663

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

	/RUSSELL BOGGS/ Examiner.Art Unit 1638

Agventure B.V. Ex. 2009
IPR2025-00136
Page 922

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	Art Unit
	RUSSELL T BOGGS	1663

Search Notes		
Search Notes	**Date**	**Examiner**
STIC search of STN	8/12/14	/RTB/
STN, EAST and Google search as per attached	9/28/14	/RTB/
STIC search	9/23/14	/RTB/
EAST search as per attached	5/11/15	/RTB/
discuss claims and rejections with A.M. Grunberg	5/8/15	/RTB/
EAST search as per attached	1/31/16	/RTB/
extensive literature search by cross-referencing, Google Scholar & PubMed	1/19 to 2/2/16	/RTB/
EAST search as per attached	1/6/17	/RTB/
discuss objection because amendment cannot be ORCed w/ A. Kubelik	08/23/2017	/RTB/
Google Scholar search up to	08/25/2017	/RTB/
EAST & STN search as per attached	08/25/2017	/RTB/
discuss rejections w. C. Worley	09/02/2017	/RTB/
EAST search as per attached	04/13/2018	/RTB/
discuss 103 rejection with A. Abraham & C. Worley	May,2018	/RTB/

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

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Page 923

Receipt date: 12/27/2017

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

U.S.PATENTS

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Receipt date: 12/27/2017

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13504156
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	First Named Inventor	Willem Hendrik LINDHOUT
	Art Unit	1663
	Examiner Name	Russell T BOGGS
	Attorney Docket Number	091876-0014

/R.T.B/	1	International Search Report relating to PCT/NL2012/050269, issued September 19, 2012.	☐
/R.T.B/	2	Johnstone, Jr., Francis E. "Chromosome Doubling in Potatoes Induced by Colchicine Treatment," American Journal of Potato Research, Vol. 16, No. 11, pages 288-304, November 1, 1939.	☐
/R.T.B/	3	Ramulu, K. Sree, H. A. Verhoeven, and P. Dijkhuis. "Mitotic blocking, micronucleation, and chromosome doubling by oryzalin, amiprophos-methyl, and colchicine in potato." Protoplasma, Vol. 160, No. 2-3, pages 65-71, June 1, 1991.	☐

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EXAMINER SIGNATURE

Examiner Signature	/RUSSELL T BOGGS/	Date Considered	04/06/2018

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

Receipt date: 12/27/2017

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

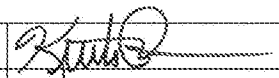
☐ See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	2017-12-27
Name/Print	Kristin A Connarn	Registration Number	57,025

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1237	800/317.2.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2018/04/13 18:04
L2	84637	potato.ab. or tuberosum.ab.	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2018/04/13 18:04
L3	404	a01h5/04.cpc.	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2018/04/13 18:04
L4	85657	L1 or L2 or L3	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2018/04/13 18:04
L5	251	L4 and (inbred near line)	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2018/04/13 18:04
L6	25	L5 and heterosis	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2018/04/13 18:04

EAST Search History (Interference)

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PTO/SB/30 (11-17)
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Request for Continued Examination (RCE) Transmittal

Address to:
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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	13/504,156
Filing Date	July 10, 2012
First Named Inventor	Willem Hendrik Lindhout
Art Unit	1663
Examiner Name	Russell T. Boggs
Attorney Docket Number	091876-0014

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 CFR 1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

   a. ☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

      i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

      ii. ☐ Other _____

   b. ☑ Enclosed

      i. ☑ Amendment/Reply

      ii. ☐ Affidavit(s)/ Declaration(s)

      iii. ☑ Information Disclosure Statement (IDS)

      iv. ☐ Other _____

2. Miscellaneous

   a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

   b. ☐ Other _____

3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

   a. ☑ The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 50-1133.

      i. ☑ RCE fee required under 37 CFR 1.17(e)

      ii. ☐ Extension of time fee (37 CFR 1.136 and 1.17)

      iii. ☐ Other _____

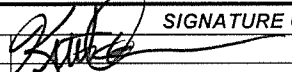
   b. ☐ Check in the amount of $ _____ enclosed

   c. ☐ Payment by credit card (Form PTO-2038 enclosed)

   d. ■ Payment by EFS-Web

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Signature		Date	8/29/2019
Name (Print/Type)	Kristin A. Connarn	Registration No.	57,025

CERTIFICATE OF MAILING OR TRANSMISSION

I hereby certify that this correspondence is being EFS-Web transmitted to the United States Patent and Trademark Office (USPTO), deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 or facsimile transmitted to the USPTO on the date shown below.

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Name (Print/Type)		Date	

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
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(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik Lindhout
Art Unit	1663
Examiner Name	Russell T. Boggs
Attorney Docket Number	091876-0014

U.S.PATENTS

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	1	1289094	CA		1991-09-17	Robert D. Reichert		☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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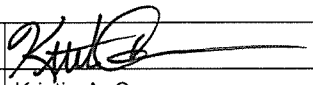
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Signature		Date (YYYY-MM-DD)	2018-08-28
Name/Print	Kristin A. Connarn	Registration Number	57,025

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(19)(CA) **CANADIAN PATENT** (12)

(54) Method of Solubilizing Potato Starch

(72) Reichert, Robert D. , Canada

(73) Majesty (Her) in right of Canada as represented by National Research Council of Canada , Canada

(57) 11 Claims

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Abstract

A process as described for solubilizing starch, particularly potato starch. Raw or partially gelled potato starch granules are mixed with a substantially saturated aqueous solution of NaCl and KCl in which the NaCl and KCl are in equilibrium, causing swelling of the starch granules to form swollen membrane-encapsulated starch granules. These swollen membrane-encapsulated starch granules are ruptured, e.g. by homogenization, to disperse the solubilized starch into the saturated NaCl/KCl solution.

Method of Solubilizing Potato Starch

This invention relates to a process for solubilizing starch, particularly potato starch.

Starch in plants is in the form of discrete granules which are not soluble in water. Before raw starch can be used in most applications, it must be gelatinized to solubilize the glucose polymers. Normally starch is solubilized by heating in water or by using certain chemicals, such as NaOH, to gelatinize the starch.

In the past, Canadian potash mines used starches to act as a clay depressant in their potassium chloride floatation operation. The clay depressing agent is added to prevent clays from reacting with the amines which are used to float off the potassium chloride and to help sediment the clays. Effectively, the clay depressing agent blocks sites on the clay in which amines can be attached.

It is also known from U.S. Patent 4,422,947 that a cross-linked potato starch is an effective agent for a wellbore fluid, providing improved water loss control. The water loss reduction was obtained using brines containing NaCl, $CaCl_2$ or KCl.

In recent years nearly all mines have switched to guar gum as a clay depressant because it is soluble in

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cold brine and because of price considerations. It was considered too costly and too inconvenient to use raw starches since it was necessary to cook them prior to use. Pre-cooked dry starches are used in some countries, such as France, but these pre-cooked starches are extremely expensive.

There is, therefore, a need for a cheap, simple way to solubilize starches.

According to the present invention, it has been discovered that potato starch appears to have the unique property of being capable of being solubilized by contact at room temperature with a solution saturated with both NaCl and KCl.

It has surprisingly been found that while saturated NaCl is only moderately effective in solubilizing potato starch and saturated KCl is totally ineffective, the combination of NaCl and KCl saturation is highly effective. Only a slight dilution of the saturated NaCl/KCl solution can be tolerated without markedly decreasing the rate of potato starch solubilization. Moreover, it was found that corn, wheat starch and tapioca stirred in saturated NaCl/KCl solution did not dissolve nor did the solutions increase in viscosity even after extended solubilization times. Potato starch is believed to be unique among starches in having high concentrations, e.g. 0.06 - 0.1%, of phosphorus present as dihydrogen orthophosphate groups esterified to amylopectin fractions.

A typical aqueous solution saturated with both NaCl and KCl in equilibrium contains about 20 wt. % NaCl and about 10 wt. % KCl. The saturated solution preferably has a pH from about 4 to about 10 and preferably the starch is present in the saturated solution in an amount of less than 10% by weight dry starch solids.

As potato starch dissolves in saturated NaCl/KCl brine, the solution increases markedly in viscosity.

The increase in viscosity is due to the swelling of the starch granules, with the granules swelling to occupy many times their original volume. The granules swell slowly and it is apparent from microscopic analysis that the contents of the granules dissolve in the brine. It was observed under microscopic analysis that the granules did not burst to release their soluble contents even after lengthy periods of stirring. It was necessary to rupture the membrane, e.g. by shearing, homogenization, sonic waves, or freezing, to disperse the contents of the swollen granules into the brine. A decrease in viscosity is observed as the swollen granules are ruptured. Although the solubilization is preferably carried out at room temperature, a higher temperature can be used to speed up the rate of solubilization. Generally, the temperature is in the range of 20-40°C.

According to a preferred embodiment, it has been discovered that it is possible to substantially reduce the viscosity of potato starch solubilized in brine by adding thereto alpha-amylase enzyme. It appears that the enzyme is capable of hydrolyzing the potato glucose polymers even in a saturated brine solution.

In accordance with another preferred embodiment, it has been found that the addition of heavy metals, such as $CuSo_4$, $CuCl_2$ or $MgCl_2$, increases the rate of potato starch solubilization in saturated NaCl/KCl brine. It is believed that this due to the stabilization of amylopectin molecules in solution by the formation of phosphate-metal ion complexes. As a consequence, it has been found that some potash brines solubilize starch better than others. For instance brine from the Cory mine, which contains Mg^{++}, solubilizes starch faster than a saturated NaCl/KCl solution.

According to another preferred embodiment, it has been found that freezing whole potatoes followed by drying in a

freeze-drier markedly increases the rate of potato starch solubilization in saturated NaCl/KCl brine.

The process of this invention has the advantage of being carried out in saturated brine which is a very dense medium. When starches are handled in water, they settle rapidly and pack extremely tightly on the bottom of a container because the starch itself has a high density. In brine, the starch does not settle quickly and is thus much easier to handle. Brine also has unique advantages in handling because of its high boiling point elevation. This allows low temperature storage of brine solubilized potato starch without freezing the solution. It is also possible to utilize brine to solubilize the starch and then partially remove the brine by lowering the temperature.

The potato starch can be in the form of pure potato starch or potato flour or the potato may be in a raw form.

Certain preferred embodiments of the present invention are illustrated by the following examples.

Example 1

A series of tests were conducted in which drum-dried potato starch and raw potato, wheat, corn and tapioca starches were mixed with different solvents. The raw potato starches were obtained from the Sigma and Sargent Chemical Companies and The Canada Starch Co. Drum-dried potato starch was prepared using potato starch from the Sargent Chemical Company. For each test with the raw starches, 2 g of starch was continuously mixed in 100 ml of solvent for a period of time. The mixture was transferred with washing (distilled water) to an Osterizer® blender and homogenized at the highest speed for 1 min. The solution was transferred with distilled water washing into a 200 ml centrifuge bottle and centrifuged at 10,000 rpm for 10 min. to sediment the insoluble starch. The supernatant was discarded and the insoluble starch

residue was stirred with 200 ml of distilled water to remove residual salt. The solution was again centrifuged for 10 minutes at 10,000 rpm and the supernatant was discarded. The insoluble starch was dried and weighed. The percentage of soluble starch (on a dry weight basis) was calculated based on the initial weight (2 g) of starch which was used and on the weight of insoluble starch.

For each test with the drum-dried potato starch, 2 g of starch was continuously mixed with 100 ml of solvent for 0.5 hr. The solution was transferred with distilled water into a centrifuge bottle and centrifuged at 10,000 rpm for 10 min. The supernatant was discarded and the insoluble starch residue was stirred with 200 ml of distilled water to remove residual salt. The residue was washed, dried and weighed as above. In one test without the homogenization step, the insoluble starch residue was washed 4 times, each with 200 ml distilled water, to remove the residual salt. The saturated NaCl/KCl solution was prepared by mixing equal amounts of weight of NaCl and KCl crystals in solution to yield 20.8% by weight NaCl and 10.4% by weight KCl. The results are shown in Table 1 below.

A

TABLE I

Solvent	Starch Solubility (%) at 22°C						
	Sigma Potato Starch			Drum-Dried Potato Starch	Wheat Starch	Corn Starch	Tapioca Starch
	0.5 hr	5 hr	96 hr	0.5 hr	96 hr	96 hr	96 hr
Water	1.1	0.8	1.4	95.9	6.5	2.5	1.5
Saturated NaCl	0.4	9.8	13.8	94.2	-	-	-
Saturated KCl	0.2	0.6	0.9	95.9	-	-	-
Saturated NaCl/KCl	40.6	73.0	74.4	96.4	9.5	2.9	2.1
Saturated NaCl/KCl diluted (5/6 concentration)	-	0.4	1.3	-	-	-	-
Saturated NaCl/KCl +0.2% $MgCl_2$	47.5	74.4	79.1	-	-	-	-
Saturated NaCl/KCl without homogenization	-	16.7	-	-	-	-	-
	Sargent Potato Starch						
Saturated NaCl/KCl	85.6	92.4	93.2				
	Canada Starch Potato Starch						
Saturated NaCl/KCl	82.4	91.0	93.0				

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The above table shows that raw potato starch as well as raw wheat, corn and tapioca starch, have limited solubilities in water, whereas drum-dried (pre-cooked) potato starch is highly soluble in water. The table shows that the combination of saturated NaCl and KCl is much more effective in solubilizing raw potato starch than is saturated NaCl or saturated KCl alone at all solubilization times tested. It also shows that a slight dilution of the saturated NaCl/KCl solution effectively eliminates its ability to solubilize the potato starch. Whereas the solubility of potato starch was very high in the saturated NaCl/KCl solution, the solubility of raw wheat, corn and tapioca starches is negligible. The rate of potato starch solubilization is increased by the addition of 0.2% $MgCl_2$ to the saturated NaCl/KCl solution at 0.5 hr. and 96 hr. solubilization times. If the homogenization step is eliminated, raw potato starch cannot be effectively solubilized in saturated NaCl/KCl brines since the results show a starch solubility of only 16.7%. The potato starches obtained from the Sargent Chemical Company and The Canada Starch Co. were more soluble in saturated NaCl/KCl solution and solubilized at a faster rate than starch from the Sigma Chemical Co.

Example 2

A series of tests were conducted to determine the effectiveness of potato starch solubilized according to this invention to depress clay in potash ore taken from the Rocanville mine. In these tests, purified raw potato starch and fresh whole potatoes were solubilized in the manner described hereinbefore and tested as a clay depressant at a level of 0.0604 kg/tonne of ore. Cooked starches are normally used at levels between 0.0906 and 0.151 kg/tonne; the present tests were conducted at a lower level to accentuate the differences between samples. The saturated brine used in preparing

the depressants was obtained from the Cory mine. The ore contained 27.13% KCl, 71.04% NaCl and 1.83% insolubles, while the Cory brine was composed of 10.63% KCl, 20.30% NaCl and 69.08% water.

1. Preparation of Depressants

Depressent A

Twenty grams of peeled, diced Russet Burbank potatoes from the Dept. of Horticulture, U. of Sask. were placed in a 500 ml flask. Saturated brine from the Cory potash mine was added to the flask until the contents weighed 336 grams. This was homogenized in a Sunbeam® blender for 4 minutes at high speed. Excess NaCl and KCl was added to resaturate the mixture. The saturated mixture was mixed for three days at 22°C, then allowed to stand for 10 seconds and the solution was decanted, leaving the salt crystals behind. This was homogenized again for 4 minutes in a blender and was diluted with Cory brine to 0.5% soluble starch level (based on the moisture content of potatoes, assuming that potatoes contained 75% starch on a dry basis and that 90% of the starch was solubilized).

Depressant B

Fresh potatoes (Russet Burbank) in an amount of 17.55 grams were cut into cubes (approximately 1/4" x 1/4" x 1/4"). The cubed potatoes were made up to 474 mls with Cory brine and the solution was resaturated with excess NaCl and KCl. The saturated mixture was mixed for two days at 22°C and decanted after allowing the excess NaCl and KCl to settle. The solution was homogenized for 2 minutes. About 0.15% of $CuSO_4$ was then added to the solution as a preservative.

Depressant C

A pure potato starch was obtained from the Sargent Chemical Company and 1.33 grams of the starch was made up to 250 mls with Cory brine. This was mixed for 15

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hours at 22°C and homogenized for 1 minute.

2. Preparation of Ore

The Rocanville ore was first screened on a 19-inch Sweco®screen to the fractions shown in Table II below:

TABLE II

Sweco Screen Size	Opening	Wire DIA
6	0.1318	0.0348
8	0.0964	0.0286
14	0.0510	0.0204
20	0.0340	0.0162
34	0.0065	0.0084
80	0.0035	0.0029

Feed samples were measured and stored in the splits shown in Table III below.

TABLE III

Mesh	Coarse (g)	Fine (g)	CUM %
- 6 + 8	25		2
- 8 + 14	258		23
-14 + 20	416		37
-20 + 34	574		51
-34 + 80		326	80
-80		551	100

3. Floatation Testing

Scrubbing and reagentizing were performed in a Denver® cell at 1200 rpm. Coarse and fine fractions were treated separately. The coarse fraction was treated at 65% solids while the fines were treated at 50% solids. The reagents and their concentrations are shown in Table IV:

TABLE IV

Reagent	Name	Conc.	Coarse		Fine
Depressant	(tab IV)	0.5	40%		60%
Collector	Amine	3.0	1 ml		.6 ml
Modifier	Esso 904^{R}	100	6 drp		nil
Frother	Dowforth P^{R}	100	2 drp	to	cell

The brine was prepared in a 300 gallon tank with an agitator. Rocanville ore was used to saturate the brine. During tests the brine was transferred to a 35 gallon barrel where pure KCl and NaCl were added to maintain saturation. The average brine assay showed 10.63% KCl, 20.30% NaCl and 69.08% water. The ambient temperature was 19°C.

Floatation was performed on a Wemco® cell. Both coarse and fine fractions were combined in the cell with 2 liters of brine. This slurry was agitated for 1 minute following the addition of the frother. The air was turned on and the concentrate was skimmed off. Floatation time was 2 minutes with 2 liters of brine added to maintain the cell level. The concentrates and tailings were filtered and dried. The wet and dry weights were recorded and the samples were pulverized and analyzed by X-ray for KCl and insoluble levels. The results are shown in Table V:

TABLE V

Comparison of Different Depressants for KCl Floatation

Depressant	% Recovery of KCl	% KCl in Concentrate	% Insolubles
A	86.2	74.6	3.4
B	89.6	77.3	2.3
C	74.8	77.5	2.5

From the above results it can be seen that potato starch in the form of a purified starch or as present in the fresh whole potato can be used effectively as a clay depressant to give a high recovery (74.8-89.6%) of KCl from the ore. Whereas the concentration of KCl in the ore was 27.13%, the concentration in the concentrate was raised to 74.6-77.5%.

The results also show that the granules in the fresh potato can be effectively swollen if the potato is completely macerated in saturated NaCl/KCl brine (Depressant A) or if the potato is dispersed in the brine in the form of cubes (1/4" x 1/4" x 1/4")(Depressant B). The brine is presumably able to penetrate the potato cubes effectively and the intact cellular structure of the potato does not inhibit the swelling of the starch granules.

When fresh potatoes were used as a depressant, it was observed that the starch from some potato varieties did not swell at room temperature even after prolonged contact with the saturated NaCl/KCl solution. However, every commercially purified potato starch which was tested showed a high degree of solubility in saturated NaCl/KCl solution.

Claims:

1. A process for solubilizing potato starch which comprises mixing (a) raw or partially gelled potato starch granules containing phosphorus as dihydrogen orthophosphate groups esterified to amylopectin fractions with (b) a substantially saturated aqueous solution of NaCl and KCl in which the NaCl and KCl are in equilibrium and maintaining contact between the starch granules and saturated solution until the starch is solubilized.

2. A process according to claim 1 wherein the starch granules swell during contact with the saturated solution to form swollen membrane-encapsulated starch granules.

3. A process according to claim 2 wherein the swollen membrane-encapsulated starch granules are ruptured to disperse the solubilized starch into the saturated NaCl/KCl solution.

4. A process according to claim 1, 2 or 3 wherein the swollen membrane-encapsulated starch granules are ruptured by shearing, homogenization, sonic waves or freezing.

5. A process according to claim 1, 2 or 3 carried out at a temperature in the range of about 20 to 40°C.

6. A process according to claim 1, 2 or 3 wherein the potato starch is in the form of pure potato starch, potato flour, raw potato or a water-insoluble potato starch derivative.

7. A process according to claim 1, 2 or 3 wherein the mixing is carried out in the presence of heavy metals used for increasing the rate of potato starch solubilization.

8. A process according to claim 1, 2 or 3 wherein the mixture contains up to 10% by weight dry starch solids.

9. A process according to claim 1, 2 or 3 wherein the saturated solution has a pH from 4 to 10.

10. A process according to claim 1, 2 or 3 wherein α-amylase enzyme is added to the mixture during solubilization to reduce the viscosity of the solubilized starch.

11. A process according to claim 1, 2 or 3 wherein fresh potatoes are used as a starch source and the potatoes are frozen and freeze-dried prior to solubilization.

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Page 948

SUBSTITUTE

REMPLACEMENT

SECTION is not Present

Cette Section est Absente

Electronic Patent Application Fee Transmittal

Application Number:	13504156
Filing Date:	10-Jul-2012
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Filer:	Kristin Anne Connarn/Kirsten Book
Attorney Docket Number:	091876-0014

Filed as Small Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
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Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
RCE- 2ND AND SUBSEQUENT REQUEST	2820	1	950	950
		Total in USD ($)		**950**

Electronic Acknowledgement Receipt

EFS ID:	33576247
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
Filer:	Kristin Anne Connarn/Kirsten Book
Filer Authorized By:	Kristin Anne Connarn
Attorney Docket Number:	091876-0014
Receipt Date:	29-AUG-2018
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Application Type:	U.S. National Stage under 35 USC 371

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Payment was successfully received in RAM	$950
RAM confirmation Number	083018INTEFSW00002654501133
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The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment Submitted/Entered with Filing of CPA/RCE	091876-0014_Amendment.pdf	564574 6f5a9f7d3dc20cab62994cf9fa41badf0899c844	no	16
Warnings:					
Information:					
2	Request for Continued Examination (RCE)	091876-0014_RCE.pdf	120033 619805c7c4a5885ad50b5e3ccf97579fe7e0127a	no	2
Warnings:					
This is not a USPTO supplied RCE SB30 form.					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	091876-0014_IDS.pdf	167318 d0cfc41c2a7b0c71d7a38db323fb22b041073dab	no	4
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
4	Foreign Reference	091876-0014_CA1289094.pdf	529685 2f73a5243adceb16f41010b9ca11aa27e6c1848a	no	15
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	30595 af28bbd45a27d998d9bbee7ed00728cb9b9588ba	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1412205		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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: 8/29/18 Signature: Kirsten Book
(Kirsten Book)

Docket No.: 091876-0014 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Willem Hendrik Lindhout, et al.	:	Customer Number: 23630
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 – RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT SUBMITTED WITH REQUEST FOR CONTINUED EXAMINATION

Sir:

In response to the final Office Action dated May 30, 2018 please amend the above-identified U.S. as directed herein. Reconsideration and further examination of the present application is requested in light of the following. In addition, this Amendment is accompanied by a Request for Continued Examination under 37 C.F.R. § 1.114, Information Disclosure Statement and the appropriate fees.

Amendments to the Claims begin on Page 2.

Remarks/Arguments begin on Page 10.

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A diploid, fertile and self-compatible *Solanum tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams; wherein at least 50% of genomic loci in said plant are homozygous;

wherein said self-compatibility originating from *Solanum chacoense* and is referred to as S-locus inhibitor (*Sli*) gene, a copy of said gene is 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 at least 25% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds, and

wherein at least 25% of the homozygous genomic loci in a plant of said line are from one or more of NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765.

2. (Cancelled)

3. (Previously Presented) 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 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.

4. (Previously Presented) The potato line of claim 1, wherein said plant of said line, when mature, attains a fresh weight of the foliage and shoots of at least 500 grams.

5. (Previously Presented) A plant of the line according to claim 1.

6. (Previously Presented) A seed or tuber of the plant according to claim 5.

7. (Cancelled)

8. (Previously Presented) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams, comprising:

(a) providing a first potato plant of a diploid, fertile, self-compatible and essentially homozygous potato line according to claim 1,

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, 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 potato plant and said second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(d) growing a multiplicity of 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 plants of said line of said first potato plant, for between 1 to 8 selfings or backcrosses, and selecting for plants that produce fertile offspring, wherein at least 25% of the plants produce seed-carrying berries, each carrying at least 5 seeds, to thereby provide a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato breeding line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams;

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

9. (Previously Presented) The method of claim 8, 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. (Previously Presented) 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 the plant of a second diploid, fertile, self-compatible and essentially homozygous potato line according to claim 1.

13. (Previously Presented) The method of claim 8, wherein said second potato plant is the plant of a second diploid, fertile, self-incompatible potato line.

14-15. (Cancelled)

16. (Previously Presented) 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 *Solanum tuberosum* potato line according to claim 1,

(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 *Solanum*

tuberosum potato line according to claim 1, 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. (Previously Presented) 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.

20. (Previously Presented) The method of claim 16, wherein said second potato plant is a plant of a second diploid or tetraploid, self-compatible and essentially homozygous *Solanum tuberosum* potato line, 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. (Previously Presented) 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. (Previously Presented) A hybrid potato plant, or part thereof, produced by growing the seed of claim 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.

26-28. (Cancelled)

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. (Cancelled)

32. (Previously Presented) A set of 2 homozygous diploid, fertile, self-compatible and essentially homozygous potato lines according to claim 1, 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 loci in said plants are homozygous.

33-34. (Cancelled)

35. (Currently Amended) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, 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 *Solanum tuberosum* potato line, said potato line of said second potato plant having 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]] at least one potato plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765 ~~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 *Solanum tuberosum* potato breeding line, said potato ~~breeeding~~ breeding 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 loci in a plant provided in step (e) are homozygous.

36. (Cancelled)

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

38. (Previously Presented) A plant of the tetraploid potato line according to claim 37.

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

40-41. (Cancelled)

42. (Previously Presented) A method for producing a uniform hybrid potato seed, comprising:

(a) providing a first potato 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,

(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 *Solanum tuberosum* potato line according to claim 1, 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.

43. (Currently Amended) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams, comprising:

(a) providing a first potato 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,

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, 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 potato plant and said second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(d) growing a multiplicity of 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 plants to [[a]] at least one potato plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765 ~~said line of said first potato plant~~, for between 1 to 8 selfings or backcrosses, and selecting for plants that produce fertile offspring wherein at least 90% of the plants produce seed-carrying berries, each carrying 5-500 seeds, to thereby provide a diploid, fertile, self-compatible and essentially homozygous Solanum tuberosum potato breeding line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 gram and wherein at least 50% of loci in the plant are homozygous.

REMARKS/ARGUMENTS

Status of Claims

Claims 1, 3-6, 8, 9, 11-13, 16, 18-25, 27-32, 35 and 37-43 were pending in this application. Claims 1, 12, 29, 35 and 43 have been amended. Claims 27, 28, 31, 40 and 41 have been cancelled without prejudice.

Basis for amendments to claims can be found throughout the application as filed. For example, support for the amendment to claim 1 can be found at page 21, lines 1-2. Support for claims 35 and 43 can be found at page 9, lines 10-13, at page 33, lines 11-33 and at page 34, lines 1-14. Claims 12 and 29 are amended to correct certain informalities.

No new matter is believed to be added herein.

Claim Objections

Claim 35 is objected to as "breeeding" was misspelt in the third to last line.

Claim 35 is amended to recite the correct spelling of breeding.

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

A. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39 and 40-41 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 *S. tuberosum* lines, provided they have a yield of 200 g per plant and have the *Sli* gene. According to the Examiner, the Applicant claims a large genus, whereas the instant application describes only the four deposited potato lines to use in the claimed methods.

Applicant respectfully disagrees. Claim 1 is amended however in an effort to expedite prosecution. Amended claim 1 requires *Sli* gene, wherein a copy of the said gene is present in the potato lines as represented by the deposits, NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765 and that at

least 25% of the homozygous genomic loci in a plant of a potato line are from one or more of NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765.

The claims as amended do not represent a broad genera of other specific *S. tuberosum* diploid potato plants that are not described by reference to a deposit. The claims are not drawn to any progeny line, without restriction as to generation. Claim 1 as amended is drawn to a potato line that is a progeny line of one or more of the claimed deposited lines, while providing a restriction to the generation.

Thus, one of skill in the art would appreciate that the Applicant was in possession of the genus as claimed.

Reconsideration and withdrawal of rejection are respectfully requested.

B. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39, and 41 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, because the specification fails to comply with the enablement requirement.

According to the Examiner, the specification while being enabling for the deposited cell lines, does not reasonably provide guidance as to how to make and use members of the species of the claimed genus other than the deposited lines.

Without acquiescing to the merits of the rejection and solely to expedite prosecution, Applicant has amended claim 1.

Claim 1 as amended discloses that at least 25% of the homozygous genomic loci in a plant of a claimed line are from one or more of NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765. It is therefore submitted that the scope of claims is limited to the deposited accessions and does not read on any potential potato line that is a "diploid, fertile, self-compatible potato line", where the self-compatibility is the same as the gene present in the deposited samples and where the potato line has yield of 200 g per plant.

On the contrary, the amended claims are limited to Applicant's deposited lines of *S. tuberosum* with a yield of 200 g per plant and have the *Sli* gene and that at least 25% of the homozygous genomic loci in a plant of a claimed line are from one or more of NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765.

In view of the foregoing, the invention can be practiced over the whole scope of the claims and does not require undue experimentation.

Reconsideration and withdrawal of rejection are respectfully requested.

Rejections under 35 U.S.C. § 103

A. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 29, 31-32, 37-39 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Phumichai et al., Euphytica 148:227-34 (2006) in view of Maris, Euphytica 46:15-33 (1990); in view of Hosaka & Hanneman, Jr., Euphytica 99:191-97 (1998); in view of Lippman & Zamir, Trends Genet 23(2):61-66 (2006); and in further view of Bradshaw et al., Potato Res 49:49-65 (2006).

B. Claims 27 and 28 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Phumichai et al., in view of Maris, Hosaka & Hanneman, Jr., Bradshaw and in further view of Wang & Ran (NZ J Crop Hort Sci 28:1-8 (2000)).

Applicant respectfully disagrees. A person of ordinary skill in the art would not have arrived at the claimed homozygous diploid, self-compatible potato lines by combining the cited references, as alleged by the Examiner. As a general remark, potato is an immensely important staple crop. If hybrid breeding using homozygous inbreds would have been possible with potato, it would have found its way to the market long ago.

Combined disclosures of the prior art may suggest that *Sli* genes were well known. The state of art of *Sli* gene is such that can be crossed into cultivated diploid potatoes, which expressed self-compatibility and were selfed up to S_2 generation. Subsequent continuous selfings successfully produced S_2 progeny (*see* Phumichai 2006, Introduction).

Phumichai 2006, cited by the Examiner discloses that the use of *Sli* gene has been very limited and the wide application of *Sli* gene in potato breeding and genetics and address the possible causes for failure in acquiring selfed progeny. However, Phumichai does not mention crossing to *S. tuberosum*.

Maris merely discloses plants that have an average tuber yield of at least 200 g/plant (*see* Maris at Table 8, pg. 26-28).

Bradshaw teaches the value of obtaining genes from *S. chacoense* and crossing such genes into *S. tuberosum* (*see* Bradshaw at pg. 56).

Wang and Ran teach the use of tissue culture to improve agronomically desirable traits of potatoes (*see* Wang at Abstract).

The general prejudice in the art of potato breeding is that, production of homozygous true breeding lines of *S. tuberosum* would not be possible due to inbreeding depression. Uijtewaal et al. (Euphytica 36 (1987) 745-753) indicated that owing to sterility problems, homozygous potato clones would be of little importance for practical breeding. Developing homozygous inbred lines was considered, but rendered impossible in potato (Umaerus, 1987, Proceeding of the 10th Triennial Conference of the European Association of Potato Research, Aalborg, Denmark, pp 72—103 as cited in Almekinders et al. 2009, Potato Research 52:275— 293). Routes involving doubling of haploids have long been presumed as promising. Nonetheless, up to the present day the ruling opinion is that inbreeding depression in diploid potato is too strong to ever result in vigorous homozygous plants. Birhman and Hosaka (Genome 43: 495-502 (2000)) have suggested the possibility to utilize the *Sli* gene derived from *S. chacoense* for development of highly homozygous true potato seed (TPS) lines and heterosis breeding of the potato. However, to date, no homozygous lines with good agronomic traits such as good tuber yield, have ever been reported from this proposed line of research. Rather, those homozygotes that have been produced do not exhibit any agronomically relevant tuber yield. Rommens in 2010 (Genetic modification of Plants, Kempen & Jung , eds, In: Biotechnology in Agriculture and Forestry 64(1): 61-77 (2010)), advocates the route of genetic transformation, due to the fact that efforts to improve the yield and quality of this crop are hampered by inbreeding depression. In short, production of true breeding lines of potato is

considered impossible. Due to this fact, potato breeding cannot escape the traditional schemes based on crossing of tetraploid heterozygotes. As a result, the challenge is considered formidable to combine various utilization traits (relating to fresh and processing uses), resistances to pathogens and pests, and numerous other relevant agronomic traits with improvements in yield into a commercially acceptable cultivar (Douches et al. 1999, Crop Science 36(6): 1544- 1552) (*see* application at page 5, lines 1-28).

The difficulty in producing true breeding lines of potato is very evident. The steps required to produce the claimed potato lines may have been routine, as suggested in the Office Action (*see* Office Action at page 38). But none of the cited references teach or suggest methods to generate progeny lines of one or more of potato lines with NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765 and that at least 25% of the homozygous genomic loci in a plant of said line are from one or more of NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765.

Given the state of art in breeding diploid, fertile and self-compatible *S. tuberosum* potato lines, it should be appreciated that there has been a long-felt, but unmet need for the development of these potato lines. The long-felt need is evidenced and recognized in the art and the problem persisted in the art for a long period of time without solution. As disclosed in the application, there is evidence of efforts by others in the art to solve the problem of producing potato lines, but with no successful outcome.

On the contrary, the Applicant succeeded in producing diploid and self-compatible *S. tuberosum* potato lines of the claimed invention when others have failed. It should also be noted that the inventors themselves had many unsuccessful attempts in achieving homozygous parental breeding lines for generative propagation of potatoes and employed a number of routes, including androgeneis, gynogenesis, doubling of haploids and continued selfings (*see* application at 'Summary of invention', lines 1-5).

The claimed invention itself solves the long-felt need in potato breeding, where others have failed before. The long-felt need arise from numerous issues such as, but not limited to, sterility

problems, inbreeding depression, resistance to pathogens, pests, agronomic traits, tuber yields, etc. as evidenced by Uijtewaal, Umaerus, Almekinders, Birhman and Hosaka, Rommens, Phumichai and others. However, the Applicant was able to meet this need, solve the problem, and succeed in developing the claimed potato lines. Applicant achieves this by repeated selfing of a self-compatible plant comprising the *Sli* gene derived from *S. Chacoense* (*see* application at 'Summary of invention', lines 5-7).

In view of the foregoing, the claims are not obvious over the cited references.

Reconsideration and withdrawal of rejection are respectfully requested.

Allowable Subject Matter

Applicant would like to thank the Examiner for the indication that claims 11 and 19 contain allowable subject matter, and would be allowable if rewritten in independent form. Applicant has not rewritten these claims in independent form at this time, as all of the claims in the application are believed to be in condition for allowance, as discussed herein.

Applicant would like to thank the Examiner for the indication that claims 21, 35 and 42-43 are allowed.

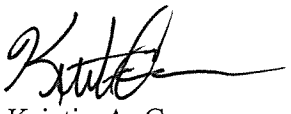
CONCLUSION

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.

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 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: August 29, 2018

Doc Code: ECOMM.AUTH/ECOMM.WTDW
Doc Description: Internet Communications Authorized/Internet Communications Authorization Withdrawn

PTO/SB/439 (11-15)

AUTHORIZATION FOR INTERNET COMMUNICATIONS IN A PATENT APPLICATION OR REQUEST TO WITHDRAW AUTHORIZATION FOR INTERNET COMMUNICATIONS		
	Application No.	13/504,156
	Filing Date	July 10, 2012
	First Named Inventor	Willem Hendrik Lindhout
	Art Unit	1663
	Examiner Name	Russell T. Boggs
	Practitioner Docket No.	091876-0014

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I. To authorize permission for Internet Communications.

☑ Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned and practitioners in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via video conferencing, instant messaging, or electronic mail. I understand that a copy of these communications will be made of record in the application file. (MPEP 502.03)

II. To withdraw authorization for Internet Communications.

☐ The authorization given on _____, to the USPTO to communicate with the undersigned and any practitioner in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via Internet communications such as video conferencing, instant messaging, or electronic mail is hereby withdrawn. I understand that the withdrawal is effective when approved rather than when received.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 57,025.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Kristin A. Connarn/ — Signature

November 27, 2018 — Date

Kristin A. Connarn — Typed or printed name

617-535-4453 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Juristic entities must be represented by a patent practitioner (see 37 CFR 1.31, which is applicable to any paper filed on or after September 16, 2012, that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below*.

☑ * Total of 1 forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	34409554
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
Filer:	Kristin Anne Connarn
Filer Authorized By:	
Attorney Docket Number:	091876-0014
Receipt Date:	27-NOV-2018
Filing Date:	10-JUL-2012
Time Stamp:	16:15:13
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Internet Communications Authorized	091876-0014sb0439.pdf	75312 836a5dc844289318909428ea7c29a2189ef4fb77	no	2

Warnings:

Agventure B.V. Ex. 2009
IPR2025-00136
Page 973

Information:	
Total Files Size (in bytes):	75312

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	091876-0014	6337

23630 7590 12/17/2018

McDermott Will & Emery
The McDermott Building
500 North Capitol Street, N.W.
Washington, DC 20001

EXAMINER	
BOGGS, RUSSELL T	

ART UNIT	PAPER NUMBER
1663	

NOTIFICATION DATE	DELIVERY MODE
12/17/2018	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ipdocketboston@mwe.com
mweipdocket@mwe.com

Applicant-Initiated Interview Summary	Application No. 13/504,156	Applicant(s) Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	AIA Status No

All participants (applicant, applicants representative, PTO personnel):

(1) Russell Boggs.

(2) Kristin Connarn.

(3) Frits Schut.

(4) Pim (Willem Hendrik) Lindhout.

Date of Interview: 30 November 2018.

Type: ☐ Telephonic ☑ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☑ Yes ☐ No.
If Yes, brief description: As attached.

Issues Discussed ☐101 ☑112 ☐102 ☑103 ☐Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 1 and 8.

Identification of prior art discussed: Phumichai et al..

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Also present were Frits (Godefridus Augustinus Maria) Michiels, Jetze Beeksma and Amjad Abraham. All but RTB were present in an Alexandria conference room.

Dr. Lindhout gave a presentation. The parties discussed potato breeding background, other work in the field, the invention represented by the pending claims, the possibility of filing a declaration, and current standards of examining claims drawn to a gene described by a deposit.

No agreement regarding patentability was reached. Applicant indicated an intention to file a supplemental amendment.
.

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☑ Attachment

/RUSSELL T BOGGS/ Examiner, Art Unit 1663	

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) 1.133 Interviews
Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiners responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicants correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,-
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicants record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

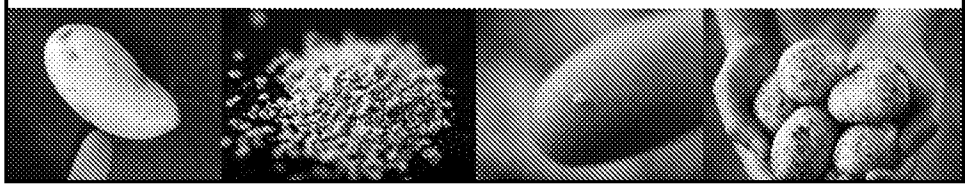
If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiners version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, Interview Record OK on the paper recording the substance of the interview along with the date and the examiners initials.

Solynta

Considerations for uniqueness of Solynta's potato seed technology

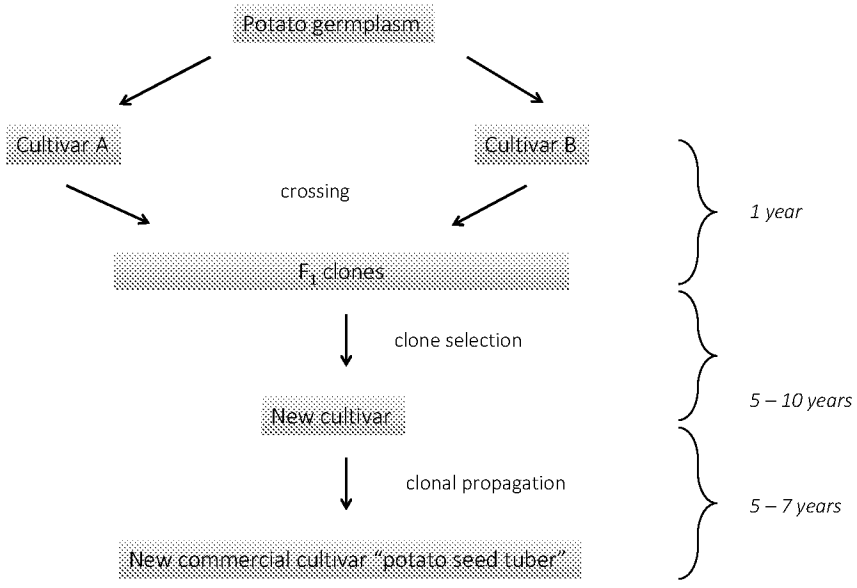
Prof. Pim Lindhout, Agventure BV

USPTO, 30 November 2018



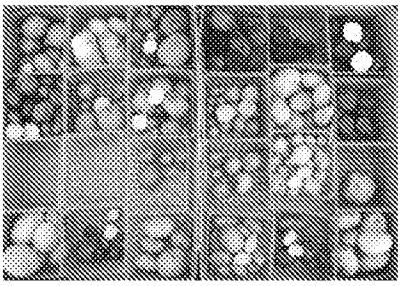
Solynta

Traditional tetraploid breeding



Solynta

Conventional potato breeding





Segregation in progenies of tetraploid crosses

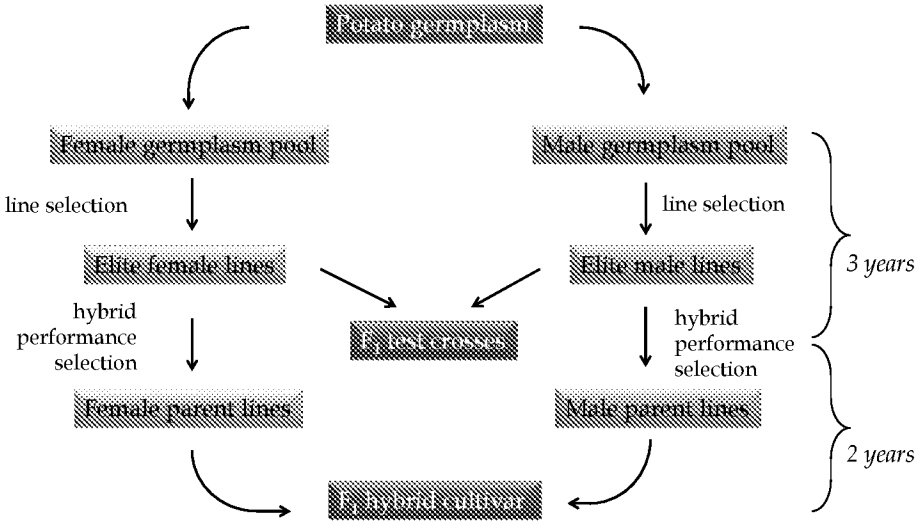
Selection for tuber quality

Field tests

Selection for yield and tuber quality

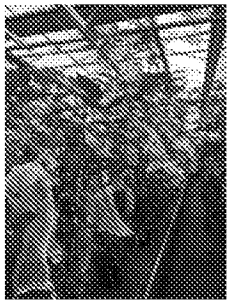
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Diploid F_1 hybrid breeding



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Hybrid potato breeding







Self- compatible inbred lines

Selection for fertility and for other traits

Field tests of hybrids

Selection for high tuber yield

High yield of hybrids

Selection for high tuber quality

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Field performance of diploid hybrids

Large tubers from seedling



Yield is similar to tetraploid controls



Solynta

Solynta

Classical breeding vs. the invention

	Clonal Breeding	F1 hybrid breeding
Breeding strategy with selection for	Improved tubers	Fertile offspring
Ploidy	Tetraploid	Diploid
Trait introduction	15 - 50 years	2 - 3 years
Time to achieve *Phytophthora* resistance	>50 years	4 years
Multiplication	Seed tubers (5 – 10 yr)	Seeds (one season)
Seed health	Accumulation of disease	Clean
Variety improvement	Russet Burbank is leading variety for 140 years	Free development of dedicated varieties

Solynta

Prior art

- Continuous selfing in potato is not successful.
- Homozygous fertile, weak doubled haploids from anther culture of *S. phureja* (Vielleux, Virginia Tech)
- Homozygous *S. tuberosum* doubled haploids are very weak and highly sterile (Jacobsen, WU)
- "Diploid progenies had significantly lower yields (due to smaller tubers) than tetraploid progenies". (Ronald Hutten, WU)
- Fertility is lost upon continuous inbreeding by using *Sli*

To obtain homozygous lines, tetraploid potatoes can be selfed, but the selfing causes marked tuber yield reduction and loss of fertility, since these traits are controlled largely by heterotic genetic effects (Rimpau 1934, 1936; Mendiburu and Peloquin 1977; Colonnetti et al. 1998a; 1998b). The use of closely related diploid species and dihaploid potatoes is hampered by gametophytic self-incompatibility controlled by multiallelic *S* genes (Pushkarnath 1942; Pandey 1962; Ogura et al. 1966a). Self-compatible variants have often been described in essentially self-incompatible diploid species (Pushkarnath 1942; Ogur et al. 1966b; De Jong and Rowe 1971; Ghosh and Hermsen 1976; De Jong 1977; Cappadocia et al. 1986; Rokotan 1986). However, as far as we could determine, these variants were not successively selfed over generations.

Phumichai Genome Vol. 48, 2005

Continuous selfing may eliminate undesirable recessive alleles as they become homozygous and may in turn lead to the recovery of fertility with advancing generations (Bushice 1968; Pfeiffer and Bingham 1983; Ray and Bingham 1992). This assessment is not supported by the present study, because there was no indication of fertility recovery even at the S_4 generation. Fertility-related traits, such as flowering

Phumichai et al., Genome , vol. 48 (2005)

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Prejudices in hybrid potato breeding

- Homozygous plants of potato are weak and sterile
- Diploids are always much weaker than tetraploids in *S. tuberosum*
- Diploid *S. tuberosum* is self-incompatible

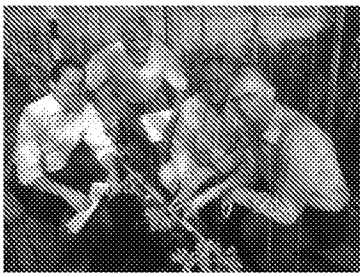
- Hybrid breeding in potato is impossible (see experts' letters)

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Five different projects to achieve hybrid breeding all with *S. tuberosum*:

1. gynogenesis
2. androgenesis
3. known doubled haploids
4. selfing of diploids
5. introducing the *Sli*-gene

Expectation that *Sli* should work was very low



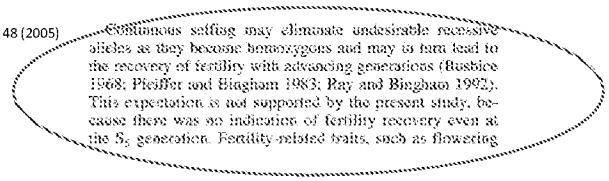
Sli parent is homozygous self-compatible diploid *S. chacoense:* low germination, weak seedling growth, weak flowering, low fertility, low seedset, small tubers, low yield, etc.

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The approach of the inventors

- The inventors succeeded to overcome inbreeding depression and establish fertile homozygotes by purging deleterious genes from a diploid self-compatible potato line by selecting for fertile offspring instead of yield (tuber size).
- The selected lines often had very low tuber yield and would have been discarded by the skilled person.
- The approach was not disclosed or suggested in the prior art. To the contrary: The art (Phumichai et al.) teaches away from this approach.

Phumichai et al., Genome , vol. 48 (2005)



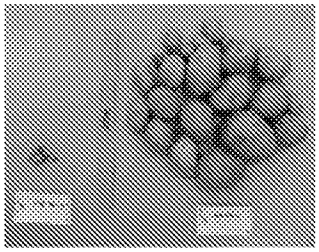
Continuous selfing may eliminate undesirable recessive alleles as they become homozygous and may in turn lead to the recovery of fertility with advancing generations (Busbice 1968; Pfeiffer and Bingham 1983; Ray and Bingham 1992). This expectation is not supported by the present study, because there was no indication of fertility recovery even at the S_5 generation. Fertility-related traits, such as flowering

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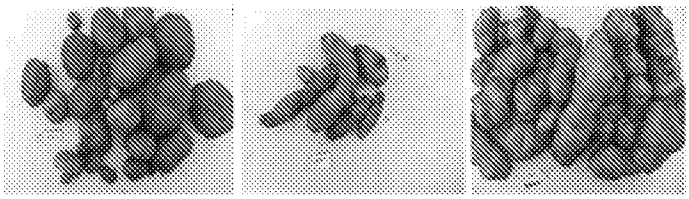
Invention: How to develop inbred lines?

- Introduction of *Sli*-gene in *S. tuberosum*: D1xH; HxD2; HxD3 (Figure 2, application as filed). All crosses were successful.
- Genomic variation in diploid potato lines D1, D2 and D3 extremely large and represents the variation available in *S. tuberosum*.
- Repeated selfings to increase homozygosity: inbred plants
- Select for fertile offspring in each generation to remove deleterious genes
- Optional: Intercross inbred lines to improve the inbred lines

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Sli parent Elite clone

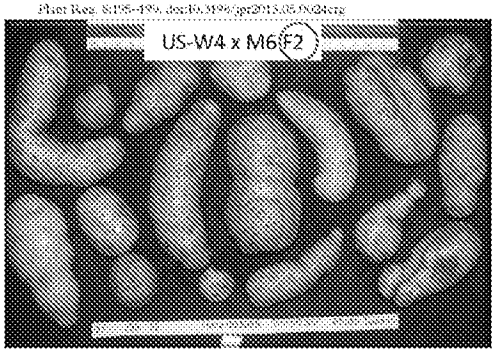


Surprise: F_3 inbred plants already show big tubers

Solynta

Jansky independently confirms invention in 2014

Jansky, S., Y. Chung, and P. Kirkpatrick. 2014b. M_2: A diploid potato inbred line for use in breeding and genetics research. J. Plant Reg. 8:195–199. doi:10.3198/jpr2013.05.0024crg



Jansky Lab website: Presentation at the Annual Meeting of the Potato Association of America, August 1, 2016. Grand Rapids, MI. PAA 2016 presentation

solution. M6 has been crossed to many diploid clones in the program, and all attempts to self-pollinate fertile offspring from those crosses have been successful. Consequently, it appears that

erate these lines. We currently have S_3 plants derived from a self-compatible *S. tuberosum* dihaploid.

Jansky copied the claimed method with different diploid *S. tuberosum* and obtained the same result!

Claim for discussion

8. A method for producing a diploid, fertile and, self-compatible ~~and essentially homozygous *Solanum tuberosum*~~ potato plant~~line~~, ~~said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams~~ wherein at least 50% of genomic loci in said plant are homozygous, the method comprising the steps of:

(a) providing a first potato plant of a diploid, fertile, self-compatible ~~and essentially homozygous~~ potato line ~~according to claim 1~~; wherein said self-compatibility originates from *Solanum chacoense* and is referred to as S-locus inhibitor (*Sli*) gene, which gene is 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; ~~,~~

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, said potato line ~~which having~~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 potato plant and said second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

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

(e) inbreeding ~~selfing~~ said self-compatible plant~~hybrid offspring potato plants by selfing~~, or backcrossing said ~~hybrid offspring~~self-compatible potato plant~~s~~ to a potato plant of said line of said first potato plant, for between 1 to 8 selfings or backcrosses to thereby increase the degree of homozygosity in each successive generation, ~~and~~ while during said inbreeding selecting within each generation for ~~plants that produce~~ a fertile offspring plant producing ~~wherein at least 25% of the plants produce~~ a seed-carrying berry~~ies, each~~, carrying at least 5 fertile seeds, to thereby provide a diploid, fertile, self-

compatible ~~and essentially homozygous *Solanum tuberosum* potato breeding line~~plant, ~~said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 gram; and~~ wherein at least 50% of genomic loci ~~in~~ in ~~said~~the plant, ~~provided in step (e)~~ are homozygous.

Main discussion points for scheduled interview on November 30, 2018 *in re:*

Willem Hendrik Lindhout et al.,
Serial No.: 13/504,156
Filing or 371 (c) date: 07-10-2012

Group Art Unit: 1663
Examiner: Boggs, Russell T
Atty. Dkt. No.: 091876-0014

1: **Introduction to the team**
2. **Scientific presentation**
3. **Preamble of the claims**
4: **Selection for fertile offspring**
5: **Written description and enablement of *S. tuberosum***
6: **Introgression of *Sli* gene**
7. **Obviousness rejection**

Agventure B.V. Ex. 2009
IPR2025-00136

P87313US10

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
In re Application of:
Willem Hendrik Lindhout *et al.*,
Serial No.: 13/504,156
Filing or 371 (e) date: 07-10-2012
For: HYBRID SEED POTATO BREEDING
Group Art Unit: 1663
Examiner: Boggs, Russell T
Atty. Dkt. No.: 091876-0014
Confirmation no.: 6337

DECLARATION OF WILLEM HENDRIK LINDHOUT UNDER 37 C.F.R. §1.132.

I, Willem Hendrik Lindhout, hereby declare as follows:

1. I am a citizen of the Netherlands, residing in Wageningen, the Netherlands.

2. I am a named inventor of U.S. patent application No.:13/504,156 to Lindhout *et al.*, assigned to Agventure B.V.

3. I am Founder and Director R&D of Florere B.V., operating under the trade name of Solynta, a privately held Limited Liability Company dedicated to F1 hybrid Potato Breeding and holding company of Agventure B.V.

4. I hold an MSc degree in Biology, an MSc degree in Chemistry, and a PhD in Molecular Biology from the University of Leiden, The Netherlands. Until 2006, I was Associate Professor of Plant Breeding at Wageningen University, The Netherlands. During this period, I published more than 100 scientific publications related to plant breeding, served as the Coordinator of Bachelors and Masters Studies in Plant Sciences at Wageningen University, and served as the National Coordinator of Tomato Genomics Research at the Centre for Biosystems Genomics (CBSG), a national network of biology sciences aiming at a better understanding of the biochemical, molecular and genetic basis of plant species, *c.q. Arabidopsis*, tomato and potato. From 2006-2009, I was director R&D of De Ruiter Seeds. After the acquisition of De Ruiter Seeds by Monsanto, I was appointed as Monsanto's Global Breeding Lead of the Vegetable Seed Division. I am currently Research Director at Solynta and Scientific Lead of the National Potato Research Program designated Holland Innovative Potato.

5. I am familiar with the contents of the Office Actions issued by the United States Patent and Trademark Office in respect of U.S. patent application No.:13/504,156, and the claims that are prosecuted thereunder.

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6. I understand that the United States Patent and Trademark Office, in assessing the patentability of the referenced patent application, has *inter alia* rejected the claims for failing to comply with 35 U.S.C. §112, i.e. failing to comply with the requirements of written description and enablement and 35 U.S.C. §103 for being obvious in view of the prior art.

Obviousness

7. As I stated during the interview on 30 November 2018 at the USPTO in Alexandria, the generation of homozygous (inbred), diploid potato lines by means of introgressing the *Sli*-gene from a *Sli*-gene donor line into diploid *S. tuberosum* plants followed by inbreeding (selfing) and selection for fertile offspring, which led to the unexpected result of the plants as claimed, was the culmination of at least three years of unsuccessful attempts using four alternative methods. Introgressing the *Sli*-gene into diploid *S. tuberosum* plants followed by inbreeding was the fifth and final attempt that we made in my lab in the years 2006-2008. There was little expectation of success in generating vigorous, fertile plants, as all previous attempts to generate fertile, homozygous, diploid potato lines by introgression of the *Sli*-gene into naturally diploid *Solanum* species such as *S. phureja* had failed.

8. In addition, all commercially relevant *S. tuberosum* plants are tetraploid, and it was believed that diploid *S. tuberosum* would form no useful basis for the production of vigorous commercial potato, since diploids usually have lower yields than tetraploids. In addition, no example was known of a tetraploid vegetatively propagated crop that was converted into a diploid F1 hybrid crop. Tetraploidy was also considered required to overcome the negative effects of the presumed large number of deleterious alleles present in *S. tuberosum*.

9. It was therefore the general belief that a combination of two deleterious alleles of a single gene in a diploid plant (which in a diploid could not be rescued by the additional presence of one or two beneficial alleles as would be the case in a tetraploid plant), would give rise to the phenomenon of inbreeding depression, and that such a phenomenon would be even more severe in *S. tuberosum* due to the fact that such genes can remain "hidden" in the tetraploid genome of *S. tuberosum*. The generation of highly homozygous, diploid lines of *S. tuberosum* was, therefore, *a priori*, not considered feasible due to severe inbreeding depression. All previous attempts to generate vigorous, inbred, diploid *S. tuberosum* potato lines had failed.

10. The claimed step of selecting for fertile offspring during inbreeding of self-compatible *S. tuberosum* was essential to arrive at the method as claimed. As indicated above, tuber yield is the most relevant selection criterion in classical potato breeding. The *Sli*-gene donor material used by the present inventors was obtained from Prof. Hosaka, from the Food Resources Education and Research Center, Kobe University, Japan. Plants are relatively small, with very few flowers/berries, and with extremely low tuber yield, indicative of low vigour and low fertility. The inventors chose to cross the *Sli*-gene donor material with diploid *S. tuberosum*. The hybrid offspring plants were self-compatible, and upon further

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selfing, the inventors selected only those self-compatible plants that had seed-carrying berries.

11. This is not an inherent step in potato breeding. Out of the hundreds of offspring plants resulting from a selfing step one could select low fertility plants with high tuber yield for further breeding. As it is undue to maintain each inbred series, selections must ultimately be made in order to keep the program manageable. The present inventors chose to select for fertility. To the surprise of the inventors, a high level of fertility in inbred *S. tuberosum* could be maintained, although tuber yield deteriorated considerably. Yet, against all expectations, successive inbreeding and selection steps resulted in highly homozygous plants with acceptable tuber yields. While fertility could be maintained, yield could even further be improved by intercrossing with other diploid *S. tuberosum* lines followed, again, by inbreeding to generate highly homozygous lines. Eventually, fertile, yet highly homozygous *S. tuberosum* lines were obtained that exhibited remarkably high tuber yields when grown from seed. Two such inbred lines could be crossed to produce F1 hybrid seed, which produced uniform plants. The inventors have presented their findings through journal articles (e.g. Lindhout et al. 2011. Potato Research 54: 301–312), and through presentations at international potato conferences (*e.g.* EAPR meeting, Oulu, Finland, July 25th, 2011).

12. This notion on the unlikeliness that diploids would provide a useful route to commercial potato production is confirmed in the prior art (Jansky *et al.*, 2009. Advances in Potato Chemistry and Technology Pages 27-62 *In*: Advances in Potato Chemistry and Technology Chapter 2 - Breeding, Genetics, and Cultivar Development https://doi.org/10.1016/B978-0-12-374349-7.00002-7), where it is indicated on page 37, *vide* "2.4.2: Sexual polyploidization":

> *"While the development of potato cultivars at the diploid level sounds appealing, it is not likely to be successful. In potato, intralocus (dominance) and interlocus (epistasis) interactions are necessary to maximize yield (Mendoza and Haynes, 1974b). Tetraploidy offers many more opportunities to create such interactions."*

13. It is also noteworthy that the golden standard in potato breeding is to select suitable breeding material based on tuber yield, as is taught in the prior art (Jansky *et al.*, 2009, *supra*, page 38, first 6 lines of full paragraph):

> *Initial studies of sexual polyploidization in potato focused on tuber yield and quality. A high degree of heterosis for yield has been demonstrated following unilateral sexual polyploidization in which the tetraploid female parent is typically a potato cultivar or advanced breeding selection and the diploid male parent is a haploid X wild species hybrid or a cultivated diploid X haploid hybrid (De Jong et al., 1981; Bani-Aameur et al., 1991; Tai and De Jong, 1991; Buso et al., 1999a, 2000, 2003; Alberino et al., 2004).*

This is understandable, as the single most commercially relevant trait in potato is tuber yield.

14. Our approach differed from that described in the prior art, in that we crossed a *Sli*-gene donor line with diploid *S. tuberosum* plants. This had never been considered or done by anyone else before. Moreover, and perhaps most importantly, we selected for fertility during subsequent inbreeding, thereby completely ignoring the industry standard, tuber yield. We started with three diploid *S. tuberosum* genotypes (D1, D2 and D3, as indicated in Table 6 of the application), which were all successful in that we were able to obtain fertile, highly homozygous (inbred), diploid potato lines. After a number of successive generations, plants started to exhibit considerable tuber yields (up to 300-500 grams), and we continued the breeding program by introgressing genetic material from other genotypes (D4-D16) into the vigorous fertile, inbred, diploid potato lines. This ultimately resulted in plants having tuber yields as high as commercial tetraploid varieties. This was all due to the availability of an inbreeding scheme wherein fertility of the plants was maintained.

Written Description and Enablement

15. I understand that the §112 rejection was, *inter alia*, based on the Examiner's consideration that the inventors were allegedly only successful in producing the inbred, diploid potato lines due to the specific starting material that was used, *i.e.* lines D1-D3 as indicated in Table 6 of the application as filed, and/or the deposited potato lines with NCIMB accession numbers 41663, 41664, 41665, and 41765, as deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17.

16. Recent whole genotyping by sequencing (GBS) data showed that the genomic variation between diploid potato genotypes, including D1, D2 and D3 is extremely large and represents virtually all variation available in *S. tuberosum*. In fact, the genomic variation in diploid potato germplasm is wider than that within tetraploid *S. tuberosum*. Hence, by showing that the three diploid *S. tuberosum* lines D1-D3 can all successfully be used as starting material, we have shown that there are no limits as to the starting material. More recent, independent research, using completely different diploid *S. tuberosum* clones as recipient of the *Sli*-gene, has confirmed that it is possible to generate fertile, essential homozygous *S. tuberosum* potato lines when selecting for fertile offspring in selfed progenies (Jansky *et al.*, 2014. J Plant Registrations. doi: 10.3198/jpr2013.05.0024crg; Jansky *et al.*, 2016. Crop Sci 56:1412–1422). This independent research supports my statement that the specific starting material is not essential to the success of the claimed method of producing the potato plants, and further supports the effectiveness of the method.

17. The application as filed teaches that selecting for fertile offspring was key to the presently claimed invention. As indicated on page 37, lines 10-13 of the application as filed:

> *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.*

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Moreover, page 37, lines 27-32 of the application as filed teach:

> *No, or at least little, attention is paid to the agronomical appearance of the plants at this stage. They may look withered and frail, with only a few flowers. Nonetheless, the selfing is repeated at least three times, but preferably 4 or 5 or even 6-8 times. In this manner a line of essentially homozygous, fertile, self-compatible, and diploid potato plants is obtained, essentially by selfing and selecting for plants that produce fertile offspring.*

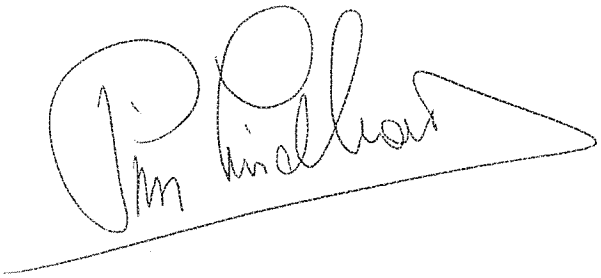
18. I therefore affirm herein that we have shown that fertile, vigorous, essential homozygous diploid potato lines can be generated from virtually any self-compatible, diploid *S. tuberosum* plant if one selects for fertile offspring in every generation, and especially in the first five generations of inbreeding.

19. A further argument against the Examiner's §112 rejection stating that no structure-function relation was provided for the *Sli*-gene from *S. chacoense*, which was used to render the plants self-compatible. In fact, the *Sli*-gene was already identified by Hanneman in a diploid *S. chacoense* line as early as 1985 (Hanneman, 1985. Am Potato J 62: 428-429). The *Sli*-gene was subsequently mapped to the distal region of chromosome 12 in a cross between *S. chacoense* and *S. phureja* (Hosaka and Hanneman, 1998A. Euphytica 103: 265-271). Thus, prior to the filing date of this patent application, the *Sli*-gene had already been used by several other research laboratories to render naturally diploid wild potato species self-compatible. Thus the *Sli*-gene was already a well-established feature in the prior art.

20. The inventors use the *Sli*-gene as a tool to confer self-compatibility to diploid *S. tuberosum*. To ensure public access to the *Sli*-gene as a tool, and thus enable the claimed invention, the inventors have provided deposits in which a functional and representative form of the *Sli*-gene is present, and which deposits may be used by one of skill in the art to repeat the invention. Alternatively, other sources of the *Sli*-gene can readily be used by one of skill in the art to render diploid *S. tuberosum* plants self-compatible. For instance, a clone of the original material described by Hanneman in 1985 was used as the source of the *Sli*-gene in publications of Jansky (Jansky et al., 2014, *supra*; Jansky et al., 2016, *supra*), and such sources are equally suitable. The presence of the *Sli*-gene can easily be determined by a skilled person by testing for self-compatibility. If needed, one may use markers, but such markers were not used by the present inventors, nor were they used by other researchers who availed themselves of the *Sli*-gene in order to convert self-incompatible potato plants into self-compatible plants (e.g. Hosaka and Hanneman, 1998B. Euphytica 99: 191-197; Birhman and Hosaka, 2000, Genome 43: 495–502; Phumichai *et al.*, 2005, Genome 48: 977–984.

21. I hereby declare that all statements made of my own knowledge are true and all statements made on information are believed to be true and further that the statements were made with the knowledge that willful false statements and the like so made are

punishable by fine or imprisonment or both under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of this application or any patent issued thereon.



Dr. Willem Hendrik Lindhout
Wageningen, January 29, 2019

Electronic Acknowledgement Receipt

EFS ID:	35006795
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
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Filer Authorized By:	Kristin Anne Connarn
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Supplemental Response or Supplemental Amendment	091876-0014_SupplementalAmendment.pdf	3124195 f905952e317c1a9ecb20c696eefdb650638fb458	no	16

Warnings:

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Information:					
2	Oath or Declaration filed	091876-0014_Declaration_Lindhout.pdf	912452 cdd05a484b4438d54c3ff70eefe80c887177f767	no	6
Warnings:					
Information:					
			Total Files Size (in bytes):	4036647	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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: 1/30/2019 Signature: /Vicky Markantonis/

Docket No.: 091876-0014 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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

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Alexandria, VA 22313-1450

SUPPLEMENTAL AMENDMENT

Sir:

Further to the Request for Continued Examination and Response to Final Office Action filed on August 29, 2018, please amend the above-identified U.S. patent application as follows.

Amendments to the Claims begin on Page 2.

Remarks/Arguments begin on Page 10.

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AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A diploid, fertile and self-compatible *Solanum tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams; wherein at least 50% of genomic loci in said plant are homozygous;

wherein said self-compatibility originating from *Solanum chacoense* and is referred to as S-locus inhibitor (*Sli*) gene, a copy of said gene is 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 at least 25% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds, and

wherein at least 25% of the homozygous genomic loci in a plant of said line are from one or more of NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765.

2. (Cancelled)

3. (Previously Presented) 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 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.

4. (Previously Presented) The potato line of claim 1, wherein said plant of said line, when mature, attains a fresh weight of the foliage and shoots of at least 500 grams.

5. (Previously Presented) A plant of the line according to claim 1.

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6. (Previously Presented) A seed or tuber of the plant according to claim 5.

7. (Cancelled)

8. (Currently Amended) A method for producing a diploid, fertile, and self-compatible ~~and essentially homozygous *Solanum tuberosum*~~ potato plant ~~line~~, ~~said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams~~ wherein at least 50% of genomic loci in said plant are homozygous, the method comprising the steps of:

(a) providing a first potato plant of a diploid, fertile, self-compatible ~~and essentially homozygous~~ potato line ~~according to claim 1~~ wherein said self-compatibility originiates from *Solanum chacoense* and is referred to as S-locus inhibitor *(Sli)* gene, which gene is 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;~~,~~

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, said potato line having ~~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 potato plant and said second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

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

(e) inbreeding ~~selfing~~ said self-compatible plant by selfing ~~hybrid offspring potato plants~~ or backcrossing said self-compatible ~~hybrid offspring~~ potato plant to a potato plants of said line of said first potato plant, for between 1 to 8 selfings or backcrosses to thereby increase the

degree of homozygosity in each successive generation, ~~and~~ while during said inbreeding selecting within each generation for ~~plants that produce~~ a fertile offspring plant producing~~, wherein at least 25% of the plants produce~~ a seed-carrying berry ~~berries, each~~ carrying at least 5 fertile seeds, to thereby provide a diploid, fertile, self-compatible ~~and essentially homozygous *Solanum tuberosum*~~ potato plant ~~breeding line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams;~~

~~and~~ wherein at least 50% of genomic loci in the plant ~~provided in step (e)~~ are homozygous.

9. (Previously Presented) The method of claim 8, 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. (Previously Presented) 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 the plant of a second diploid, fertile, self-compatible and essentially homozygous potato line according to claim 1.

13. (Previously Presented) The method of claim 8, wherein said second potato plant is the plant of a second diploid, fertile, self-incompatible potato line.

14-15. (Cancelled)

16. (Previously Presented) 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 *Solanum tuberosum* potato line according to claim 1,

(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 *Solanum tuberosum* potato line according to claim 1, 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. (Previously Presented) 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.

20. (Previously Presented) The method of claim 16, wherein said second potato plant is a plant of a second diploid or tetraploid, self-compatible and essentially homozygous *Solanum tuberosum* potato line, 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. (Previously Presented) 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. (Previously Presented) A hybrid potato plant, or part thereof, produced by growing the seed of claim 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.

26-28. (Cancelled)

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. (Cancelled)

32. (Previously Presented) A set of 2 homozygous diploid, fertile, self-compatible and essentially homozygous potato lines according to claim 1, 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 loci in said plants are homozygous.

33-34. (Cancelled)

35. (Currently Amended) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, 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 *Solanum tuberosum* potato line, said potato line of said second potato plant having 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]] at least one potato plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765 ~~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 *Solanum tuberosum* potato breeding line, said potato ~~breeeding~~ breeding 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 loci in a plant provided in step (e) are homozygous.

36. (Cancelled)

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

38. (Previously Presented) A plant of the tetraploid potato line according to claim 37.

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

40-41. (Cancelled)

42. (Previously Presented) A method for producing a uniform hybrid potato seed, comprising:

(a) providing a first potato 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,

(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 *Solanum tuberosum* potato line according to claim 1, 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.

43. (Currently Amended) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams, comprising:

(a) providing a first potato 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,

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, 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 potato plant and said second potato plant to provide a seed and collecting said seed to thereby provide a hybrid offspring seed;

(d) growing a multiplicity of 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 plants to [[a]] at least one potato plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765 ~~said line of said first potato plant~~, for between 1 to 8 selfings or backcrosses, and selecting for plants that produce fertile offspring wherein at least 90% of the plants produce seed-carrying

berries, each carrying 5-500 seeds, to thereby provide a diploid, fertile, self-compatible and essentially homozygous Solanum tuberosum potato breeding line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 gram and wherein at least 50% of loci in the plant are homozygous.

REMARKS/ARGUMENTS

Status of Claims

Claims 1, 3-6, 8, 9, 11-13, 16, 18-25, 27-32, 35 and 37-43 were pending in this application. Claim 8 is newly amended in this Supplemental Amendment. Claims 1, 12, 29, 35 and 43 were amended in the Response filed in August 2018, but have not yet been entered. Claims 27, 28, 31, 40 and 41 have been cancelled without prejudice.

Basis for amendments to claims can be found throughout the application as filed. For example, support for the amendment to claim 1 can be found at page 21, lines 1-2. Support for claims 35 and 43 can be found at page 9, lines 10-13, at page 33, lines 11-33 and at page 34, lines 1-14. Claims 12 and 29 are amended to correct certain informalities.

No new matter is believed to be added herein.

Examiner Interview Summary

Applicant thanks Examiner Boggs and Supervisor Amjad Abraham for the in-person interview of November 2018. The 112 and 103 issues were discussed, as well as an explanation of the prior art. Possible claim amendments and Declaration subject matter were discussed and are included herewith.

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

A. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39 and 40-41 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 *S. tuberosum* lines, provided they have a yield of 200 g per plant and have the *Sli* gene. According to the Examiner, the Applicant claims a large genus, whereas the instant application describes only the four deposited potato lines to use in the claimed methods.

Applicant respectfully disagrees. As described in the Declaration of Pim Lindhout, filed concurrently herewith, the inventors were in possession of the claimed genus at the time of filing. Whole genome sequencing data shows that the genomic variation between lines D1, D2 and D3 is extremely large and represents virtually all variation available in *S. tuberosum*. In fact, the genomic variation is wider than that within tetraploid *S. tuberosum*. Hence, by showing that the three diploid *S. tuberosum* lines D1-D3 can all successfully be used as starting material, we have shown that there are no limits as to the starting material. Independent research, using completely different diploid S. tuberosum clones as recipient of the *Sli*-gene, has confirmed that it is possible to generate fertile, essential homozygous *S. tuberosum* potato lines when selecting for fertile offspring in selfed progenies (Jansky et al., 2014. J Plant Registrations. doi: 10.3198/jpr2013.05.0024crg; Jansky et al., 2016. Crop Sci 56:1412–1422). Thus, the specific starting material of D1-D3 is representative of the genus claimed. The specific lines D1, D2, and D3 are exemplary but not essential to the success of the claimed method of producing the potato plants.

Reconsideration and withdrawal of rejection are respectfully requested.

B. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39, and 41 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, because the specification fails to comply with the enablement requirement.

According to the Examiner, the specification while being enabling for the deposited cell lines, does not reasonably provide guidance as to how to make and use members of the species of the claimed genus other than the deposited lines.

Further to the arguments submitted in the response of August 2018, and supported by the Declaration of Pim Lindhout, Applicant respectfully disagrees. The inventors do not claim the *Sli*-gene from *S. chacoense*, nor do the inventors claim the self compatibility trait from *S. chacoense* as discovered by Hanneman. The inventors merely use the *Sli*-gene as a tool to confer self-compatibility to diploid *S. tuberosum*. To ensure public access to the *Sli*-gene as a tool, and thus enable the claimed invention, the inventors have provided deposits in which a functional and representative form of the *Sli*-gene is present, and which deposits may be used by one of skill in the art to repeat the invention. In addition, other sources of the *Sli*-gene can readily be used by one of

skill in the art to render diploid *S. tuberosum* plants self-compatible. For instance, a clone of the original material described by Hanneman in 1985 was used as the source of the *Sli*-gene in publications of Jansky (Jansky et al., 2014, supra; Jansky et al., 2016, supra), and such sources are equally suitable. The presence of the *Sli*-gene can easily be determined by a skilled person by testing for self-compatibility. If needed, one may use markers, but such markers were not used by the present inventors, nor were they used by other researchers who availed themselves of the Sli-gene in order to convert self-incompatible potato plants into self-compatible plants (e.g. Hosaka and Hanneman, 1998B. Euphytica 99: 191-197; Birhman and Hosaka, 2000, Genome 43: 495–502; Phumichai et al., 2005, Genome 48: 977–984).

The specification teaches that fertile and vigorous diploid potato lines can be generated from virtually any self-compatible, diploid *S. tuberosum* plant if one selects for fertile offspring in every generation, and especially in the first five generations of inbreeding. In view of the foregoing, the invention can be practiced over the whole scope of the claims and does not require undue experimentation.

Reconsideration and withdrawal of rejection are respectfully requested.

Rejections under 35 U.S.C. § 103

A. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 29, 31-32, 37-39 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Phumichai et al., Euphytica 148:227-34 (2006) in view of Maris, Euphytica 46:15-33 (1990); in view of Hosaka & Hanneman, Jr., Euphytica 99:191-97 (1998); in view of Lippman & Zamir, Trends Genet 23(2):61-66 (2006); and in further view of Bradshaw et al., Potato Res 49:49-65 (2006).

B. Claims 27 and 28 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Phumichai et al., in view of Maris, Hosaka & Hanneman, Jr., Bradshaw and in further view of Wang & Ran (NZ J Crop Hort Sci 28:1-8 (2000)).

Applicant respectfully disagrees. The non-obviousness of the claimed invention is further evidenced by the *unexpected and improved properties* of the claimed invention. Evidence of

secondary considerations, including unexpected results, if presented by the Applicant, must be considered by the Examiner in determining obviousness. M.P.E.P. § 2145 and, *e.g.*, *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1372, 82 USPQ2d 1321, 1339 (Fed. Cir. 2007). "A factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon ex post reasoning." *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. at 1742. Accordingly, "[a] flexible TSM test remains the primary guarantor against a non-statutory hindsight analysis." *In re Translogic Tech.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). However, it is of particular importance to detect evidence of nonobjective criteria showing nonobviousness beyond the *prima facie* analysis, including "unexpected results… skepticism of experts and copying – other respected sources of objective evidence of nonobviousness – as well as commercial success… this evidence is not just a cumulative or confirmatory part of the obviousness calculus but *constitutes independent evidence of nonobviousness*." (Emphasis added). *Ortho-McNeil Pharmaceutical v. Mylan Labs* (Fed. Cir. 2008). M.P.E.P. § 2145 further states that the non-obviousness of the claimed invention may be demonstrated by rebuttal evidence which may "include evidence that the claimed invention yields unexpectedly improved properties or properties not present in the prior art."

As explained during the Examiner Interview and presented in the concurrently filed Declaration of Pim Lindhout, the claimed invention is based on surprising results and satisfies a long-felt, but unmet need for the development of these potato lines. The long-felt need is evidenced and recognized in the art and the problem persisted in the art for a long period of time without solution.

The generation of homozygous (inbred), diploid potato lines by means of introgressing the *Sli*-gene from a *Sli*-gene donor line into diploid *S. tuberosum* plants followed by inbreeding (selfing) and selection for fertile offspring, led to the unexpected result of the plants as claimed. After at least three years of unsuccessful attempts using four alternative methods, the inventors surprised the industry and themselves by introgressing the *Sli*-gene into diploid *S. tuberosum* plants followed by inbreeding. There was only a minimal expectation of success in generating vigorous, fertile plants, as all previous attempts to generate fertile, homozygous, diploid potato lines by introgression of the *Sli*-gene into naturally diploid *Solanum* species such a *S. phureja* had failed. In addition, all

commercially relevant *S. tuberosum* plants are tetraploid, and it was believed that diploid *S. tuberosum* would form no useful basis for the production of vigorous commercial potato, since diploids usually have lower yields than tetraploids. In addition, no example was known of a tetraploid vegetatively propagated crop that was converted into a diploid F1 hybrid crop. Tetraploidy was also considered required to overcome the negative effects of the large number of deleterious alleles present in *S. tuberosum*. The generation of highly homozygous, diploid lines of *S. tuberosum* was not considered feasible due to severe inbreeding depression.

The present inventors chose to deviate from common practice of selecting for tuber yield, and instead chose to select for fertility. To the surprise of the inventors, a high level of fertility in inbred *S. tuberosum* could be maintained, although tuber yield deteriorated considerably. Yet, against all expectations internally and externally, successive inbreeding and selection steps surprisingly resulted in highly homozygous plants with acceptable tuber yields.

In view of the foregoing, the claims are not obvious over the cited references.

Reconsideration and withdrawal of rejection are respectfully requested.

Allowable Subject Matter

Applicant again thanks the Examiner for the indication that claims 11 and 19 contain allowable subject matter, and would be allowable if rewritten in independent form. Applicant has not rewritten these claims in independent form at this time, as all of the claims in the application are believed to be in condition for allowance, as discussed herein.

Applicant would like to thank the Examiner for the indication that claims 21, 35 and 42-43 are allowed.

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.

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

Respectfully submitted,

McDERMOTT WILL & EMERY LLP



Kristin A. Connarn
Registration No. 57,025

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Date: January 30, 2019

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/504,156	Filing Date 07/10/2012	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $30 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $ 125 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	01/30/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 28	Minus	** 34	= 0		x $ 50 =	0
	Independent (37 CFR 1.16(h))	* 5	Minus	*** 7	= 0		x $ 230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $ 0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $ 0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/HELENA L PAYTON/
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(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13504156
	Filing Date	2012-07-10
	First Named Inventor	Willem Hendrik LINDHOUT
	Art Unit	1663
	Examiner Name	Russell T BOGGS
	Attorney Docket Number	091876-0014

	1	Birhman, R.K. and K. Hosaka, "Production of inbred progenies of diploid potatoes using an S-locus inhibitor (Sli) gene, and their characterization," Genome 43: 495-502 (2000).	☐
	2	Jansky, S.H., et al., "M6: A Diploid Potato Inbred Line for Use in Breeding and Genetics Research," J. Plant Registrations (February 21, 2014).	☐
	3	Hanneman, "Self Fertility in Solanum," Am Potato J 62: 428-429 (1985).	☐
	4	Hosaka, K. and R.E. Hanneman, Jr., "Genetics of self-compatibility in a self-incompatable wild diploid potato species Solanum chacoense. 2. Localization of an S locus inhibitor (Sli) gene on the potato genome using DNA markers," Euphhytica 103:265-271 (1998).	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kristin A. Connarn/	Date (YYYY-MM-DD)	2019-02-01
Name/Print	Kristin A Connarn	Registration Number	57,025

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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EFS ID:	35037393
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
Filer:	Kristin Anne Connarn
Filer Authorized By:	
Attorney Docket Number:	091876-0014
Receipt Date:	01-FEB-2019
Filing Date:	10-JUL-2012
Time Stamp:	16:07:37
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	091876_0014IDS.pdf	65128 6535644de4b564b285efdf9e5b0c90b8adaf8d15	no	4

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IPR2025-00136
Page 1017

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Warnings:					
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Warnings:					
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

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Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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FOREIGN PATENT DOCUMENTS

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Attorney Docket Number	091876-0014

	1	STOKSTAD, "The New Potato: Breeders seek a breakthrough to help farmers facing an uncertain future," Science, Vol. 363, Issue 6427, pp. 574-577, Feb. 8, 2019.	☐

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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Signature	/Kristin A. Connarn/	Date (YYYY-MM-DD)	2019-03-06
Name/Print	Kristin A. CONNARN	Registration Number	57,025

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Electronic Acknowledgement Receipt

EFS ID:	35340063
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
Filer:	Kristin Anne Connarn/Yvonne Carter
Filer Authorized By:	Kristin Anne Connarn
Attorney Docket Number:	091876-0014
Receipt Date:	06-MAR-2019
Filing Date:	10-JUL-2012
Time Stamp:	16:41:35
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	NPL_STOKSTAD.pdf	860374 ef3e5cc92a55630b9aefe49a9f7483f7a8462be0	no	4

Warnings:

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Page 1023

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	IDS_091876_0014_FINAL2.pdf	177008 b6a76ddc8daddd4b060b90944892e0a02359c82e	no	4
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
			Total Files Size (in bytes):	1037382	

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New International Application Filed with the USPTO as a Receiving Office

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2011-053135	WO	A2	2011-05-05	Agventure B.V.		☐

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Signature	Kristin A. Connarn	Date (YYYY-MM-DD)	2019-04-23
Name/Print	Kristin A. Connarn	Registration Number	57,025

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(19) World Intellectual Property Organization
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(21) International Application Number:
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26 October 2010 (26.10.2010)

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(71) Applicant *(for all designated States except US)*: **AGVENTURE B.V.** [NL/NL]; Burg. Arriensweg 32, NL-7431 BM Diepenveen (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **LINDHOUT, Willem, Hendrik** [NL/NL]; Delhorstpad 1A, NL-6703 BE Wageningen (NL). **SCHOTTE, Teunis, Philippus** [NL/NL]; Westzijdeweg 33A, NL-2391 JE Hazerswoude-Dorp (NL). **VISSER, Richard, Gerardus, Franciscus** [NL/NL]; Emmalaan 17, NL-6721 ET Bennekom (NL). **VAN ECK, Herman, Johannes** [NL/NL]; Eykmanstraat 9, NL-6706 JT Wageningen (NL). **HUTTEN, Ronaldus, Cornelis, Bernardus** [NL/NL]; De Thijmenstoren 12, NL-3912 AT Rhenen (NL).

(74) Agent: **JANSEN, C.,M.**; Vereenigde, Johan de Wittlaan 7, NL-2517 JR Den Haag (NL).

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Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

— *with (an) indication(s) in relation to deposited biological material furnished under Rule 13bis separately from the description (Rules 13bis.4(d)(i) and 48.2(a)(viii))*

(54) Title: HYBRID SEED POTATO BREEDING

(57) Abstract: 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 preparing such plants and to hybrid seeds obtained by crossing such homozygous potato lines and to potato plants grown from said see.

WO 2011/053135 A2

Agventure B.V. Ex. 2009
IPR2025-00136
Page 1029

Title: Hybrid Seed Potato Breeding

FIELD OF THE INVENTION

The invention relates to the field of agriculture, in particular to new plants and processes for obtaining them. The invention also relates to methods for improving the genetic constitution of crop plants, and to plants thus obtained. The invention further relates to a method for producing hybrid seeds and to hybrid seeds thus produced and to methods of producing crops using the hybrid seeds of the invention.

BACKGROUND OF THE INVENTION

The potato (*Solanum tuberosum* L.) is an integral part of the global food system. It is the world's number one non-grain food commodity, with production reaching a record 325 million tonnes in 2007.

Unlike other major field crops, potatoes are reproduced vegetatively from other potatoes. Therefore, a part of each year's crop - ranging from 5 to 15 percent, depending on the quality of the harvested tubers - is set aside for re-use in the next planting season. Most farmers in developing countries select and store their own seed tubers. In developed countries, farmers are more likely to purchase disease-free "certified seed" from dedicated suppliers.

Seed potatoes are more difficult to produce and supply than grain or pulse seed. A seed:harvest ratio of 1:20 for potatoes is considered good, compared to 1:400 for maize or 1:10.000 for tomato. One hectare may therefore require two tonnes of seed material to maximize the yield of harvestable products, compared to 18 kg for maize. In order to break dormancy, seed potatoes should be stored for several weeks before they can be planted. The right conditions during storage such as amount of light, temperature and humidity are crucial to ensure good “seed” quality.

In addition to the poor seed:harvest ratio, seed potatoes attract and transport pests and diseases. These include (amongst others) late blight, Andean potato weevils, nematodes, tuber moths and viruses. The latter are transmitted in the field by aphids and then carried from generation to generation in the seed. Such a virus infection can decrease yields by up to 20 percent.

Seed potatoes have high transportation costs because of the great distances between the major seed production areas and the major consumer production areas and the relatively high weight of individual seed potato tubers.

To feed the growing world population now and in future, the potato industry has to keep growing to meet the needs of the consuming public. Substantial research and development efforts are devoted to the modernization of planting and harvesting of fields and processing of potatoes, and to the development of economically advantageous potato varieties. Through crossbreeding of potatoes, researchers hope to obtain potatoes with the desirable characteristics of good processing, both for fresh consumption as well as for industrial purposes, high soluble solids content, high yield, resistance to diseases and pests and adaptability to various growing areas and conditions.

The research leading to potato varieties which combine the advantageous characteristics referred to above is largely empirical. This research requires large investments of time, manpower, and money. The development of a potato cultivar can often take up to eight years or more followed by at least five years of propagation to get sufficient quantities for commercial usage. Breeding begins with careful selection of superior parents to incorporate the most important characteristics into the progeny. Since all desired traits usually do not appear in one progeny, breeding is a continuous process of selecting the best recombinants, combining favourable traits of the ancestors.

The arduous task of producing a new potato variety is best understood when understanding the genetics of potato. The commercial potato has a tetraploid genome. Diploid tubers are generally too small for important commercial applications. In addition, the tetraploid genome is extremely heterozygous, often harbouring multiple alleles per locus. It is believed that self-incompatibility, which is primarily experienced at diploid level, and inbreeding depression are responsible for the maintenance of the high genetic variability found in potato and that overdominance of heterozygous alleles (heterosis) results in vigorous plants. In a typical potato offspring obtained from a cross between two unrelated parental lines deleterious alleles may therefore contribute to either a reduced fitness in case of homozygosity or an increased vigour in case of heterozygosity. It is clear that a breeder needs large populations to maximise the chance of finding individuals that carry a relatively high

number of heterozygotic loci and a low number of homozygotic loci, while also exhibiting beneficial combinations of agronomically desirable traits.

Present potato breeding techniques rely on the controlled crossing of parental clones which themselves are the result of a comprehensive pre-breeding development during which amongst others special techniques such as chromosome doubling, embryo rescue, and somatic fusion are applied in order to introduce the beneficial characteristics of for instance wild and primitive *Solanum* species into these clones. The parental material that is found suitable for further breeding after a phenotypic selection procedure is then mutually crossed and the resulting non-uniform hybrid seeds are sown in large numbers in greenhouses. From tens of thousands of individual F1 seedlings tubers are harvested and retained for the next year's planting. The next year a single "seed" tuber from each resulting seedling is planted in the field. Extreme caution must be taken to avoid the introduction of viruses and diseases since the material is only clonally (vegetatively) expanded before it is sold to individual customers years later. After the second year, samples of tubers are taken for density measurements and preliminary fry tests to determine the suitability of the tubers for commercial use. A multitude of tubers of plants which have survived the selection process to this point are then planted in the third year for a more comprehensive series of fry tests and density determinations. At the fourth-year stage of development, a diminishing number of surviving selections is grown in ever expanding numbers and plants thereof are subjected to field trials in several stages to determine their adaptability to different growing conditions. Eventually, the varieties having superior agronomical qualities are transferred to other farms and the "seed" (in the form of tubers) is increased to commercial scale. Since one "seed" tuber may generate between 6 and 20 harvested tubers this up-scaling process may take years before sufficient "seed" is produced. Generally, by this time, eight or more years of planting, harvesting and testing have been invested in attempting to develop a new and improved potato cultivar.

To reduce inbreeding depression a breeder may introduce new genes from a genetically more remote parent such as from wild and primitive species with ploidy levels ranging from diploid to hexaploid. However, when two genetically unrelated potato plants are crossed, the level of heterozygosity may be increased but simultaneously more deleterious genes are also introduced. As a consequence, a

breeder will typically make additional crosses with more commercial germplasm to enrich the population for favourable alleles. All together such a multiple crossing breeding programme may take dozens of years as the selection of the favourable genotypes in each generation may already take five years. Therefore, potato breeding is currently a predominantly empirical exercise, strongly characterised by trial and error.

Potatoes and their related wild species (tuber-bearing *Solanum* species) are mostly outbreeding because self fertilisation is hampered by a gametophytic self-incompatibility system. Self-incompatibility (SI) is a general name for several genetic mechanisms in angiosperms, which prevent self-fertilization and inbreeding. In plants with SI, when a pollen grain produced in a plant reaches a stigma of the same plant or another plant with a similar genotype, the process of pollen germination, pollen tube growth, ovule fertilization, and embryo development is halted at one of its stages, and consequently no seeds are produced. Self-incompatibility is not found in tetraploid potatoes.

The provision of such self-compatible clones may facilitate the generation of selfed progenies of potato, and hence the production of (highly) homozygous potato lines. This could provide a great opportunity to the development of homozygous elite breeding lines in potato. However, to date, the development of homozygous elite lines with genetically fixed agronomically desirable traits, that would enable the production of genetically uniform hybrid potato seed, has been unsuccessful.

The provision of homozygous elite lines is hampered by unknown causes. Selfing of an occasionally encountered self-compatible clone results in a slower decrease of heterozygosity than theoretically expected. The slower decline of heterozygosity may be the result of unintentional but unavoidable selection during selfing for the heterozygous plants in the offspring that exhibit higher vigour, fertility and seed germination. It is implied that, as the heterozygosity is reduced by selfing, the fertility and vigour are also reduced and the plants may become weak and completely sterile. The situation is perhaps worsened by the establishment of homozygous configurations of recessive deleterious genes. This phenomenon which is generally referred to as inbreeding depression has greatly hampered the development for homozygous potato lines and hence the production of uniform hybrid potato seed.

There is a large prejudice against the production of homozygous breeding lines in potato due to inbreeding depression. Uijtewaal et al. (Euphytica 36 (1987) 745-753) indicated that owing to sterility problems, homozygous potato clones would be of little importance for practical breeding. Developing homozygous inbred lines was considered, but rendered impossible in potato (Umaerus, 1987, Proceeding of the 10th Triennial Conference of the European Association of Potato Research, Aalborg, Denmark, pp 72–103 as cited in Almekinders et al. 2009 Potato Research 52:275–293). Routes involving doubling of haploids have long been presumed as promising. Nontheless, up to the present day the ruling opinion is that inbreeding depression in diploid potato is too strong to ever result in vigorous homozygous plants.

Birhman and Hosaka (Genome 43: 495–502 (2000)) have suggested the possibility to utilize the *Sli* gene derived from *S. chacoense* for development of highly homozygous true potato seed (TPS) lines and heterosis breeding of the potato. However, to date, no homozygous lines with good agronomic traits such as good tuber yield, have ever been reported from this proposed line of research. Rather, those homozygotes that have been produced do not exhibit any agronomically relevant tuber yield.

Rommens in 2010 (Genetic modification of Plants, Kempen & Jung , eds, In: Biotechnology in Agriculture and Forestry 64(1): 61-77 (2010)), advocates the route of genetic transformation, due to the fact that efforts to improve the yield and quality of this crop are hampered by inbreeding depression.

In short, production of true breeding lines of potato is considered impossible. Due to this fact, potato breeding cannot escape the traditional schemes based on crossing of tetraploid heterozygotes. As a result, the challenge is considered formidable to combine various utilization traits (relating to fresh and processing uses), resistances to pathogens and pests, and numerous other relevant agronomic traits with improvements in yield into a commercially acceptable cultivar (Douches et al. 1999, Crop Science 36(6):1544-1552).

It is an objective of the present invention to provide means and methods for the production of elite breeding lines of potato and for the production of uniform hybrid potato seed from which plants can be grown that exhibit agronomically relevant tuber yield.

SUMMARY OF THE INVENTION

The present inventors have attempted to achieve homozygous parental breeding lines for generative propagation of potatoes via a number of routes, none of which were successful. These unsuccessful routes included androgenesis, gynogenesis, doubling of haploids and continued selfings. Only by repeated selfing of a self-compatible plant comprising the *Sli* gene derived from *S. chacoense* and the use of did the inventors arrive at the product of the present invention. The present invention now provides in a first aspect a diploid, fertile, self-compatible and essentially homozygous potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant. Plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant are in general terms also referred to herein as being vigorous.

In a preferred embodiment, said line in addition to said tuber yield comprises at least one, more preferably at least 2, 3, 4, 5 or 6 (additional) agronomically desirable traits. Preferably, said agronomically desirable traits are selected from the group consisting of insect tolerance, nematode resistance, disease resistance (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, and cold sweetening resistance.

In another preferred embodiment of said potato line of the invention, plants of said line when mature attain an average fresh weight of the foliage and shoots of at least 500 grams per plant. Plants attaining an average fresh weight of the foliage and shoots of at least 500 grams per plant are in general terms also referred to herein as being vigorous.

In another aspect, the present invention provides a plant of a line according to the invention as described above. Preferably, said plant is diploid, fertile, self-compatible and essentially homozygous and has an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant.

In another aspect, the present invention provides a seed of a plant as described above. Said seed may be homozygous (i.e. represent a selfed seed), but may

also be heterozygous for the alleles where the parents differ. In one embodiment, said seed is preferably a uniform hybrid potato seed. Such uniform hybrid potato seed being the result of a cross between two homozygous, self-compatible, fertile and vigorous plants of a line according to the invention as described above, preferably of two different lines, wherein the lines contain at least 20 % contrasting homozygous loci as determinable by molecular marker analysis.

In another aspect, the present invention provides a method for producing a diploid, fertile, self-compatible and essentially homozygous 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 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 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 an offspring generation in the form of 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, self-compatible and essentially homozygous potato breeding line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant.

A first potato plant in a method as described herein is preferably a plant of a first diploid, self-compatible, fertile and essentially homozygous potato line, wherein the self-compatibility is conditioned by the presence of a dominant allele of an S-locus (self-incompatibility locus) inhibitor gene (Sli) that is nonallelic to the S locus as described in Hosaka and Hanneman 1998 Euphytica, 99: 191–197.

The above method, when performed on a sufficiently large scale (at least more than 10.000 plants) and performed with the use of a suitable second potato plant, which is preferably a diploid potato clone that is essentially not homozygous, 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, preferably a line such as IVPAA-096-18 (D2) as described in the Examples herein below, results in the production of an essentially homozygous, fertile, vigorous and self-compatible breeding line, wherein said vigour is in particular represented by an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant. The provision of such a breeding line is a crucial step in the provision of genetically homozygous true potato seed (TPS).

The first and second breeding line can subsequently be used in the production of the TPS when both the first and second breeding line comprise agronomically desirable characteristics, have good general combining abilities, and preferably have at least 20% contrasting homozygous loci as determinable by molecular marker analysis.

In a preferred embodiment of said method for producing a diploid, fertile, self-compatible and essentially homozygous potato line according to the invention, said steps a-e are repeated wherein step b comprises the provision of third (or further) potato plant wherein said third potato plant is a plant of a diploid or tetraploid potato line which may have any level of homozygosity, wherein said third potato plant is a donor for an additional agronomically desirable trait. Preferably, said trait is selected from the group consisting of insect tolerance, nematode resistance, disease resistance (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, and cold sweetening resistance, or any other agronomically beneficial trait or desirable characteristic as defined herein.

The second or third potato plant as described above may suitably be a diploid potato clone selected from the plants D1-D21 as listed in Table 6 of Example 3 below. The skilled person will understand that other diploid potato clones may also be used. Highly preferred is the use of potato clone IVPAA-096-18 (D2) which is available

from Laboratory of Plant Breeding (IVP) (Dr. Ir Ronald B.C. Hutten), Wageningen University, Droevendaalsesteeg 1, 6708 PB Wageningen, The Netherlands.

Proper (commercial) sources of tetraploid cultivars are provided through the European Cultivated Potato Database (ECPD) at http://www.europotato.org/menu.php and/or the Potato Pedigree Database of the expertise group Plant Breeding (a cooperation between the Laboratory of Plant breeding of Wageningen UR, the Netherlands) and the business unit Biodiversity and breeding of Plant Research International (PRI), Wageningen, the Netherlands at http://www.plantbreeding.wur.nl/potatopedigree/.

In another preferred embodiment of said method, said first potato plant is a plant of potato line NCIMB 41663, NCIMB 41664, NCIMB 41665, or NCIMB 41765, representative seeds of said line having been deposited with the NCIMB, Aberdeen, Scotland.

In yet another preferred embodiment of said method, said second potato plant is a plant of a second diploid, fertile, self-compatible and essentially homozygous potato line.

In yet a further preferred embodiment of said method, said second potato plant is a plant of a second diploid, fertile, self-incompatible potato line.

The method for producing a diploid potato breeding line may further comprise the steps of enhancing the breeding value of the diploid potato breeding line by intercrossing, selfing and backcrossing while continuous selecting for agronomically desirable traits. Experimental crosses are done to evaluate general combining abilities (intercrossability).

In another aspect, the present invention provides a diploid potato breeding line, more preferably an elite line, obtainable by the method of the present invention as described above.

In another aspect, the present invention provides a hybrid potato seed obtainable by crossing plants of a first and second diploid potato breeding line according to the present invention as described above, wherein said plants of said first and second diploid potato breeding line contain at least 20 % contrasting homozygous loci as determinable by molecular marker analysis.

In another aspect, the present invention provides 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,

(b) providing a second potato plant, wherein said second potato plant is a plant of a second diploid, fertile, self-compatible and essentially homozygous potato line, wherein said first and second plant contain at least 20 % contrasting homozygous loci as determinable 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 an offspring generation in the form of a hybrid offspring seed.

In a preferred embodiment of a method for producing hybrid seed, said first and second potato plant are from potato lines comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, preferably wherein said first and second potato plant are plants having a tuber yield of at least 200 grams fresh weight per plant.

In another preferred embodiment of said method of producing hybrid seed, at least one of said first and second potato plants comprises at least one agronomically desirable trait, preferably selected from the group consisting of insect tolerance, nematode resistance, disease resistance (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, and cold sweetening resistance.

In another preferred embodiment of a method for producing hybrid seed according to the present invention, said first potato line is a diploid, self-compatible and essentially homozygous offspring potato plant comprising the *Sli*-gene, preferably wherein said first potato plant is a plant of potato lines NCIMB 41663, NCIMB 41664, NCIMB 41665, or NCIMB 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.

In another preferred embodiment of a method for producing hybrid seed according to the present invention, said second potato plant is a plant of a second diploid, self-compatible and essentially homozygous potato line preferably comprising at least two agronomically desirable traits selected from the group consisting of insect tolerance, nematode resistance, disease resistance (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, and cold sweetening resistance.

In another aspect, the present invention provides a seed of potato lines NCIMB 41663, NCIMB 41664, NCIMB 41665, or NCIMB 41765, representative seeds of said line having been deposited with the NCIMB, Aberdeen, Scotland.

In another aspect, the present invention provides a seed produced by the method for producing a uniform hybrid potato seed as disclosed herein.

In another aspect, the present invention provides a hybrid potato plant, or part thereof, produced by growing the seed of the present invention.

In another aspect, the present invention provides pollen or an ovule of the hybrid potato plant, or part thereof, of the present invention.

In another aspect, the present invention provides a tuber from the hybrid potato plant of the present invention.

In another aspect, the present invention provides a potato plant having all of the physiological and morphological characteristics of the hybrid potato plant produced by growing the seed of the present invention.

In another aspect, the present invention provides a tissue culture of the hybrid potato plants of the present invention.

In another aspect, the present invention provides a potato plant regenerated from the tissue culture of the present invention, wherein said regenerated potato plant has all the physiological and morphological characteristics of the hybrid potato plant produced by growing the seed of the present invention.

In another aspect, the present invention provides a method for producing a hybrid potato seed wherein the method comprises crossing a first potato plant with a second potato plant and harvesting the resultant hybrid potato seed, wherein said first and/or second parent potato plant is a diploid, fertile, self-compatible and essentially homozygous plant according to the present invention that has an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant.

In another aspect, the present invention provides a method of producing a hybrid potato plant, said method comprising producing a seed according to a method of the present invention and growing said seed into a potato plant.

In another aspect, the present invention provides a potato plant produced by the method of the invention, or a tuber thereof.

In another aspect, the present invention provides a method set of at least 4 intercrossable homozygous diploid, fertile, self-compatible and essentially homozygous potato lines comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant according to the present invention, wherein each of said lines differ from another line in said set by having at least 20 % contrasting homozygous loci as determinable by molecular genetic marker analysis.

The invention also provides as an embodiment of methods of the invention as described above methods comprising the steps of:

(a) providing a first potato plant, which first potato plant is a plant of a first diploid, self compatible and essentially homozygous potato line carrying chromosomes with alleles for agronomically desirable traits that are to be expressed in an offspring generations,

(b) providing a second potato plant, wherein said second potato plant is a plant of a second diploid, self compatible and essentially homozygous potato line carrying chromosomes with alleles for agronomically desirable traits that are to be expressed in an offspring generations and that may be different form the traits in the said first plant, and

(c) cross pollinating said first and second potato plant such that one of said parent plants produces berries with seeds and collecting said seeds from said berries to provide an offspring generation in the form of a hybrid offspring seed carrying combinations of chromosomes with said alleles.

Thus, in an alternative embodiment the plant of the first potato line may carry chromosomes with alleles for agronomically desirable traits that are to be expressed in an offspring generations, in which case the agronomically desirable trait in the plant of the second potato line may be different from the traits in the said first plant.

In another aspect, the present invention provides a method of producing a herbicide resistant, nematode resistant, insect resistant and/or disease resistant potato plant, said method comprising producing a seed according to a method of the invention described above by crossing parental lines that are herbicide resistant, nematode resistant, insect resistant and/or disease resistant and growing said seed a potato plant.

In another aspect, the present invention provides a herbicide resistant, nematode resistant, insect resistant and/or disease resistant potato plant produced by the method of the invention as described above.

In yet another aspect, the present invention provides a method for preventing transmittal of virus infections between potato generations, comprising:

(a) providing a first potato plant, which first potato plant is a plant of a first diploid, self-compatible and essentially homozygous potato line,

(b) providing a second potato plant, wherein said second potato plant is a plant of a potato line that may have any level of ploidy and/or any level of homozygosity, said second potato plant carrying a chromosome with an allele for a agronomically desirable trait that is to be expressed in an offspring generation;

(c) cross pollinating said first and second potato plant such that one of said parent plants produces berries with seeds and collecting said seeds from said berries

to provide an offspring generation in the form of a hybrid offspring seed carrying a chromosome with said allele;

(d) growing said hybrid offspring seed into a hybrid offspring potato plant carrying a chromosome with said allele, and

(e1) harvesting tubers from said hybrid offspring potato plant to provide tubers expressing said trait, or

(e2) 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, thereby providing further offspring plants carrying a chromosome with said allele and wherein said offspring plants are increasingly homozygous following each backcrossing or selfing step.

In another aspect, the present invention provides a diploid, fertile, self-compatible and essentially homozygous potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, said plant being obtainable by:

(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,

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid potato line 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 and allowing one of said parent plants to produce berries with seeds and collecting said seeds from said berries to provide an offspring generation in the form of a hybrid offspring seed,

(d) growing said hybrid offspring seed into a hybrid offspring potato plant,

(e) backcrossing said hybrid offspring potato plant to a potato plant of said line of said first potato plant, and selecting from the offspring plants thus generated a plant that is diploid, self-compatible and vigorous in that it produces tubers at a yield expressed in grams of fresh weight of at least 200 grams per plant, and

(f) selfing said diploid, self-compatible and vigorous plant for between 1 to 8 generations while selecting for self-compatibility and vigour as defined in (e).

In another aspect, the present invention provides a hybrid potato seed which seed, when sown produces a diploid, fertile, self-compatible and essentially heterozygous potato plant having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, said plant being obtainable by:

(a) providing a first diploid, fertile, self-compatible and essentially homozygous potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant,

(b) providing a second diploid, fertile, self-compatible and essentially homozygous 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 determinable by molecular marker analysis, 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 an offspring generation in the form of a hybrid offspring seed.

The steps of selecting or providing plants that are homozygous, or the step of selecting or providing plants having at least 20% contrasting loci as defined herein above, may comprise marker assisted selection using the molecular genetic markers as provided herein.

DESCRIPTION OF THE DRAWINGS

Figure 1 shows a schematic presentation of a development scheme for the development of hybrid potato cultivars using the methods and plants of the present invention, wherein the various steps in obtaining commercial potato hybrids are indicated:

0, Potato germplasm: The origin comprises in principle all potato genotypes within the cultivated potato species (*Solanum tuberosum*) and related crossable species;

1, Self-compatible diploid potato: Cultivated potato (*Solanum tuberosum*) is usually self incompatible. Self-compatibility is introduced from related species (see for instance Hermsen, J.G.Th. 1978, Euphytica 27, 1-11);

2, Homozygous fertile self-compatible diploid potato: Homozygous diploids can be obtained by doubling haploids (Uijtewaal et al., 1987, Theor. Appl. Genet. 73,

751-78) by anther culture (Jacobsen and Sopory, 1977, Theor. Appl. Genet. 52, 119-123), by ovule culture or by repeated selfings (Phumichai & Hosaka, 2006, Euphytica 149, 251-258). The example of the latter is illustrated herein;

3, Vigorous fertile homozygous self-compatible diploid potato: The vigour is enhanced by crossing with other diploid potato, selfing and backcrossing while selecting for higher vigour;

4, Diploid potato breeding Lines: Agronomically desirable traits are introduced by crossing with other diploid potato, selfing and backcrossing while selecting for these traits;

5, Elite diploid potato breeding Lines: The breeding value is further enhanced by intercrossing, selfing and backcrossing while continuous selecting for agronomically desirable traits. Experimental crosses are done to evaluate general combining abilities;

6 Potato hybrid cultivars: Good combining breeding lines are crossed. The seeds obtained are hybrid true potato seeds that are uniform.

Figure 2 shows a schematic presentation of the pedigrees of the populations, deposits and plants as described in the Examples, starting from a cross between a diploid, essentially homozygous and self-compatible potato plant ("H") and three different diploid clones (D1, D2, and D3) that are essentially non-homozygous and self-incompatible and that act as donor lines of one or more desirable agronomic traits. The production of an array of essentially homozygous lines from backcross lines to fully selfed clones, each having one or more desirable traits derived from the donor lines provides a set of elite breeding lines for the production of an array of hybrid potato cultivars in the form of hybrid seed. ⊗ Refers to selfings. As can be seen, and as detailed in the Examples, only donor line D2 resulted in the production of a large number of self-compatible plants that would show vigour as defined herein. Vigorous plants could be obtained from the other crossings as well, albeit at a much lower frequency (0.1-1%).

Figure 3 displays the ultra-dense genetic linkage map of the genome of diploid breeding clone RH89-039-16. The number on the left of the linkage group indicates the cumulative number of recombination events counted from the top. The number of AFLP markers in each bin is represented by shades of grey according to the figure legend. Putative centromere positions are indicated with "Cen" alongside the

chromosome (van Os et al., 2006 Genetics 173(2):1075-1087). The numbers on the right of the linkage group indicate the approximate location of the corresponding PotSNPmarker as used herein, wherein reference is made to Table 5B in Example 3, below, for marker annotations. The figure clearly indicates the distribution of informative markers over the potato genome of this clone. A similar distribution was observed for these markers with another clone used herein, clone SH83-92-488.

Figure 4 shows marker data of 100 markers over 20 different diploid potato genotypes, representing the diploid potato breeding germplasm (Example 2).

Figure 5 shows the result of SNP marker analysis as described in Example 3 on a set of six F3 populations and their respective parents.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

The term "potato" is used herein to refer to material that is essentially of species *Solanum tuberosum*, but may include introgression segments of other tuber bearing *Solanum* species such as *Solanum chacoense, Solanum phureja, Solanum andigena, Solanum demissum*.

The term "potato plant" is used herein to refer to a seedling or mature plant as grown from cell culture or seed. Persons of ordinary skill in the art will recognize that when the term "potato plant" is used in the context of the present invention, this also includes derivative varieties that retain the essential distinguishing characteristics of for instance potato varieties that are subject of the present invention, such as a Single Gene Converted plant of that variety or a transgenic derivative having one or more value-added genes incorporated therein (such as herbicide or pest resistance). Backcrossing methods can be used with the present invention to improve or introduce a characteristic into the variety.

The term "crossing" as used herein refers to the fertilization of female plants (or gametes) by male plants (or gametes). The term "gamete" refers to the haploid reproductive cell (egg or sperm) produced in plants by mitosis from a gametophyte and involved in sexual reproduction, during which two gametes of opposite sex fuse to form a diploid zygote. The term generally includes reference to a pollen (including the sperm cell) and an ovule (including the ovum). "Crossing" therefore generally refers to the fertilization of ovules of one individual with pollen

from another individual, whereas "selfing" refers to the fertilization of ovules of an individual with pollen from the same individual. Crossing is widely used in plant breeding and results in a mix of genomic information between the two plants crossed one chromosome from the mother and one chromosome from the father. This will result in a new combination of genetically inherited traits. Usually, the progeny of a crossing is designated as: "F1". If the F1 is not uniform (segregates) it is usually designated as "F1 population". "Selfing" of a homozygous plant will usually result in a genetic identical plant since there is no genetic variation. "Selfing" of an F1 will result in an offspring that segregates for all traits that have heterozygotic loci in the F1. Such offspring is designated: "F2" or "F2 population"

When referring to "crossing" in the context of achieving the introgression of a genomic region or segment, the skilled person will understand that in order to achieve the introgression of only a part of a chromosome of one plant into the chromosome of another plant, it is required that random portions of the genomes of both parental lines will be recombined during the cross due to the occurrence of crossing-over events in the production of the gametes in the parent lines. Therefore, the genomes of both parents must be combined in a single cell by a cross, where after the production of gametes from said cell and their fusion in fertilization will result in an introgression event.

The term "intercrossable", as used herein, refers to the ability to yield progeny plants after making crosses between parent plants.

As used herein, the terms "introgressing", "introgress" and "introgressed" refer to both a natural and artificial process whereby individual genes or entire chromosomes are moved from one individual, species, variety or cultivar into the genome of another individual, species, variety or cultivar, by crossing those individuals, species, varieties or cultivars. In plant breeding, the process usually involves selfing or backcrossing to the recurrent parent to provide for an increasingly homozygous plant having essentially the characteristics of the recurrent parent in addition to the introgressed gene or trait.

The term "introgression" refers to the result of an introgression event.

The term "backcross" refers to the result of a "backcrossing" process wherein the plant resulting from a cross between two parental lines is (repeatedly) crossed with one of its parental lines, wherein the parental line used in the backcross

is referred to as the recurrent parent. Repeated backcrossing results in replacement of genome fragments of the donor parent with those of the recurrent. The offspring of a backcross is designated "BCx" or "BCx population", where "x" stands for the number of backcrosses.

The term "backcrossing" as used herein refers to the repeated crossing of a hybrid progeny back to the recurrent parents. The parental potato plant which contributes the gene for the desired characteristic is termed the nonrecurrent or donor parent. This terminology refers to the fact that the nonrecurrent parent is used one time in the backcross protocol and therefore does not recur. The parental potato plant to which the gene or genes from the nonrecurrent parent are transferred is known as the recurrent parent as it is used for several rounds in the backcrossing protocol. In a typical backcross protocol, the original variety of interest (recurrent parent) is crossed to a second variety (nonrecurrent parent) that carries the single gene of interest to be transferred. The resulting progeny from this cross are then crossed again to the recurrent parent and the process is repeated until a potato plant is obtained wherein essentially all of the desired morphological and physiological characteristics of the recurrent parent are recovered in the converted plant, in addition to the single gene or a limited number of genes transferred from the nonrecurrent parent.

The selection of a suitable recurrent parent is an important step for a successful backcrossing procedure. The goal of a backcross protocol is to alter or substitute a single trait or characteristic in the original variety. To accomplish this, a single gene of the recurrent variety is modified, substituted or supplemented with the desired gene from the nonrecurrent parent, while retaining essentially all of the rest of the desired genes, and therefore the desired physiological and morphological constitution of the original variety. The choice of the particular nonrecurrent parent will depend on the purpose of the backcross. One of the major purposes is to add some commercially desirable, agronomically important traits to the recurrent parent. The exact backcrossing protocol will depend on the characteristic or trait being altered or added to determine an appropriate testing protocol. Although backcrossing methods are simplified when the characteristic being transferred is a dominant allele, a recessive allele may also be transferred. In this instance, it may be necessary to introduce a test of the progeny to determine if the desired characteristic has been

successfully transferred. Preferably, such genes are monitored by diagnostic molecular markers.

Likewise, transgenes can be introduced into the plant using any of a variety of established recombinant methods well-known to persons skilled in the art.

Many single gene traits have been identified that are not regularly selected for in the development of a new variety but that can be improved by backcrossing and genetic engineering techniques. Single gene traits may or may not be transgenic, examples of these traits include but are not limited to: herbicide resistance; resistance to bacterial, fungal or viral disease; insect resistance; uniformity or increase in concentration of starch and other carbohydrates; enhanced nutritional quality; decrease in tendency of tuber to bruise; and decrease in the rate of starch conversion to sugars.

The term "selfing" refers to the process of self-fertilization wherein an individual is pollinated or fertilized with its own pollen. Repeated selfing eventually results in homozygous offspring.

A "line", as used herein, refers to a population of plants derived from a single cross, backcross or selfing. The individual offspring plants are not necessarily identical to one another. It is possible that individual offspring plants are not vigorous, fertile or self compatible due to natural variability. However, it is foreseen that suitable plants that are vigorous, fertile and self compatible can be easily identified in a line and used for additional breeding purpose.

As used herein, the term "allele(s)" means any of one or more alternative forms of a gene, all of which alleles relate to at least one trait or characteristic. In a diploid cell or organism, the two copies of a gene occupy corresponding loci on a pair of homologous chromosomes. Each copy may be a distinct allele.

A "gene" is defined herein as a hereditary unit (often indicated by a sequence of DNA) that occupies a specific location on a chromosome and that contains the genetic instruction for a contribution to potential phenotypic characteristics or trait in a plant.

A "locus" is defined herein as the position that a given gene occupies on a chromosome of a given plant species.

As used herein, the term "homozygous" means a genetic condition existing when identical alleles reside at corresponding loci on homologous chromosomes.

The term “essentially homozygous” refers to a level of homozygosity of at least 25%, preferably at least 50%, more preferably at least 75%, still more preferably at least 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, or 100% homozygosity when testing 100, preferably 1000, more preferably at least 10.000 loci.

Homozygosity levels are average values for the population, and refer preferably to those loci wherein the parents differ.

As used herein, the term "heterozygous" means a genetic condition existing when different alleles reside at corresponding loci on homologous chromosomes.

The term “recombination” or “recombine” refers to the exchange of information between two homologous chromosomes during meiosis. In a “recombinant” plant, DNA that is originally present on a specific location within the chromosome, e.g. linked to a gene/locus, is exchanged for DNA from another plant (i.e. maternal for paternal or *vice versa*). In order to exchange only the required material, and maintain the valuable original information on the chromosome as much as possible, two flanking crossover or recombination events will usually be required. In a double recombinant this exchange has taken place on both sides of a gene/locus. one way to find such a double recombinant, is to screen a population of F2-plants. This population has to be large, since double recombination occurs in only a limited frequency. Alternatively, double recombinants within a genetic unit can be the result of subsequent backcrossing. The frequency of double recombination is the product of the frequencies of the single recombinants. (E.g. a recombinant in a 10 cM area can be found with a frequency of 10%, double recombinants are found with a frequency of 10% x 10% = 1 %).

As used herein, the term "progeny" means (a) genetic descendant(s) or offspring.

As used herein, the term "population" means a genetically heterogeneous collection of plants sharing a common genetic derivation.

A "recombination event" refers to a mitotic or meiotic crossing-over event, including a GMO event.

As used herein, the term "hybrid" means any offspring of a cross between two genetically unlike individuals, more preferably the term refers to the cross

between two (elite or inbred) breeding lines which will not reproduce true to the parent from seed.

The term “segregate”, as used herein, refers to the separation of paired alleles during meiosis so that members of each pair of alleles appear in different gametes. The term includes reference to the result of this genetic phenomenon wherein the offspring population of a crossing in which at least one of the parents is heterozygous for an allelic gene is non-uniform with respect to phenotypic trait conferred by said gene.

The term “breeding line”, as used herein, refers to a line of a cultivated potato having commercially valuable or agronomically desirable characteristics, as opposed to wild varieties or landraces. The term includes reference to an elite breeding line or elite line, which represents an essentially homozygous, usually inbred, line of plants used to produce commercial F_1 hybrids. An elite breeding line is obtained by breeding and selection for superior agronomic performance comprising a multitude of agronomically desirable traits. An elite plant is any plant from an elite line. Superior agronomic performance refers to a desired combination of agronomically desirable traits as defined herein, wherein it is desirable that the majority, preferably all of the agronomically desirable traits are improved in the elite breeding line as compared to a non-elite breeding line. Elite breeding lines are essentially homozygous and are preferably inbred lines.

The term "elite line", as used herein, refers to any line that has resulted from breeding and selection for superior agronomic performance. An elite line preferably is a line that has multiple, preferably at least 3, 4 5, 6 or more (genes for) desirable agronomic traits as defined herein.

The terms "cultivar" and “variety” are used interchangeable herein and denote a plant with has deliberately been developed by breeding, cq crossing and selection, for the purpose of being commercialized, cq used by farmers and growers, to produce agricultural products for own sonsumption or for commercialization (fresh consumption, processing, feed, etc). The term “breeding germplasm” denotes a plnat having a biological status other than a "wild" status, which "wild" status indicates the original non-cultivated, or natural state of a plant or accession.

The term "breeding germplasm" includes, but is not limited to, semi-natural, semi-wild, weedy, traditional cultivar, landrace, breeding material, research

material, breeder's line, synthetic population, hybrid, founder stock/base population, inbred line (parent of hybrid cultivar), segregating population, mutant/genetic stock, market class and advanced/improved cultivar. Examples of cultivars include such cultivated varieties as Bintje, Russet Burbank, Eigenheimer, and Nicola.

As used herein, the terms "purebred", "pure inbred" or "inbred" are interchangeable and refer to a substantially homozygous plant or plant line obtained by repeated selfing and-or backcrossing.

As used herein, the term "molecular genetic marker" or short "marker" refers to an indicator that is used in methods for visualizing differences in characteristics of nucleic acid sequences. Examples of such indicators are restriction fragment length polymorphism (RFLP) markers, amplified fragment length polymorphism (AFLP) markers, single nucleotide polymorphisms (SNPs), insertion/deletion (INDEL) mutations, microsatellite markers (SSRs), sequence-characterized amplified regions (SCARs), cleaved amplified polymorphic sequence (CAPS) markers or isozyme markers or combinations of the markers described herein which defines a specific genetic and chromosomal location.

As used herein, the term "plant part" indicates a part of the potato plant, including organelles, single cells and cell tissues such as plant cells that are intact in plants, cell clumps and tissue cultures from which potato plants can be regenerated. Examples of plant parts include, but are not limited to, single cells and tissues from pollen, ovules, leaves, embryos, roots, root tips, tubers, anthers, flowers, fruits, stems shoots, and seeds; as well as pollen, ovules, leaves, embryos, roots, root tips, anthers, flowers, fruits, stems, shoots, scions, rootstocks, seeds, tubers, protoplasts, calli, and the like.

Unless expressly stated otherwise, the term "seed", as used throughout this specification, refers to the body from which a new plant develops (or kernel in some plants) containing the small embryonic plant enclosed in a seed coat covering, usually together with some stored food. This seed, referred to as botanical or "true" seed is the product of the ripened ovule of gymnosperm and angiosperm plants which occurs after fertilization and some growth within the mother plant.

As used herein the terms "vigour" and "vigorous" refer to the relative amount of above-ground or below-ground tissues of a plant, which relative amount may be more or less independent of one another.

The relative amount of above-ground tissues can be expressed as visual observations of the amount of foliage, in terms of plant height, number of stems, number of leaves assessed on ordinal scales, and/or in terms of fresh weight or dry matter. This trait has relevance during the first period of the plant growth cycle with an average duration of 100 days of cultivation (range 75 – 130 days) under normal growth conditions that prevail in North Western Europe during the season from May trough to August. Under these conditions, the plants of the present invention attain a weight of the foliage and shoots (above-ground plant) expressed in grams of fresh or dry weight which is at least 50%, more preferably at least 60%, 70%, 80%, 90% or more of the (essentially heterozygous) diploid breeding clone RH89-039-16, which – in turn - has 68% (range 44 – 86%) of the tuber yield of tetraploid potato varieties based on nine years of testing. Clone RH89-039-16 is available for reference purpose from Dr. Ir Ronald B.C. Hutten, Laboratory of Plant Breeding, Wageningen University, Droevendaalsesteeg 1, 6708 PB Wageningen, The Netherlands.

Alternatively, or in addition, the term vigour may be used in connection with a certain minimal tuber yield. The term "tuber yield", as used herein, will generally refer to a tuber yield expressed in grams of fresh weight which at harvest in plants according to the present invention is at least 30-50%, more preferably at least 60%, 70%, 80%, 90% or more of the (essentially heterozygous) diploid breeding clone RH89-039-16, which – in turn - has 68% (range 44 – 86%) of the tuber yield of tetraploid potato varieties based on nine years of field testing under conditions of a 100 days cultivation period with normal growth conditions that prevail in North Western Europe during the season from May trough to August. As indicated above, clone RH89-039-16 is available for reference purpose from Dr. Ir Ronald B.C. Hutten, Laboratory of Plant Breeding, Wageningen University.

Tuber yield, unless expressly stated otherwise, is based on the tubers formed from a seedling plant, in contrast to the tubers formed from a tuber-grown plant – which yield may be 50-200% more than the yield of a seedling.

Alternatively, or in addition, the term vigour may refer to a tuber yield expressed in grams of fresh or dry weight which at harvest is at least 30-50%, more preferably at least 60%, 70%, 80%, 90% or more of the diploid breeding clone RH89-039-16. This means that the tuber yield expressed in grams of fresh weight may (in plants of the present invention, reach levels of at least 200, more preferably at least

300, 400 or 500 grams per plant grown from seed in clay soil under normal North Western European summer conditions, and even 400, 500, 600, 700, 800 or more, such as 900 or 1000 grams of fresh tuber weight or more per plant when said plant is raised from tubers and grown in clay soil under normal North Western European summer conditions.

The term "a line comprising plants", wherein said plants are indicated as having a certain characteristic, such as tuber yield, should preferably be understood as referring to a line essentially consisting of plants having the said trait, while allowing for some biological variation.

The term "diploid" as used herein refers to a plant wherein each vegetative cell contains two sets of chromosomes (2x=2n, wherein n is the number of chromosomes). One set of chromosomes is donated from each parent.

The term "tetraploid" as used herein refers to a plant wherein each vegetative cell contains four sets of chromosomes (2x=4n).

The term "nematode resistance" as used herein refers to a plant in which a functional resistance gene has been introgressed that prevents the multiplication of at least one nematode population or isolate.

The term "disease resistance" as used herein refers to the ability to show more than 50 % reduction of the amount of diseased leaf surface or tuber volume, or the amount of multiplication of an insect or pathogenic microorganism including but not limited to *Streptomyces* spp, *Rhizoctonia*, Silver scurf and, *Phytophthora infestans*,

The term "herbicide tolerance" as used herein refers to a plant which shows less than 50% damage of the foliage than the usual damage upon the application of a specified dosage of herbicide.

The term "cold tolerance" as used herein refers to the average amount of leaf surface of a plant which shows frost damage, which damage in cold tolerant plants is less than the average damage observed at a temp of minus 3 °C for relatively cold sensitive reference varieties such as e.g. Caribe and/or Kennebec.

The term "drought tolerance" as used herein refers to a plant which shows less than average damage at limiting water conditions as compared to relatively drought sensitive reference varieties such as Caribe and/or Carlton.

The term "flooding tolerance" as used herein refers to a 50% lower proportion of affected tubers (anaerobic degradation) relative to a plant which shows average damage at flooding

The term "tolerance to wet rot" as used herein refers to a plant with the slightest level of resistance to *Erwinia* species (currently termed *Pectobacterium* spp.).

The term "tolerance to dry rot" as used herein refers to a plant with the slightest level of resistance to *Fusarium* species.

The term "salinity tolerance" as used herein refers to a plant which shows less damage than average at salinity conditions.

The term "growth rate" as used herein refers to the increase of plant biomass per unit of time.

The term "tuber development defects" (e.g. misshapen or damaged tubers)" as used herein refers to a plant which shows visual as well as internal malformations of tubers during plant development and/or tuber harvest.

The term "tuber yield" as used herein refers to the total weight of tubers of a plant or of a population of plants generally expressed in grams of fresh weight.

The term "tuber size" as used herein refers to the absolute width, height and length of a tuber. Beneficial tuber sizes include plant- average tuber sizes of about 80-160 grams per tuber. Mean tuber number for commercially valuable plants are about 8-12 tubers per plant.

The term "tuber skin colour" as used herein refers to the colour of the skin of a tuber after harvest as the result of anthocyanin accumulation in tuber skin tissues.

The term "eye depth" as used herein refers to the relative distance between the skin surface and the shoot primordium of a tuber.

The term "tuber shape" as used herein refers to the length / width ratio, to indicate the continuous variation from round, oval to long tuber shaps, as well as the height/width ratio, to indicate the continuous variation from cylindrical to the amount of flatness of a tuber.

The term "tuber flesh colour" as used herein refers to the colour of the interior of the tuber flesh after harvest as the result of the absence or presence of carotenoid compounds causing white or yellow flesh colour, respectively, as well as the

absence of anthocyanins compounds causing red, blue, purple shades of flesh colour, irrespective of the presence of colour in patterns being partial or full.

The term "tuber taste" as used herein refers to the consumers appreciation by consuming a cooked potato tuber.

The term "tuber shelf life" and "tuber storage ability" as used herein are synonymous and refer to lack of changes in appearance of a tuber at storage.

The term "tuber dormancy period" as used herein refers to the time period between sowing and sprouting of a tuber, while sown at normal conditions.

The term "resistance to tuber dehydration" as used herein refers to a plant with shows less dehydration of the tuber than average at low humidity conditions (see shelf life).

The term "tuber starch content" as used herein refers to the starch weight over the total fresh weight of a tuber.

The term "tuber dry matter content" as used herein refers to the weight of the dry components of a potato divided over the total fresh weight.

The term "tuber cooking quality" as used herein refers to the continuous variation from firm to mealiness of a tuber after cooking.

The term "tuber frying quality" as used herein refers to the consumers appreciation of a tuber after frying.

The term "tuber chip making quality" as used herein refers to the consumers appreciation of a tuber after making chips.

The term "tuber uniformity" as used herein refers to the standard deviation of tuber traits, whereby a low standard variation refers to high uniformity and vice versa.

The term "cold sweetening resistance" as used herein refers to resistance of a tuber to produce glucose and/or fructose while stored at temperatures below 8 °C.

The term "tetraploid" as used herein refers to a plant wherein each vegetative cell contains four sets of chromosomes (4n). The terms "fertile" and "fertility" broadly refer to the capacity to reproduce, i.e. to conceive and to produce offspring, preferably fertile offspring. Thus, the term fertility refers to individuals that can be crossed to produce fertile offspring in that the flowers, when pollinated produce berries that contain seeds which when sown result in a plant that itself carries fertile flowers, etc. .

The term "fertile offspring" or "fertile seed" is defined herein as seed capable of growing into a flower-producing potato plant wherein flowers are male and female fertile. Thus, the term preferably refers to a plant or seed that when grown into a plant is capable of producing offspring as male and as female parent by virtue of the presence of fertile ovules and fertile pollen (i,e, both male and female flowers are fertile).

The term "fertile plant" is defined herein as a plant capable of producing fertile seed carrying berries. Preferably said berries each carry at least 5, more preferably at least 15-20, even more preferably at least 50 fertile seed, still more preferably between 50 and 500 seeds. Alternatively, a plant is said to be fertile when the number of seeds produced per berry is at least 10%, more preferably at least 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%, 150% 200% or more of the number found in berries of the diploid breeding clone RH89-039-16. The term also, or alternatively, refers to plant lines having more than 25 %, preferably more than 90% fertile plants.

The term "self-compatible" refers to capacity to develop seeds in berries that are the result of self-pollination, self fertilization and producing fertile progeny.

The term "capable of being backcrossed/selfed/crossed and resulting in (self) fertile and self-compatible offspring" refers to the capability of producing one or more berries with seed as a result of backcrossing, selfing or crossing and wherein more than 60%, preferably more than 70%, 80%, 85%, 90% or more of said seed in said one or more berries is capable of developing into plants that are (self) fertile and self-compatible.

For other terms as used herein, reference is made to Allard, R. W. Principles of Plant Breeding, 2nd Edition, Wiley New York, 1999, and specifically to the Glossary therein.

Description of the preferred embodiments

The present inventors discovered that elite breeding lines for potato breeding can be successfully produced. Crossing of two elite breeding lines provides F1 hybrid seeds, such F1 hybrid seeds, when grown into plants, result in plants of superior agronomic performance. More importantly, all seeds are genetically essentially identical, meaning that, except for the occasional crossover or mutation event, all seeds are uniform.

The present inventors have discovered a method that allows the provision of elite potato breeding lines, which, when crossed mutually, provide uniform F1 hybrid potato seeds which, when grown into plants, result in plants having superior agronomic performance. The elite potato breeding lines may have complementary traits and, as a result of their homozygosity, the F1 plants grown from the F1 hybrid seeds are uniform, but when these F1 plants are subsequently selfed or cross-pollinated the resulting F2 plants will segregate for the various traits.

Thus, in contrast to the currently available true potato seeds (TPS) generated in the conventional ways of the prior art and harvested from berries in which every individual seed is genetically different from every other seed, the seeds obtained from crossing of the potato lines and elite potato breeding lines in accordance with aspects of the present invention are genetically essentially identical.

The TPS varieties of the prior art are derived from crosses between selected but heterozygous parents and hence variability is expected in plants and tubers. Hybrid potato breeding as proposed herein differs from the conventional production of TPS in that the present TPS are the result of the crossing of two pure breeding lines, resulting in uniform cultivars, whereas TPS varieties of the prior art are the result of open pollination or crossing between two genetically non-homozygous and often tetraploid breeding lines resulting in non-uniform cultivars.

Not only are the presently provided plants novel in that they combine a number of properties, heretofore never attained together in a single potato line, they also allow for novel and very advantageous breeding methods. Hence, the plants of the invention are an intermediate in the production of novel potato cultivars, which cultivars can be produced by methods as disclosed herein. The advantageous breeding methods allow for the elimination of many of the drawbacks of conventional potato breeding as indicated in hereinabove including the elimination of the time-consuming selection of clones to arrive at a new potato variety and the possibility to provide uniform hybrid potato seed. In addition, the novel plants and methods also allow for the elimination of drawbacks related to clonal propagation and production, including the possibility to eliminate high transportation costs and the clonal persistence of pests and diseases.

Novel potato plants

Parental breeding lines

The present invention provides potato plants that are essentially homozygous, diploid, vigorous, fertile and self-compatible.

Preferably the plants of the invention have fixed within their genome nucleic acid sequences encoding for genes that confer to the plant an agronomically desirable trait. Such nucleic acid sequences may be introgressions or transgenes derived from potato germplasm with agronomically desirable traits, preferably from diploid germplasm.

- *Essentially homozygous*

In breeding, plants are propagated by sexual reproduction, usually by crossing of selected parents with desirable traits to produce improved progeny. Progeny inherit genes for both desirable and undesirable traits from both parents. Repeated selection of meritorious individuals from each generation that will serve as parents of the next will conserve desired characteristics and eliminate undesirable ones. The ultimate parent in plant breeding is a purebred, a highly homozygous line that, when used in crossings with other purebreds results in offspring that is identical, both phenotypically and genotypically, within a single generation and between consecutive generations obtained from other crossings of the same parents. Purebreds, or pure inbreds, can be obtained by everal generations of selfing or inbreeding (crossing of close relatives, such as brother to sister plants or offspring to parent (backcrossing)) each successive generation showing an increased degrees of genetic uniformity, or homozygosity. The use of homozygous inbreds as breeding parents results in offspring that is identical, both phenotypically and genotypically, within a single generation and between consecutive generations obtained from other crossings of those parents. Hence, the pure inbreds can be used repeatedly to produce the same offspring plants.

In potato, selfing and inbreeding results in severe inbreeding depression, or the expression of deleterious recessive genes, which expression is revealed by loss of vigour and loss of fertility. Hence, it has hitherto been impossible to produce homozygous pure inbreds in potato since until the present invention, high levels of homozygosity in potato with sufficient vigour could not be attained. The present invention now, for the first time, provides plants having a level of homozygosity that

is above 25%, and preferably above 75 % and that is combined with fertility, self compatibility and plant vigour.

- *Diploid*

The plants of the present invention are diploid plants, in contrast to the commercial potato varieties, which are tetraploid. It should be noted that in plants of the present invention higher ploidy levels are expressly envisaged, since the diploid stage is used primarily during the development of the breeding lines. Once the purebreds have been established, the lines may be made tetraploid. Hence, plants of the invention may also be tetraploid. Tetraploid plants can be produced from tetraploid cells or tissue cultures, which in turn may be produced by duplicating the genome of diploid cells or tissue cultures by methods known per se, for instance by using oryzalin as described by Barandalla *et al.* (Barandalla et al. Potato Research (2006) 49:143-154). Tetraploid plants may have the advantage that they provide higher yields.

- *Vigorous*

Although commercial tetraploid potato varieties are fertile and self-compatible and vigorous in that they grow well, do not produce deformed plants, or fruits, but manifest as healthy plants with a high tuber yields, their selfed progeny shows serious inbreeding depression, that is, result in faint growing and low yielding plants with deformed tubers. Prior art diploid and essentially homozygous lines, such as those reported by Phumichai et al. as referred to herein, also grow only very poorly, and manifest as very weak and small plants, that have poor seed set. In fact, diploid potato plants resulting from inbreeding, and attaining homozygosity of at least 25 % or 50% on the alleles are invariably weak growers.

The plants of the present invention are not weak and frail, and although they need not necessarily be as vigorous as present day commercial tetraploid varieties, they do not show inbreeding depression. Hence, within the context of the present invention, they are vigorous. Tuber formation exemplifies the vigour of the plants of the present invention. Although all commercial (tetraploid and seed-tuber derived) potato varieties produce large tubers, or at least tubers of sufficient size, prior art diploid lines and essentially homozygous plants produce only small tubers,

which are, for instance, of no use in the production of potato chips or French fries. Prior art diploid lines and essentially homozygous plants produce also very few tubers such that the yield of tubers per plant is at least ten times lower than that of heterozygous diploids plants and commercial tetraploid potato varieties. In contrast, the plants of the present invention exhibit beneficial tuber formation characteristics, including tubers of beneficial size profile, and a tuber yield that may be at least 50% compared to the diploid heterozygous plants used as donors in the examples as described herein (D1, D2, and/or D3).

As was found herein, the tuber yield of the diploid F1's was on average 443 grams per plant, with values as high as 600 and 634 grams.

Backcrossing with the F1: "IVP08-06" yielded on average 155 and 209 grams, while backcrossing with the F1: "IVP08-07" yielded on average 209 and 259 grams.

The "pseudo F2's" yielded on average 172 and 332 grams per plant, and occasionally produced higher than the diploid F1's.

The F2's yielded on average 69 and 252 grams per plant. Several plants overlap with the yield values of the diploid F1s.

- *fertile*

The plants of the present invention – although essentially homozygous – are also fertile. That means that they can be used in breeding programs because their offspring will also be fertile.

- self compatible

The plants of the present invention are self compatible. This feature is introduced in order to allow the selfing of plants and the production of homozygous lines. The preferred basis of the self compatibility is derived from the dominant S locus inhibitor gene (*Sli*) (Hosaka and Hanneman, 1998, Euphytica, 99: 191–197).

The essentially homozygous potato plants of the present invention have as an advantage that they can be crossed with other essentially homozygous potato plants whereby the hybrid offspring of said cross is essentially genetically uniform and will not segregate.

The present invention, in a preferred embodiment, provides essentially homozygous, diploid, vigorous, fertile, and self-compatible potato plants having agronomically desirable traits.

The novel potato plants of the invention are capable of:

- being backcrossed to an essentially homozygous recurrent parent and resulting in (self) fertile and self-compatible offspring;
- being selfed (self-fertilization of 1 offspring individual) and resulting in (self) fertile and self-compatible offspring;
- being mutually crossed (fertilization between 2 offspring individuals) and resulting in (self) fertile and self-compatible offspring.

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, Aberdeen, 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.

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, Aberdeen, 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.

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, Aberdeen, 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 D1 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.

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, Aberdeen, 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.

A plant of the present invention can very suitably be used as a recurrent parent wherein additional agronomically desirable traits are introgressed by crossing, or introduced by other means such as by transgenic means. Once a number of agronomically desirable traits have been stacked into an essentially homozygous, vigorous, diploid, fertile and self-compatible plant according to the invention, that plant can be used as an elite breeding line for the production of commercial F_1 hybrid potato seed. Likewise, a second elite breeding line can be provided that can serve as the parent of opposite sex so that both plants can be crossed to produce the commercial F_1 seed of a novel potato variety.

The breeding of uniform hybrid seed depends on a number of technical conditions. Prerequisites to achieve uniform hybrid seed are that i) an initial introgression crossing can be made between an essentially homozygous, diploid, fertile and self-compatible plant and a plant that acts as donor for an agronomically desirable trait, that ii) a backcross can be produced between the offspring of that initial crossing and the essentially homozygous, diploid, fertile and self-compatible plant, and that iii) the offspring thereof can be selfed. Potato lines AGVD1, AGVD2 and AGVD3 exhibit these characteristics and individual plants of these lines can be used in additional introgression crossings, backcrossings and selfings to arrive at the

elite breeding lines suitable for use as parents for commercial F1 hybrid seed that can be grown into hybrid potato plant of a new potato variety.

A highly preferred plant according to the present invention is a plant of line AGVD2 or an offspring plant thereof having all of the physiological and morphological characteristics of the plant of line AGVD2.

Another line deposited as example of embodiments of the present invention is AGVD17 (NCIMB 41765, deposited 05 October 2010). The advantage of AGVD17 is that it is a highly homozygous line (> 80% homozygous) combining vigour and fertility with a tuber yield of on average 300 grams (fresh weight) per plant. Individual plants of related populations even showed tuber yields of 500 grams per plant. These data were generated from field grown plants that were raised from seedlings. Potato plants raised from clones generally yield tuber weights that are 50 to 100% higher than plants raised from seedlings. Hence, the tuber yield expressed in grams of fresh weight from plants as claimed herein – when clonally propagated and raised from tubers and grown in clay soil under normal North Western European summer conditions – is expected to reach levels of at least about 1000 grams fresh weight per plant.

Thus, line AGVD17 demonstrates in particular the possibility to intercross individual elite lines of the present invention (i.e. that are self-compatible, fertile, and essentially homozygous) to arrive at the hybrid seed that is the aim of the present invention. Hence, another highly preferred plant according to the present invention is a plant of line AGVD17 or an offspring plant thereof having all of the physiological and morphological characteristics of the plant of line AGVD17.

Hybrids

The hybrid plants of the invention are produced by a method of the invention as exemplified in Figure 1. The hybrid plants of the invention are produced by crossing two essentially homozygous elite potato parental breeding lines comprising among them a number of agronomically desirable traits selected from the group consisting of insect tolerance, nematode resistance, disease resistance (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity

tolerance, cold sweetening resistance and resistance to tuber dehydration. In addition to these agronomically desirable traits, the parental breeding lines may exhibit such characteristics as desired in specific use markets such as desirable tuber skin color, desirable tuber shape, desirable tuber flesh color, desirable tuber taste, desirable tuber starch content, desirable tuber dry matter content, desirable tuber cooking quality, or desirable tuber frying quality. In addition to such market-specific characteristics, the parental breeding lines, when crossed, preferably result in hybrids that exhibit such beneficial traits as beneficial growth rate, beneficial tuber yield, beneficial tuber size, beneficial tuber storage ability, beneficial tuber dormancy period, beneficial tuber shelf life, beneficial tuber chip making quality, and beneficial tuber uniformity.

The present invention now provides a set of potato plants or a set of potato plant lines, which plants or plant lines are: diploid (2n); essentially homozygous (preferably more than 60% on all alleles); self compatible; fertile; and vigorous. Hitherto it has proven impossible to provide the combination of all these features in a single potato plant (line). The set of potato plant of the invention can be used to produce novel varieties or cultivars.

The invention particularly relates to a set of at least 2 diploid (2n), essentially homozygous (preferably more than 60% on all alleles), self compatible, fertile, and vigorous plants that are crossable to produce hybrid varieties according to the invention.

Novel method of potato seed breeding

The provision of the novel potato plants now provides for the first time the attainment of the method of the invention.

The present inventors have generated potato plants that are essentially homozygous, diploid, vigorous, fertile and self-compatible and having fixed within their genome nucleic acid sequences encoding genes that confer to the plant an agronomically desirable trait derived from suitable diploid donor lines. The said nucleic acid sequences are the result of introgressions from potato germplasm having agronomically desirable traits. Conventionally, at least in most species other than potato, homozygous plants can in principle be obtained in as little as two generations by doubling of monohaploids generated from unfertilised generative cells such as egg

or pollen cells by methods known as doubled haploid (DH) technology. This is not possible in potato, as the resulting plants have hitherto shown to be infertile, due to - what is considered – expression of recessive deleterious genes. The DH method was extensively tested by the present inventors, but was found unsuccessful.

The present inventors used the strategy of repeated selfing, backcrossing and crossing of potato germplasm 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 tetraploid plants. Unexpectedly, this radically new approach proved successful for obtaining increasingly homozygous, diploid offspring plants, that were self-compatibel 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 germplasm without loss of self-compatibility and fertility.

In essence the method for obtaining the plants is as follows:

Starting point is a diploid self-compatible potato line (examples of suitable lines have been deposited under depositors reference AGVD 1, AGDV 2, AGDV 3 and AGVD17). In general a line being self-compatible due to the presence of the *Sli* gene may be used as starting point. Plants of this diploid self-compatible line are selfed and seeds obtained from seed-carrying berries are sown and grown into offspring plants. Offspring plants carrying flowers are again selfed and seeds obtained from seed-carrying berries are again sown and grown into offspring plants. No, or at least little, attention is paid to the agronomical appearance of the plants at this stage. They may look withered and frail, with only a few flowers. Nonetheless, the selfing is repeated at least three times, but preferably 4 or 5 or even 6-8 times. In this manner a line of essentially homozygous, fertile, self-compatible, and diploid potato plants is obtained, essentially by selfing and selecting for plants that produce fertile offspring.

Next, an agronomically desirable trait is added to the essentially homozygous, fertile, self-compatible, diploid potato genotype by crossing a plant of that line with a plant of an unrelated essentially heterozygous diploid potato line, preferably a line containing an agronomically desirable trait. This essentially heterozygous line (which term merely reflects that the line is not an essentially homozygous line as used herein) functions as a donor for an agronomically desirable trait, in this case vigour.

The resulting hybrid is selfed and/or backcrossed to the self-compatible line while selecting for higher vigour. In this way, the vigour of the essentially homozygous, fertile, self-compatible, diploid potato plant line is enhanced and at the same time the line is agronomically improved. These steps will thus result in a vigorous fertile homozygous self-compatible diploid potato: The vigour may further be enhanced by crossing with other essentially heterozygous diploid potato lines, which additional lines serve as donors for additional agronomically desirable traits, followed by selfing and/or backcrossing to to the self-compatible line while selecting for these additional traits, which additional steps will result in the provision of diploid potato breeding lines.

In order to produce elite diploid potato breeding lines, the breeding value of the breeding lines is further enhanced by intercrossing, selfing and backcrossing while continuous selecting for the agronomically desirable traits provided to the breeding line, and by establishing lines that exhibit good combining abilities with other lines. Such combining abilities are evaluated by the use of experimental crosses.

Finally, hybrid potato cultivars can be produced by crossing individual elite diploid potato breeding lines that exhibit good combining abilities. The seeds resulting from this cross of homozygous parents are hybrid true potato seeds that are uniform.

Using the methods of the present invention, generally, around 7 to 8 selfing cycles will result in essentially homozygous plants, but the skilled artisan will understand that more generations of selfing may also be used. Also fewer generations, such as six generations may be used to provide essentially homozygous plants of the present invention. The number of backcross generation can even be reduced to three to reach more than 95% homozygosity when applying molecular genetic markers.

Essentially, the novel method of producing hybrid potato cultivars provides for the possibility to produce a new potato variety within about 5 years. A detailed process for the production of hybrid potatoes starting from AGVD17 (F3 line) is provided in Example 5. This line is >80% homozygous such that very few selfings are needed to obtain a plant that is about 95%-100% homozygous. In addition AGVD17 is already vigorous as defined herein.

The present invention now provides a method for producing a genetically homogenous or uniform true potato seed (TPS). This method is *inter alia* useful in a method of preventing transmittal of virus infections between potato generations, but also for overcoming many of the other problems associated with classical potato breeding, "seed" potato production and transport and cultivation. Moreover, the present parental material for production of hybrid seed can be maintained in the form of seed, and not in the form of vegetative material as is required by traditional TPS production.

The present invention provides in one aspect a method for producing a hybrid potato cultivar comprising the use of the deposited plant material provided herein as a starting material.

Alternatively, other essentially homozygous, diploid, fertile, vigorous and self-compatible plant lines different from the deposits referred to herein may be developed and the production of a hybrid potato cultivar can commence from that early stage level by using the teaching provided herein since the present inventors have demonstrated that this route, although laborious, is successful. Such an alternative breeding material is also vigorous, essentially homozygous, diploid, fertile and self-compatible.

As a first step, such an early stage development may comprise the provision of a plant of a first cultivated potato species (*Solanum tuberosum*) or a related crossable species (generally a tuber bearing *Solanum* species).

Next, said plant is developed into a line of self-compatible diploid potato plants, preferably a *Solanum tuberosum*. Diploid potato is usually self incompatible. Self-compatibility may suitably be introduced from related species (see for instance Hermsen, J.G.Th. 1978, Euphytica 27, 1-11).

The resulting line of self-compatible diploid potato plants is then developed into a homozygous fertile self-compatible diploid potato line. Homozygous diploids can

be obtained by doubling haploids (Uijtewaal et al., 1987, Theor. Appl. Genet. 73, 751-78) by anther culture (Jacobsen and Sopory, 1977, Theor. Appl. Genet. 52, 119-123), by ovule culture or by repeated selfings (Phumichai & Hosaka, 2006, Euphytica 149, 251-258). The latter method was used for producing the homozygous fertile self-compatible diploid potato line that formed the basis of the vigorous plants as described herein.

Next, the homozygous fertile self-compatible diploid potato line is developed into a vigorous fertile homozygous self-compatible diploid potato line. The vigour may be enhanced by crossing with other diploid potato plants, selfing and backcrossing while selecting for higher vigour. It must be noted that high populations are needed and that even for some unrelated essentially heterozygous diploid potato lines that are used as donor of the agronomically desirable trait, very few self compatible plants may be found in a population of 1000 plants. Generally, such attempts are terminated, and only when about 10-50% of the offspring plants is self-compatible (such as in the case of D2 in Example 2 below) the donor line exhibits such good general combining ability that a successful introduction of the agronomical trait into the self-compatible lineage is foreseen.

Next, the vigorous, fertile, homozygous, self-compatible, diploid potato line is developed into a diploid potato breeding line. Most preferably, at least two separate vigorous fertile homozygous self-compatible diploid potato lines are produced and at least two distinct diploid potato breeding lines are developed. Such breeding lines comprise a high number of agronomically desirable traits. Agronomically desirable traits are introduced by crossing with other diploid potato plants, selfing and backcrossing while selecting for these traits. This breeding program may comprise testing for disease, such as whether the shoots or tubers are free of disease, or whether they are resistant for disease.

Next, the diploid potato breeding lines are developed into elite diploid potato breeding lines. This is accomplished by enhancing the breeding value by intercrossing, selfing and backcrossing while continuously selecting for agronomically desirable traits. At this stage experimental crosses are performed to evaluate general combining abilities. The diploid elite lines can now also be developed into tetraploid (4x) elite lines by methods known per sé, such as by chemical treatment with e.g. colchicine, or by "spontaneous" doubling of the genome using tissue culture.

Finally, potato hybrid cultivars are produced from these elite diploid or tetreploid potato breeding lines by crossing of good combining breeding lines. The seeds obtained are hybrid true potato seeds that are uniform.

The method of the invention for producing a potato hybrid cultivar comprises the steps of producing a diploid potato breeding line. Said method comprises the steps of:

(a) providing a first potato plant, which first potato plant is a plant of a diploid, self-compatible and essentially homozygous potato line, preferably a plant of a vigorous fertile homozygous self-compatible diploid potato line, more preferably a diploid potato breeding line;

(b) providing a second potato plant of a potato line that may have any level of ploidy, preferably diploid, and/or any level of homozygosity wherein said second potato plant serves as a donor for an agronomically desirable trait which trait is to be introgressed into said essentially homozygous line of said first potato plant or at least in an offspring plant resulting from a crossing between said first and second plant, wherein said trait is selected from the group consisting of insect tolerance, nematode resistance, disease resistance (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, rooting ability, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, growth rate, tuber development defects (e.g. misshapen or damaged tubers), tuber yield, tuber size, tuber skin color, eye depth, tuber shape, tuber flesh color, tuber taste, tuber storage ability, tuber dormancy period, tuber shelf life, resistance to tuber dehydration, tuber starch content, tuber dry matter content, tuber cooking quality, tuber frying quality, tuber chip making quality, tuber uniformity and cold sweetening resistance.

Following the provision of these two plants, the method then comprises the step of:

(c) cross-pollinating said first and second potato plant such that one of said parent plants produces seed-carrying fruits (berries) and collecting said seeds from said fruits to provide a hybrid offspring seed.

Seeds are then grown to plants and the plants that comprise the agronomically desirable trait from the donor plant are selected, either directly or following additional selfing and backcrossing steps, as is well known in the art of

plant breeding. In these methods markers may be used to assist in the breeding process.

The hybrid offspring seed is preferably grown into a plant that is subsequently backcrossed a plant to the recurrent parent line

The following steps are not essential to either of the above methods. However, these additional steps may either provide for the production of consumption tubers by growing the seeds of the invention and/or may provide for the production of new homozygous, self-compatible, diploid elite breeding lines that can serve as parents for the inclusion of yet further traits into an offspring generation. The plants of the invention are fertile and vigorous. These additional benefits are attained by the following further steps of:

(d) growing said offspring seed into a hybrid offspring potato plant, and

(e1) harvesting tubers from said hybrid offspring potato plant to provide tubers carrying said trait, or

(e2) 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 to provide further offspring plants carrying said trait and wherein said of offspring plants are increasingly homozygous following each backcrossing or selfing step.

Preferably said second potato plant used in the method described above is a hybrid offspring potato plant as defined in step (d) above and obtained by the method as described above. More preferably, said second potato plant used in the method described above is a hybrid offspring potato plant as defined in step (e2) above and obtained by the method as described above.

Preferably, said step (e2) comprises from 2 to 7 backcrosses using a plant of line AGVD1, AGVD2, AGVD3 or AGVD17 as the recurrent parent and testing offspring plants for the presence of the trait (e.g. in the form of the homozygous or heterozygous presence of alleles responsible for the trait), followed by one or two (or more) selfings, to provide an essentially homozygous plant that is genetically equal to a plant of population AGVD1, AGVD2, AGVD3 or AGVD17, but in which alleles responsible for the trait are heterozygously, preferably homozygously present. This plant has at least one additional allele not available in population AGVD1, AGVD2, AGVD3 or AGVD17.

The above method now provides a breeding process for the production of homozygous breeding lines or elite breeding lines based on the background of population AGVD1, AGVD2, AGVD3 or AGVD17, to which background successively additional alleles are added, thereby providing elite breeding lines wherein desirable traits are stacked.

The method of the present invention now for the first time provides for a method for preventing transmittal of virus infections between potato generations while at the same time also solving many of the other problems of the prior art related to breeding of new potato varieties and commercial production of potatoes for consumption. This has become possible through the provision of true potato seed, i.e. botanical seed, which seed can be grown to a potato plant that produces tubers for consumption, and which seeds are from a cross in which at least one of the parents is a plant of a diploid, self-compatible and essentially homozygous potato line, preferably said seeds are from a cross wherein both of the parents are plants from a diploid, self-compatible and essentially homozygous breeding line.

An important advantage of this new method is that, in this way, the transmittal of infection with a virus that is not spread through the gametes and seeds can effectively be prevented.

The present inventors now provide a method for further breeding for homozygous lines that are easy to handle, and which exhibit improved fertility and plant vigour when compared to prior art inbreds, while maintaining the self-compatibility and high level of homozygosity. It will be appreciated that – just as in tomato - a 100% homozygosity is not always needed to provide for an effective breeding program. This is not a problem as long the self-compatibility is maintained.

The genetic transfer of agronomically desirable or beneficial traits into a homozygous potato line has now for the first time been successfully shown.

Based on the means and methods provided herein, the skilled person will be able to successfully produce homozygous potato breeding lines based on his own germplasm. In addition, the skilled person will appreciate that means and methods are provided by which he is able to, for instance, stack additional traits into the presently provided self-compatible and essentially homozygous lines in order to establish a population of lines that are enriched for agronomically desirable traits and that can serve as germplasm for commercial breeding in their own right.

EXAMPLES

Example 1. General description of the breeding procedure and pedigrees.

Many attempts were made to generate homozygous, fertile, self compatible diploid genotypes of potato without success. These attempts included the formation of doubled haploids, and the subsequent screening for fertile flowers. Several methods were employed like anther culture to regenerate haploid and eventually double haploid homozygous plants, repeated selfings to gradually increase the level of homozygosity in existing diploid germplasm and prickle pollination by using S. phureja as pollen donor to induce embryo formation from unfertilized egg cells. Especially the latter method was done at a large scale, by analyzing more than two million offspring but without the desired success. None of these tests resulted in vigourous self compatible plants.

An essentially homozygous potato line was obtained by multiple generations of selfing of plants of a line derived from public germplasm which plants have the self-compatibility controlling *Sli* gene (Phumichai et al. Euphytica (2006) 148: 227–234). These plants, designated "H" or IVP07-1001/4 herein, grew poorly, had very few flowers and each berry contained only few seeds. Moreover, the plants were very small (max 60 cm). The plants produced almost no tubers and those that formed were very small (average tuber weight about 5 grams/tuber). In all, the plants were of no value to commercial potato breeding, as they exhibited a plant weight and tuber yield that was less than 20% of that of diploid breeding clone RH89-039-16. The plants merely contained homozygous alleles on many of the loci in their genome, were self-compatible and diploid.

In the summer of 2008 plants of this IVP07-1001/4 line were crossed with different diploid donor lines (D1, D2 and D3, See for complete pedigree figure 2). D1 is early, has long sized oval tubers, light yellow flesh, and good cooking fries making quality and good cooking quality and was used as male parent (Table 6). The resulting progeny is referred to as F1(D1) in this example. Other F1 offspring plants were obtained in the similar way but using donor D2 as a female parent. D2 is an elite diploid breeding clone that is essentially non-homozygous, and is not self-compatible,

but which has the desirable agronomic trait of early cooking, oval tubers, yellow flesh and good cooking chips making quality). This resulted in lines designated as F1(D2).

The above F1's were (D1) was selfed to produce an F2(D1). This line was deposited under breeders reference AGVD1. It is estimated that AGVD1 is about 50% homozygous, meaning that about 50% of the loci for which the parents differ are homozygous.

F1(D1) was crossed with F1(D2) to produce a pseudo F2. This line (F2(D1/2)) was deposited under breeders reference AGVD2. It is estimated that AGVD2 contains about 25% homozygous alleles originating from IVP07-1001/4.

The F1's were(D1) was also backcrossed with IVP07-1001/4 to produce a BC1's line. This line (BC1(D1) and BC1(D2)) was deposited under breeders reference AGVD3. It is estimated that AGVD3 is about 75% homozygous for the loci for which the parents differ.

Other F1 offspring plants were obtained in a similar way by using donor D3 as female parent. D3 is a diploid breeding clone with yellow flesh and with the resistance genes R3, H1, Gpa2, RXadg. This resulted in a line designated F1(D3).

Similarly as described above, F1(D3) was selfed to generate an F2(D3) and backcrossed with the Sli gene donor to generate BC1(D3) offspring.

F1(D1) was crossed with F1(D2) to produce a pseudo F2. This line (F2(D1/2)) was deposited under breeders reference AGVD2. It is estimated that AGVD2 is about 25% homozygous for the loci for which the parents differ.

F1(D1) was also backcrossed with IVP07-1001/4 to produce a BC1 line. This line (BC1(D1)) was deposited under breeders reference AGVD3. It is estimated that AGVD3 is about 75% homozygous for the loci for which the parents differ.

The BC1's were selfed in a winter nursery resulting in BC1S1 populations. Next summer (2010) the F2's, the pseudo F2's and the BC1S1's were sown in seed beds in a nursery and transplanted in small peat pots. In June 2010 the seedlings were transplanted to the field at a clay and at a sandy soil in The Netherlands. In total more than 15000 plants were grown from seedlings and selected for self compatibility and for good tuber quality and yield. Most F2 and BC1S1 populations showed a very low frequency of self-compatibility. Rare plants with reasonable good berry- and seed set were selected for progeny testing without further agronomic evaluations. Only two F2 populations, originating from the D2 x H cross, showed

about 25% self compatibility. For each of the most self-compatible populations maximally fifteen plants with the best tuber quality and quantity were selected for progeny testing.

Plants of the pseudo F2's showed much more vigour than the other populations, probably as these plants do not harbour any locus with homozygous alleles of the donor parents. One of these populations showed more than 50% self-compatibility. Similarly as described above, also maximally fifteen plants of the most self-compatible populations were selected for progeny testing.

In addition, crosses were made with self-compatible plants from the field as pollen donor on two to twelve plants of the donors D1-D19 (Example 3). After evaluation of the tuber quality and quantity only crosses with selected plants or their full sibs, in case of lack of sufficient numbers of crosses, were selected for progeny testing.

In this way, in each generation, plants are selected for self-compatibility and good agronomic performance. Seeds of the selfed berries of these selected plants are collected for further testing in order to generate homozygous lines. In addition, crosses of the selected plants with other diploid donors or other breeding lines are made to enhance the genetic variation. These F1 seeds are heterozygous and several rounds of inbreeding are needed to generate homozygous offspring with the desired traits.

In this way two generations of selections, selfings and crosses can be done per year. This process is even further enhanced by exploiting marker aided breeding by using diagnostic markers for specific traits and random markers to select for the recurrent parent genome. When elite parents have been obtained, derivatives of these lines can be made by two to three generations of backcrossing and two generations of selfing.

Example 2 Breeding self compatible diploid potato.

1. Introduction

A common characteristic of diploid potato is self-incompatibility (SI); upon self-fertilisation no vital progeny is generated. The S-locus inhibitor gene (*Sli*)

originating from *Solanum chacoense* has been described (*Euphytica* 99,191-197, 1998) to inhibit this self-incompatibility and rendering diploid potato self-compatible (SC). Upon repeated selfings, close to homozygous self-compatible diploid potato clones have been generated (Genome 48, 977-984, 2005). The agricultural quality of these clones was very poor indeed reflecting a poor germination, plant growth, tuber quality and tuber yield.

2. Experiments

2.1 Materials

In order to develop self-compatible potato clones with much higher level of agricultural traits we crossed the *Sli* gene donor with various potato clones, designated: IVP97-079-9, IVPAA-096-18 and SH83-92-488. These clones are available at Dr. R.C.B. Hutten, Laboratory of Plant Breeding, Wageningen University, The Netherlands. As used herein, these clones are designated as clones D1, D2 and D3 resp. The progenies (F1) were selfed and backcrossed to the *Sli* gene donor generating F2 and BC1 populations, respectively. The BC1 was selfed to generate BC1S1 populations. All these crosses and self fertilisations were performed without any other selection than self compatibility of the plants.

2.2 Evaluation of progenies in a wintertrial

In a pilot experiment several random BC1 and F2 progenies were grown in a heated greenhouse with 16 hours artificial light in while outside temperatures were below zero for almost three months. We evaluated the self-compatible % as the number of plants with berries after hand pollination and the yield as the weight of tubers per plant (Table 2).

Results

The *Sli* donor is self-compatible (SC) and most of the F1 and BC1 plants were also self-compatible, while a minority of the F2 plants was self-compatible. The *Sli* donor showed an extremely low tuber yield, while the BC1 and one F2 was about 50% of the F1 tuber yield. The tuber yield of some BC1 plants was close to that of the F1 plants and some (unselected) F2 plants were better than the weakest F1 plants.

Table 2. Some characteristics of winter grown plants of a diploid potato breeding program to introduce the *Sli* gene.

	# plants	compatibility	yield (gram per SC plant)	
		frequency (%)	average	variation
Sli donor	2	100	22*	0 - 43
F1 (HxD3)	9	89	443**	258 - 634
BC1 (Hx(HxD1)	49	81	206**	0 - 524
BC1 (Hx(HxD2)	64	72	237**	28 - 543
F2 selfed (HxD1)	23	22	252**	131 - 376
F2 selfed (HxD2)	20	25	69**	0 - 201

* from tuber

** from seedling

2.3 Evaluations of progenies in the field

In the summer of 2010 progeny plants of F2 and BC1S1 populations were tested in the field to select self-compatible progeny plants with good agricultural performance (Table 3).

Table 3. Breeding scheme to introduce self-compatibility (SC) into diploid potato. In bold the most promising materials are indicated.

P	F1 (HxD)	F2: selfed (HxD)				BC1S1: selfed (Hx(HxD))			
parents	plants (DxH)	Populations tested	plants in the field	self compatible plants	plants selected*	populations tested	plants in the field	self compatible plants	plants selected
	#	#	#	#	#	#	#	#	#
H = *Sli* donor									
D1	33	15	2460	± 50	7	38	2521	< 10	1
D2	45	29	***5598***	***> 500***	***52***	24	1380	< 10	1
D3	8	8	1602	± 10	7				

* sufficient seedset

Results

We tested 52 F2 populations comprising 30 to 840 plants and 62 BC1S1 populations comprising 1 to 390 plants, in total 9660 F2 plants and 3901 BC1S1 plants resp. Most of the populations showed a weak plant growth and a low frequency of self-compatibility. Only two F2 populations derived from the D2 parent showed about 25% self compatible plants. The best plants of these populations were selected on the basis of tuber yield and tuber quality.

3. Conclusion

Only two out of the 52 F2 populations and none of the BC1S1 populations showed a reasonable level of self-compatibility. However, unexpectedly, the desired plants could be obtained, starting from material that would otherwise have been neglected by breeders. The main differences of the plants of the invention and those of the prior art are given in Table 4 below.

Table 4. Characteristics of the parental potato lines of the present invention proposed for the production of hybrid (true) potato seed.

	Vigour	**Ploidy**	**Tuber yield**	**Fertility**	**Self-compatibility.**
Sli-gene donor (Phumichai et al. Euphytica (2006) 148: 227–234).	low	2n	low	low/ intermediate	high
Diploid trait Donor (e.g. D1)	intermediate	2n	intermediate	intermediate	low
Commercial variety	high	4n	high	high	low
Lines of present invention	Intermediate /high	2n	Intermediate /high	low/ intermediate	high

Example 3 Development of a molecular marker platform

Introduction

Numerous marker systems are available to support genetic research. For the present invention a molecular marker platform in potato was developed and used to evaluate the level of homozygosity versus heterozygosity in diploid potato.

Selection of most informative sequences for SNP assays

In order to analyse SNPs in potato, the Illumina standard GoldenGate protocol (Shen et al. 2005. Mutation Research 573:70–82) has been used previously (Anithakumari et al. 2010. Mol. Breeding, 26:65-75). This platform comprises 384 SNPs and was later expanded with another 768 SNPs. These 384 and 768 SNPs have been developed using EST sequences, which represent the mRNA without intron sequences. Since the present inventors have access to the first draft sequence of the potato genome (www.potatogenome.net) it was possible to compare the mRNA with the genomic DNA sequence including the intervening sequences. This comparison with the potato genome sequence was performed with the Basic Local Alignment Search Tool (BLAST; Altschul et al. 1990. J. Mol. Biol. 215: 403-410). This resulted in 538 and 1681 hits, respectively. The occurrence of multiple BLAST hits was considered to reflect paralogs or intron spanning sequences. These were removed from

the initial collection of SNPs that were first developed for GoldenGate analysis (Anithakumari et al. 2010). This resulted in 279 and 453 unique BLAST hits representing the occurrence of only one copy in the potato genome sequence of *Solanum tuberosum* Group Phureja DM1-3 516R44 (CIP801092) as known hitherto (Potato Genome Sequencing Consortium, www.potatogenome.net).

From the total of 732 SNPs with unique BLAST hits only a few (31 cases, equally distributed over the 384 and 768 set) were omitted due to high level of sequence mismatches (3-6 SNPs within 101 bp). One mismatch should be expected and a second SNP was tolerated to be included in the SNP-spanning sequences selected.

For the present SNP design the minimal sequence length was set at 101 bp. Therefore 81 sequences were removed as they were shorter. The resulting 553 sequences have a length of at least 101 bp. A total of 100 sequences were then removed for having incomplete matches of only 35 up to 94 nucleotides within a scaffold of a doubled monoploid (DM-3 516R44; www.potatogenome.net). Also removed were sequences with introduced alignment gaps and sequences having other potential mismatch problems.

Though twenty-five sequences did not meet the criteria described above, they were kept as these were were known to be highly informative in the GoldenGate SNP assays. These SNPs even allowed to discriminate between the five genotype classes that occur in tetraploids (Voorrips et al, EAPR-EUCARPIA congress "Potato Breeding after completion of the DNA Sequence of the Potato Genome", 27-30 June 2010, Wageningen, the Netherlands, e-publication at http://edepot.wur.nl/143559, pg 42).

Finally, 515 sequences were selected. The final selection of 100 sequences was based on the known map position of 237 markers (out of the 515) on the potato genetic map (Anithakumari et al, 2010 and Van Os et al. Genetics 173: 1075-1087, 2006). The selected markers were evenly distributed over the 12 potato chromosomes including the most distal telomeric as well as centromeric markers and with a preference for SNPs that were heterozygous in clone RH (RH89-039-16; www.potatogenome.net), because clone RH is a progenitor of the material used in the present research. Or in other words, the alleles of clone RH are also present in material used in the present research (see Table 2 and Figure 3).

Testing of markers

The 100 SNP sequences selected as described above were used in a KASPar SNP genotyping system (KBioscience Ltd. Hoddesdon, UK; http://www.kbioscience.co.uk/lab%20services/SNP%20Genotyping/genotyping_chemistry.html). The markers were tested on a set of 20 diploid potato genotypes (see Figure 4) including the three diploid parents used in the present study and further on the donor of the *Sli* gene, clone 07-1004-1 (see also Example 2 herein above).

Results

All SNP sequences generated polymorphisms in the KASPar SNP genotyping system (see Figure 4), corresponding to a 100% success rate. In total, 100 markers x 20 genotypes were tested, comprising 2000 datapoints. We observed 29 missing data, which is less than 2 %. As control, one genotype was tested twice whereby plant samples from different locations were used (Figure 4, columns 4 and 7). All data were identical. These results illustrate that the KASPar SNP genotyping system is an efficient, reliable and reproducible marker platform for diploid potato. This indicated that The KASPar SNP genotyping system is efficient, reliable and reproducible for diploid potato.

All markers showed a high frequency of occurrence in the diploid potato germplasm used in this experiment (Appendix III). The heterozygote frequency in the germplasm by suing 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).

The number of informative markers between the Sli donor and the three parents used in the present study was 54, 52 and 62 resp. This indicates that the KASPar SNP genotyping system is also informative for diploid potato.

Based on the above, it was concluded that the KASPar SNP genotyping system as described herein and based on the markers as developed herein is efficient, reliable and reproducible and very informative to describe the level of homozygosity / heterezygosity in diploid potato.

Table 5A. Sequences of 100 SNP markers in potato

SNPs				
SNPID	SNPNum	AlleleY	AlleleX	Sequence
PotSNP002	11940065	G	C	ACCTGGTGCAGGCCT[C/G]CGTATTGATACGATT
PotSNP011	11940098	C	T	GACTGTGATTCGAAA[T/C]GTTTACCTATCTCTT
PotSNP021	11940075	C	T	TCGTAGAAATGACAT[T/C]TGGGGTGCTAGAGAT
PotSNP026	11940044	C	T	AGTTTCCAGCTGATG[T/C]TATTCTAGGAGACGA
PotSNP032	11940037	G	A	AGAGGCTCTTGAGGC[A/G]CAGCGAAAAGAGGAA
PotSNp038	11940016	C	T	TGGTGACGTTCATGT[T/C]GGACGTAATGCTTCT
PotSNP043	11940036	C	A	AGTATCTCCGTCCGA[A/C]TCACAGTCCTACTCT
PotSNP045	11940094	G	A	GGTGCTAAGATTCGC[A/G]TTGATGATTCACTAG
PotSNP047	11940054	C	T	CCAACACTGGAAAAA[T/C]TATGGAAGCAGAAAG
PotSNP052	11940097	C	T	GCTAGCATTAGAGCT[T/C]GCTAAGCGACTCAAT
PotSNP055	11940021	G	A	GCCTTGGAGTAAGAG[A/G]TTTTCTGTTTTGGGC
PotSNP057	11940040	C	T	GGATGTTCATCAACG[T/C]CGACTTCGACAAGCT
PotSNP061	11940032	C	T	ACAACCTGCAAGAGC[T/C]TTGCATCTGTTTAGT
PotSNP068	11940023	C	T	TACAATCATGATCCT[T/C]TTGCCTAATTGCCCT
PotSNP072	11940005	G	A	CTGAGCTAGTAGATC[A/G]ATCAAACGGTGCTCC
PotSNP073	11940076	G	T	GACTGTATGGACAGT[T/G]ATTGGGTCAGAGGAC
PotSNP080	11940068	C	T	AAGATGACGTGGAGT[T/C]CGGCACTGCGCCGTT
PotSNP081	11940047	C	T	GCCGCACAAGGTGCT[T/C]GCCGTCGATGTTAGC
PotSNP083	11940033	C	T	AGGTAGTGTTGCAAA[T/C]ACAATTAGAGGGTTG
PotSNP089	11940062	G	A	AAGTACATTTATGAG[A/G]AGATTAACAAGTGTT
PotSNP099	11940092	C	T	ACTGCTGGAACTGAG[T/C]TGAACAATGCTATTA
PotSNP100	11940083	C	T	GAGTGCCGGCAGCGT[T/C]ACAGATCCGACGATG
PotSNP102	11940070	G	A	TATGGCAGAGAAAGA[A/G]ATGGAGTATAGAGTG
PotSNP1026	11940059	G	C	TAAACTCCAACATAT[C/G]AACACAAATTAGTGC
PotSNP1034	11940001	G	A	TTCTACATCCTTCGC[A/G]GGCATTTTTGAGGAG
PotSNP1049	11940051	T	C	TTTGGGGAGGAACAC[C/T]TGTGCTTTAGAACTC
PotSNP1057	11940022	A	C	TGTCACTAAGAAAGC[C/A]CAAGAGGCAATGCAG
PotSNP106	11940010	G	T	GCAAGCTACTTGTTC[T/G]AAAGGACCTGCTACT
PotSNP1072	11940027	G	T	AGCGAGTTTGGATGC[T/G]GAGCTTTTGCAGTTA
PotSNP1083	11940019	C	T	TACAAAGTTCACTGC[T/C]GAGGAGGTCATGCAG
PotSNP1105	11940041	A	C	GATGAGGAAAGGCAC[C/A]GGCGGAGGTGTTGGA
PotSNP1115	11940071	T	C	CACCACCGTCCAAAC[C/T]GGTTTTGCCAATCGC
PotSNP1122	11940060	T	C	GGTCCCTGAGCAAGG[C/T]AATCAACGAATTAGG
PotSNP1139	11940004	G	A	AGTCTCTACAAACCC[A/G]TGGTTTCGATCTTGA
PotSNP116	11940058	G	A	TAATGTGGTCGGCAC[A/G]CTGACGCTTGCTGAT
PotSNP118	11940091	G	A	AGATGCATTCTATGC[A/G]GAACCACAAAGATAT
PotSNP120	11940082	G	A	TTCGTGTTGCACTCA[A/G]CGATTCAGTTGGATG
PotSNP121	11940099	C	T	AGCTTGTGCTAATAG[T/C]TGTGCTGATTTTCTC
PotSNP122	11940078	G	A	TATGCAATCCCAGCC[A/G]ACATATCCGATCCAT
PotSNP124	11940055	G	A	TCATACTTCACATAT[A/G]TCAGAGTGGTCTGAT

PotSNP130	11940050	C	T	AGAGAAAAAAGCTGT[T/C]GTTGTTGATGACGAG
PotSNP134	11940080	C	T	CGCGTATTTCCCTTA[T/C]TATAACTCGTTCTCT
PotSNP138	11940052	C	T	TTACATATGCAATAG[T/C]GGTGGTGATCTTTAT
PotSNP152	11940077	C	T	GAAGTTGTCTTACAT[T/C]GCTCTTGACTATGAA
PotSNP162	11940074	C	T	CTATGATGCATTTAG[T/C]TCATGGAGCAAACTT
PotSNP165	11940009	G	A	AGTTCCTTTTTCTCC[A/G]AGTTCTCAGACTCCG
PotSNP178	11940026	G	T	GAGGAATTGATGCGT[T/G]CTGAACTGGCACAGT
PotSNP182	11940095	G	A	ATACACAGGAAGGGT[A/G]AAGTGCTTCAAATTG
PotSNP184	11940038	G	A	TTTGACCATTCTTTC[A/G]GTCCTAGCTAACCAC
PotSNP185	11940002	C	T	AAGATAAGAAGAAAG[T/C]TAAGAGAACCAAGAT
PotSNP194	11940064	C	T	GGCCCACTTTCCACA[T/C]ATTCAATTTGGTCTC
PotSNP205	11940042	G	A	TCAACTCACCACTGG[A/G]TTTTACTCAAAATCA
PotSNP213	11940096	G	A	TAATATGTTGTGTCT[A/G]TAATTTTTGGGTCAT
PotSNP220	11940013	C	T	CATTAACCAAGGTTG[T/C]ATCGTTCGAGAGATC
PotSNP229	11940056	C	T	TCCTTTGTCATTGTA[T/C]GCCATGGAAGAAGCA
PotSNP392	11940003	T	A	GCTTTGTTTAAGAAC[A/T]GCCAGAAGAAGTTGC
PotSNP401	11940012	G	A	GCCTACGCGGCATGA[A/G]GATGTGGATATTGTT
PotSNP402	11940072	T	C	AAAGCTCAAATTAAA[C/T]GACGATGTTCAGGAA
PotSNP423	11940020	A	G	GGCCAACCAATTCCA[G/A]CGTCTTCTCCCAGAC
PotSNP446	11940081	C	T	AAAACCATTTGGTCT[T/C]GTTGATAATTCTGAG
PotSNP458	11940069	A	G	TACATAGCTCTACAA[G/A]CTTGGAAACATGTCA
PotSNP470	11940043	T	A	GACACAAAATTCATA[A/T]TGGCTGATACTTTGT
PotSNP543	11940049	T	A	GCAACTTGTCGTCGG[A/T]AAACTCGACTAGATT
PotSNP567	11940014	A	C	CTAGAAACAAAATCA[C/A]AATATAAGTTACATA
PotSNP569	11940028	G	A	GTTGTTTGCTTTGTT[A/G]TGCTGACTTATTGTA
PotSNP573	11940034	C	T	ATGCTTCTTGGTTGC[T/C]GTTTGTTTAGGCTCT
PotSNP580	11940087	T	C	AAATATGTTGTTCCA[C/T]TAGAAAAAAGAGTAA
PotSNP586	11940088	C	T	GTGAATACTGGTATC[T/C]TTCCAATTGAAGTCA
PotSNP587	11940067	C	T	AATATTCTTGTAGTA[T/C]ATATTGTCTAAAATC
PotSNP607	11940084	T	C	CAACGATATCGAGAA[C/T]TATTGTTCTAAGGGA
PotSNP626	11940045	G	A	GCTGAAAGTAAAGAC[A/G]GTGTTCAACATCTTG
PotSNP645	11940007	T	G	CATGCAATTGTAATA[G/T]TATCAATGTTTGTTG
PotSNP652	11940024	T	C	TGCTCAAGCTGCCAA[C/T]GCTAATCCGCTTTAC
PotSNP700	11940061	G	A	CAAGATATATGCAGC[A/G]GAGTCCCTTCGAGCA
PotSNP702	11940039	A	T	TTATGGTTATGGTGG[T/A]GGAGGTTGGATTAAT
PotSNP712	11940057	C	G	GGGAGGGTGAAAATA[G/C]TCGAAAACGGGCAAC
PotSNP713	11940073	G	A	GATTGTTATCCTTCC[A/G]CCACCTCCAACAGAT
PotSNP731	11940035	A	G	CAACTTCCAGTCGTG[G/A]GAGTGGGGTTAACGG
PotSNP753	11940046	G	A	ATGGTGTCTCCAAGG[A/G]ACTATTACAGTCACT
PotSNP759	11940090	C	T	AACATCGATAGGACT[T/C]TGAAGGCCGCGGATG
PotSNP766	11940089	T	C	CTGCCACTGCGGCTG[C/T]AGGTTCTGCAGCTGC
PotSNP775	11940079	G	A	TGAAATGATTGGATT[A/G]TGACCCATAGTTTAG
PotSNP796	11940025	C	A	ATCTCTAAGTTGGGG[A/C]AACCCATAATTTCTA
PotSNP827	11940053	T	A	CGCTTGGGAAGAACC[A/T]TTCGGTCCAGTTTTG

PotSNP834	11940006	T	C	CCAATTCCGACGGCC[C/T]TCGTCGTTTCACCGC
PotSNP853	11940066	A	C	GGTCGACCATTGGGG[C/A]CCCGTAGAGGGTATA
PotSNP866	11940048	G	T	AAGGCGAATTCCGGT[T/G]CCCGAAATGGATCTC
PotSNP893	11940011	A	G	TCATTACATCAAAAT[G/A]TTTTATCAATGCCCA
PotSNP908	11940100	T	A	TGATCCATTTGGTCT[A/T]GACCAGTTCTTGACA
PotSNP910	11940017	T	A	TGCTGTGCTCCTTCT[A/T]TTCCTCATCTCTCAC
PotSNP928	11940030	A	T	TCATTCTCACTCTCC[T/A]GCTGAACAAGCCATT
PotSNP947	11940015	T	G	AAAAGACAAGAATCT[G/T]GTTCAGATTCTCCAG
PotSNP948	11940063	T	A	TGGGGAAAACTTAAT[A/T]TGACAGCCAAGGCGT
PotSNP960	11940031	C	T	GGTTTTGTGGACTGC[T/C]AACACTGAAAGATAC
PotSNP964	11940029	A	T	TTATTTCAATGAAGC[T/A]TCTGGTGGACGTTAT
PotSNP982	11940085	C	T	TCTGTGGTTTTTTCA[T/C]CACCTCCATCTTCAA
PotSNP983	11940086	G	A	TAAGATTAGTTCTAA[A/G]CTTAGCGCAGAAGAC
PotSNP985	11940018	A	G	GAGCTCTATAAGTGC[G/A]CCTGTTACTCCACCT
PotSNP987	11940008	C	A	GGGCTATGGTTGGTT[A/C]GGAAAAAAGGTGCAA
PotSNP996	11940093	C	T	GGATATTGGGTTCGT[T/C]CCATGATTCGTGGCA

Table 5B: List of PotSNPmarkers and their specific annotation for position on the SH and RH map of Figure 3.

Marker	Annotation	Marker	Annotation	Marker	Annotation
PotSNP072	1.1	PotSNP573	5.1	PotSNP102	9.1
PotSNP834	1.2	PotSNP184	5.2	PotSNP587	9.2
PotSNP645	1.3	PotSNP702	5.3	PotSNP1115	9.3
PotSNP1034	1.4	PotSNP731	5.4	PotSNP402	9.4
PotSNP987	1.5	PotSNP043	5.5	PotSNP713	9.5
PotSNP185	1.6	PotSNP057	5.6	PotSNP080	9.6
PotSNP392	1.7	PotSNP1105	5.7	PotSNP458	9.7
PotSNP165	1.8	PotSNP032	5.8	PotSNP162	9.8
PotSNP1139	1.9	PotSNP205	6.1	PotSNP021	10.1
PotSNP038	2.1	PotSNP753	6.2	PotSNP073	10.2
PotSNP910	2.2	PotSNP470	6.3	PotSNP152	10.3
PotSNP106	2.3	PotSNP026	6.4	PotSNP122	10.4
PotSNP893	2.4	PotSNP626	6.5	PotSNP775	10.5
PotSNP401	2.5	PotSNP081	6.6	PotSNP134	10.6
PotSNP220	2.6	PotSNP866	6.7	PotSNP446	10.7
PotSNP567	2.7	PotSNP124	7.1	PotSNP120	10.8
PotSNP947	2.8	PotSNP047	7.2	PotSNP586	11.1
PotSNP055	3.1	PotSNP543	7.3	PotSNP100	11.2
PotSNP985	3.2	PotSNP130	7.4	PotSNP607	11.3
PotSNP1083	3.3	PotSNP1049	7.5	PotSNP766	11.4
PotSNP423	3.4	PotSNP229	7.6	PotSNP759	11.5
PotSNP1057	3.5	PotSNP712	7.7	PotSNP118	11.6
PotSNP068	3.6	PotSNP138	7.8	PotSNP982	11.7
PotSNP652	3.7	PotSNP827	7.9	PotSNP983	11.8
PotSNP796	3.8	PotSNP1026	8.1	PotSNP580	11.9
PotSNP178	4.1	PotSNP1122	8.2	PotSNP099	12.1
PotSNP1072	4.2	PotSNP700	8.3	PotSNP011	12.2
PotSNP960	4.3	PotSNP853	8.4	PotSNP996	12.3
PotSNP061	4.4	PotSNP089	8.5	PotSNP045	12.4
PotSNP569	4.5	PotSNP948	8.6	PotSNP121	12.5
PotSNP083	4.6	PotSNP194	8.7	PotSNP908	12.6
PotSNP964	4.7	PotSNP116	8.8	PotSNP182	12.7
PotSNP928	4.8	PotSNP002	8.9	PotSNP213	12.8
				PotSNP052	12.9

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Table 6. Diploid potato genotypes used for SNP marker development and testing

Nr.	Abbr.	code	Short description	reference
1	H	07-1004-1	*Sli* gene donor	07-1004-1 is a progeny of the *Sli*-donor F1-1 as described in Phumichai et al. (2005) Genome Vol. 48:977-984, Phumichai and Hosaka (2006) Euphytica 149:251–258 and Phumichai et al. (2006) Euphytica 148: 227–234.
2	D1	IVP97-079-9	Parent 1 used in present research, early, long, Y (yellow flesh), Qcook	Examples 1, 2 and 4 herein; available from Ronald Hutten, Laboratory for Plant Breeding, Wageningen University.
3	D2	IVPAA-096-18	Parent 2 used in present research, early, Y, Qcook	Examples 1, 2 and 4 herein; available from Ronald Hutten, Laboratory for Plant Breeding, Wageningen University.
4	D3	SH83-92-488	Parent 3 used in present research, *R3*, *H1*, *Gpa2*, *RXadg*, Y	Examples 2 and 4 herein; available from Ronald Hutten, Laboratory for Plant Breeding, Wageningen University.
5	D4	parent C	Parent of the CxE population	Anithakumari A.M. et al. (2010) Molecular Breeding 26(1):65-75
6	D5	parent E	Parent of the CxE population	Anithakumari A.M. et al. (2010) Molecular Breeding 26(1):65-75
7	D3	SH83-92-488	Independent duplo of nr 3	Van Os, H. et al. (2006) Genetics 173(2):1075-1087
8	D6	RH89-039-16	Used for genome sequencing	Van Os, H. et al. (2006) Genetics 173(2):1075-1087; available from Ronald Hutten, Laboratory for Plant Breeding, Wageningen University
9	D7	3778-16	*Grp1*, early, long (shape), *Ro1*	Rouppe van der Voort et al. (1997) Mol Gen Genetics 255(4):438-447
10	D8	IVP92-057-3	early, long, Y, Qfry	Used for marker development in Example 3
11	D9	IVP98-082-14	Long, Y, Qfry, *H1*, Qcook	Used for marker development in Example 3
12	D10	IVP02-089-5	Early, long, Y, *H1*, Qcook, Zep (orange flesh)	Used for marker development in Example 3
13	D11	IVP05-113-1	Early, y(white flesh)	Used for marker development in Example 3
14	D12	IVP05-122-24	Qstarch, Y	Used for marker development in Example 3
15	D13	IVP06-142-12	Wild species	Used for marker development in

			hybrid: Phyt avl	Example 3
16	D14	IVP06-145-2	Wild species hybrid: Phyt rch	Used for marker development in Example 3
17	D15	IVP06-148-13	Round (shape), Qcook, Qfry	Used for marker development in Example 3
18	D16	IVP06-149-12	Early, round, Zep, Y, spectacled, Qcook, blue anthocyans	Used for marker development in Example 3
19	D17	IVP06-155-9	Wild species hybrid: Phyt tar	Used for marker development in Example 3
20	D18	IVP06-161-16	Early, Phyt vnt1, round, Y, *H1*	Used for marker development in Example 3
21	D19	IVPAA-134-16	Early, round, y (white flesh)	Used for marker development in Example 3

Early: early flowering (short cycle); Qcook: good cooking quality; Qfry: good frying quality; Phyt indicates *Phytophthera* resistance genes

Example 4. Development of homozygous diploid potato plants and generation of heterozygous F1 hybrid progeny

Introduction

The objectives of this Example were to develop homozygous diploid potato lines that are self-compatible (SC) and have good agronomic performance. A breeding programme to combine self-compatibility with good agronomic performance is described above in Example 2 above. The aim of the current experiment is to prove that homozygous diploid self-compatible potato genotypes can be generated by inbreeding and that diploid potato plants containing contrasting homozygous loci scattered over the potato genome can be crossed (are intercrossable) to generate heterozygous F1 hybrid progeny.

Materials and methods

A self-compatible diploid homozygous potato genotype, that harbours the *Sli*-gene as described in the Examples above was crossed with two potato clones, designated D1 and D2 (see Examples 1 and 2) The F1 progenies were selfed and two F2 progenies were generated from two random SC F1 plants. Random self-compatible plants of these two F2 populations were selfed and per F2 population three F3 populations were tested for level of homozygosity and for segregation of SNP markers.

The 6 F2 plants were tested for ploidy level (by fluorescent quantitation of DNA) and were all found to be diploid.

A set of 36 markers was used on 265 individual F3 plants by applying the KASPar SNP genotyping system (see Example 3) covering all 24 chromosome arms of potato (see Figure 5).

Results

Subsets of 35 to 56 plants from the six F3 populations, in total 265 plants, were tested with at least 24 informative markers per parent pair. In total 36 markers were used (see Figure 5). For position of markers on the potato genome see Example 3, above. The *Sli* donor was 100% homozygous for these markers tested, while the D1 and D2 parents contained 20 and 19 loci resp. that were heterozygous out of the 24 informative markers tested per parent pair, while the other five and six loci resp. contained homozygous alleles originating from the from the donor parent (D1 or D2).

Six homozygous F3 plants

As expected, the F3 populations segregated for markers that were heterozygous in the F2 and not for markers that were fixed in the F2 (Figure 5). The mean heterozygote level ranged from 84 to 95 %, while that of individual plants ranged from 71 to 100% (Table 7).

Table 7. Homozygote frequencies (%) of six F3 populations

F3 population	Donor parent	mean	range
126	D1	85	74 – 96
126B	D1	88	74 – 100
127	D1	84	71 – 96
121	D2	85	71 - 96
122	D2	89	79 -100
123	D2	94	88 - 100

Three F3 populations of the D1 x H and of the H x D2 crosses were analysed for frequency of homozygous loci based on the data in Figure 5 as shown in Table 9.

These frequencies are expected giving the allele frequencies of the parents. There were six plants from three populations that were already 100 % homozygous.

These harboured mainly homozygous loci with *Sli* donor alleles. This is expected as the *Sli* donor harbours homozygous alleles, while the other parents contained one common allele with the *Sli* donor per heterozygous marker. So, *Sli*–donor derived alleles were abundant in all offspring populations. These six homozygous F3 plants, designated 122-34, 123-6, 123-20, 123-23, 123-24 and 126B-17, contained two, five, four, three, five and seven loci resp. with homozygous alleles from the donor parent. So, already in two selfed generations 100 % homozygosity was reached for 24 marker loci representing 24 chromosome arms.

No absolute lethal allele

It is often stated that repeated selfings in diploid potato will only result in weak plants due to inbreeding depression. This should be due to numerous deleterious alleles that reduce plant fitness, when these alleles are homozygously present. Therefore, we tested the segregation of 36 markers in the six F3 populations mentioned (see Figure 5).

These markers, that were chosen because they are informative for the parent pairs used in this study, were also tested for the frequencies in 19 diploid potato genotypes, that were chosen as donors for the breeding programme (see Example 3, Figure 4 and Table 9). If lethal alleles are present, then loci with homozygous alleles should be absent. Indeed, seven markers (designated PotSNP165, PotSNP205, PotSNP753, PotSNP 238, PotSNP 700, PotSNP 100 and PotSNP 607) did not show homozygous alleles that were different from the *Sli*-donor alleles in this diploid germplasm. Most of these markers were already fixed in the F2, most of them for *Sli* donor alleles as these were more abundant in the parents, but also examples were observed whereby the F3 population was fixed for the allele of the non-*Sli* parent (PotSNP753 in populations 126B and 127). Three of these seven markers (PotSNP205, PotSNP753 and PotSNP100) segregated in the F3 populations, whereby the PotSNP753 segregated normally and PotSNP205 and PotSNP100 showed distorted segregation. These may represent deleterious alleles. Only one plant with homozygous PotSNP100 donor alleles was identified. Without wishing to be bound by theory, it is believed that this may represent a very deleterious allele. As a single plant has been identified with a homozygous allele of the donor parent, this does not provide full proof for an absolute lethal allele.

F3 x F3 crosses

The 265 F3 plants tested were raised in an unheated greenhouse in the summer of 2010. In addition about 600 additional F3 plants were raised in the field with clay soil (see also Example 2). All these plants were from unselected F2 plants grown in a winter-nursery in The Netherlands (see Example 2). Crosses were made by applying pollen from greenhouse and field grown self-compatible plants on stigma of greenhouse grown self-compatible F3 plants. Only crosses were made between F3 plants with different great-grandparents (F3 plants of populations 121 - 123 crossed with 126 – 127). The greenhouse plants designated 126-24, 126-31, 126B-2 and 127-21 were successfully crossed as female self-compatible parent with a self-compatible F3 plant from population 123 as male parent. The female F3 plants were more than 80% homozygous, while the F3 plant in the field was not tested but the population mean homozygosity level was 94% with a range from 88 to 100%.

The parents of the F3 x F3 crosses were compared for loci that are already fixed in the F3 populations (see Table 8). Ten homozygous loci on nine chromosomes were identified that were at least contrasting between one of the four female and the one male parent used for the F3 x F3 crosses. As a consequence, the F1 hybrid progeny will be at least heterozygous for those contrasting loci. As each individual parent pair contained at least five contrasting loci, each individual progeny plant will harbour at least five contrasting chromosome regions.

Table 8. Contrasting fixed loci between the parents of the F3 x F3 crosses.

		chr	126-24	126-31	126B-2	127-21
Homozygosity level	%		86	80	88	88
Contrasting homozygous loci with F3 population 123	PotSNP392	1	x			
	PotSNP038	2	x	x		x
	PotSNP985	3			x	x
	PotSNP1105	5	x	x	x	x
	PotSNP753	6			x	
	PotSNP124	7				x
	PotSNP162	9	x	x	x	
	PotSNP021	10			x	x
	PotSNP120	10	x	x	x	x
	PotSNP213	12	x	x		
Total #	10	9	6	5	6	6

The codes 126-24, 126-31, 126B-2 and 127-21 refer to individual F3 plants that were used as females in crosses with one field grown plant of the F3 population designated "123" (see above). The homozygosity level was calculated as the percentage of homozygous loci over all loci tested (Figure 5). The "x" refers to homozygous markers that with contrasting alleles between the four female plants and the one plant of population 123.

Conclusions

It was found that after two generations of selfings homozygous diploid potato plants were obtained comprising alleles from both parents. Not a single marker out of 36 markers tested provided proof for a lethal allele. Furthermore, plants with more than 84% homozygous loci can be successfully crossed to obtain hybrid plants with at least five heterozygous chromosome regions. This means that hybrid seeds that are essentially uniform and that represent true potato seed have now been produced.

Table 9. Allele frequencies of genome wide SNP markers in diploid germplasm and F3 populations.

SNP marker	chrom	allele frequencies											
code	no	diploid germplasm				F3 from H X D1				F3 from H x D2			
		HH**	HD	DD	HD	HH	HD	DD	HD	HH	HD	DD	HD
		#*	#	#	%***	#	#	#	%	#	#	#	%
PotSNP834	1	4	9	5	50	47	79	17	55	122	0	0	0
PotSNP392	1	5	11	3	58	9	32	14	58	122	0	0	0
PotSNP165	*1*	*13*	*5*	*0*	*28*	*142*	*0*	*0*	*0*	n.i.			
PotSNP038	2	2	12	5	63	15	48	80	34	122	0	0	0
PotSNP947	2	8	9	1	50	118	13	12	9	122	0	0	0
PotSNP985	3	3	8	6	47	62	17	63	12	18	46	58	38
PotSNP796	3	2	12	5	63	142	0	0	0	122	0	0	0
PotSNP960	4	6	10	3	53	59	61	20	44	n.i.			
PotSNP569	4	13	2	4	11	n.i.				121	0	0	0
PotSNP928	4	5	13	1	68	141	0	0	0	88	19	15	16
PotSNP184	5	2	7	10	37	61	59	23	41	122	0	0	0
PotSNP1105	5	2	12	5	63	140	0	0	0	19	40	62	33
PotSNP205	*6*	*13*	*6*	*0*	*32*	n.i.				*91*	*27*	*3*	*22*
PotSNP753	*6*	*9*	*10*	*0*	*53*	*28*	*20*	*91*	*14*	n.i.			
PotSNP626	6	9	8	2	42	n.i.				122	0	0	0
PotSNP081	6	12	6	1	32	142	0	0	0	n.i.			
PotSNP124	7	8	9	2	47	85	0	55	0	n.i.			
PotSNP229	7	7	11	1	58	56	0	0	0	15	37	69	31
PotSNP138	*7*	*9*	*10*	*0*	*53*	*55*	*0*	*0*	*0*	*121*	*0*	*0*	*0*
PotSNP1026	8	10	6	3	32	n.i.				80	0	42	0
PotSNP700	*8*	*9*	*9*	*0*	*50*	*140*	*0*	*0*	*0*	*34*	*0*	*0*	*0*
PotSNP116	8	7	9	3	47	140	0	0	0	n.i.			
PotSNP102	9	3	12	2	71	141	0	0	0	122	0	0	0
PotSNP458	9	11	7	1	37	n.i.				122	0	0	0
PotSNP162	9	14	4	1	21	11	31	98	22	n.i.			
PotSNP021	10	0	10	9	53	33	55	53	39	35	0	0	0
PotSNP152	10	0	8	11	42	141	0	0	0	82	23	17	19
PotSNP120	10	9	9	1	47	n.i.				48	23	51	19
PotSNP100	*11*	*14*	*5*	*0*	*26*	*53*	*89*	*1*	*62*	n.i.			
PotSNP607	*11*	*14*	*5*	*0*	*26*	n.i.				*122*	*0*	*0*	*0*
PotSNP580	11	2	5	12	26	142	0	0	0	43	53	24	44
PotSNP099	12	1	10	8	53	56	0	0	0	120	0	0	0
PotSNP996	12	7	8	4	42	142	0	0	0	n.i.			
PotSNP182	12	6	10	3	53	n.i.				56	43	21	36
PotSNP213	12	9	8	1	44	22	38	80	27	n.i.			
PotSNP052	12	4	8	7	42	142	0	0	0	89	18	14	15

#: number of plants; HH: homozygous *Sli*-donor locus; DD: homozygous donor locus; HD: heterozygous locus; % is percentage heterozygous plants, low numbers indicate high level of homozygosity in F3.

Example 5. Breeding scheme for a commercial potato variety

Starting from F3 materials obtained from crosses between an *Sli* donor and another diploid potato as described in Examples 2 and 4 above, a breeding scheme for producing commercial potato varieties is set out herein below. This scheme consists of a number of consecutive steps, which, in combination with the teaching as described herein, will allow the skilled person to arrive at a diploid or tetraploid hybrid potato variety that is as good as or preferable better then existing commercial hybrids and that can be multiplied much faster than conventional bred varieties within five years.

1. Definition of the product variety

Based on the invention as described herein, the production of a novel potato variety based on the production of commercial hybrids is not a matter of chance, but a directed design process, starting with the articulation of the product profile of the variety. Herein, the desired product profile (target product profile) for a specific market (chips potatoes, starch industry, consumption potato must be defined. In addition, evaluation methods for the relevant traits in the product profile must be defined. Preferably, the presence of relevant traits is assessed by diagnostic markers. Such markers are well known in the art of conventional potato breeding.

2. Field trials

Depending on the season at which the development process is started, a suitable trial field is selected. When starting in September or October, it is preferred that a suitable trial field located on the southern hemisphere is selected. Field trials may start with at least 2, preferably more F3 populations, selected from at least one, but preferably more crosses of a diploid *Sli* donor and another diploid potato genotype serving as a donor for an agronomical trait, preferably the trait of vigour, which F3 populations represent the diploid, fertile, self-compatible, essentially homozygous and vigorous potato lines of the invention as exemplified in Example 2. In addition to

these F3 populations, F1 progenies are taken from at least two, preferably more selected F2 plants (as exemplified in Example 2 herein above) crossed with at least two, preferably more diploid potato genotypes that are different from the grandparents of the selected F2 plants. At least 50, preferably more individual plants of these F3 and F1 populations are then grown on the selected potato field and are selfed.

3. Evaluations and selection

During the growth in the field, the frequency of self-compatible plants that carry berries within a period of 2-6 weeks following the onset of flowering is evaluated, and at least two, preferably more F3 and F1 populations with at least 10%, preferably more self-compatible plants are selected. Further, during the growing season, the agronomic characteristics as defined in the product profile of the self-compatible plants in the selected populations is evaluated. Leaf samples of all self-compatible plants of the selected populations are collected for DNA marker testing.

At the end of the growing season the tuber quality and quantity of the self-compatible plants in the selected populations is evaluated, and the DNA marker genotypes is assessed by using diagnostic and random markers. Based on this evaluation and assessment, at least the five, preferably more, self-compatible plants of each population are selected based on: (i) the combination of traits that is closest to the target product profile; (ii) the highest level of homozygosity, and (iii) with the maximum number of contrasting homozygous loci. The selected and selfed F3 and F1 plants provide F4 and F2 progenies, respectively, in the form of seeds.

4. Tuber and seeds harvest and shipment

The tubers of the selected F3 and F1 plants as well as the F2 and F4 seeds in the berries of these selected plants are harvested at a period of at least at six weeks, preferably more, after flowering. The F4 seeds are collected for further field trials involving testing of the general combining abilities between F4 plants grown thereform, and the F2 seeds provide additional gene pools for breeding and are collected for further field trials. Depending on the season and in order to safe time, the seeds may suitably be shipped to the northern hemisphere for growing in a

greenhouse, provided that all phytosanitary regulations of the countries involved are met.

5. Tuber storage and evaluation

The tubers of the selected F1 and F3 plants are preferably stored in the region of cultivation to avoid undesired spread of pathogens and pests, and these stored tubers are evaluated for some relevant intrinsic tuber traits of the stored tubers as defined in the product profile.

6. Tuber propagation and evaluations after 1 year

The tubers of the selected F1 and F3 plants are grown the next season, preferably in the same region as the original potato field to avoid spread of unwanted pathogens or pest. At least two, preferably more potato tubers are used per plot and preferably one preferably more replicates per clone are used. At least one, preferably more relevant commercial cultivars are included as controls. Side-rows with commercial cultivars are preferably included to avoid side effects. The relevant plant characteristics as defined in the product profile (e.g. cooking, frying, chips making, starch content, etc) are evaluated. Further evaluated are the tuber yield per plot as well as the intrinsic relevant tuber characteristics as defined in the product profile. Such evaluations are used for family characterisation and progeny selections. These trials are repeated each year, preferably at locations in both hemispheres to continuously select the ancestor properties of plants, grown in the field. At later stages, when hybrids are obtained that are tested for commercial introductions, the evaluation trials are extended to at least two, preferably more, replicates at plot sizes of at least one, preferably more m^2 and at two, preferably more, locations preferably in but not restricted to the target markets.

7. Testcrosses with F4 seeds and field trials

Soon after the collection of the F4 progeny seeds of the selected selfed F3 plants, at least fifty, preferably more, of these seeds are sown. If needed, this sowing may occur in a heated greenhouse. The seedlings are preferably transplanted in small pots about 1 month after sowing and then transferred to the field in a suitable location some weeks thereafter. Evaluations and selections as described above are

continued and at least two, preferably more selected F4 plants per population are testcrossed with at least two, preferably more, other selected F4 progeny plants of two, preferably more selected parents with maximum number of contrasting loci to produce test hybrids (F4 x F4 -> hybrid). Additionally, at least two, preferably more selected F4 plants per population may be crossed with at least one, preferably more diploid genotypes with desirable characteristics or traits that are missing in the selected plants to enhance the genetic diversity of the breeding germplasm. Further, at least two, preferably more selected F4 plants per population may be selfed to produce F5 seeds. Still further, plant parts of at least two, preferably more selected F4 plants per population may be sterilised, *in vitro* propagated and treated with suitable chemicals (colchicine / oryzaline) to produce tetraploid F4 genotypes, and testcrosses are made with tetraploid F4 plants between the same parents as described above. In addition, similarly F2 progeny seeds are sown, transplanted and evaluated, crossed and selfed but not test/crossed

The above breeding scheme is repeated each year whereby an incremental increase in plant traits as defined in the product profile is achieved. The evaluations of the tubers from testcrosses are instrumental to determine the general combining abilities of parents. General combining ability is defined herein as the average performance of a line in a series of crosses. For each market at least two, preferably more elite parent lines are achieved that will render commercial hybrid seeds. It is expected that in five years a diploid or tetraploid hybrid variety is generated that is as good as or preferable better then existing commercial hybrids and that can be multiplied much faster than conventional bred varieties.

Claims

1. A diploid, fertile, self-compatible and essentially homozygous potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant.

2. The potato line of claim 1, wherein said line in addition to said tuber yield comprises at least one, more preferably at least 2, 3, 4, 5 or 6 agronomically desirable traits.

3. The potato line of claim 2, wherein said at least one agronomically desirable trait is selected from the group consisting of insect tolerance, nematode resistance, disease resistance (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, and cold sweetening resistance.

4. The potato line of any one of claims 1-3, wherein plants of said line when mature attain an average fresh weight of the foliage and shoots of at least 500 grams per plant,

5. A plant of a line according to any one of claims 1-4.

6. A seed of a plant according to claim 5.

7. Seed according to claim 6, wherein said seed is a uniform hybrid potato seed.

8. A method for producing a diploid, fertile, self-compatible and essentially homozygous 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 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 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 an offspring generation in the form of 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, self-compatible and essentially homozygous potato breeding line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant.

9. 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.

10. The method according to claim 9, wherein said trait is selected from the group consisting of insect tolerance, nematode resistance, disease resistance (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, and cold sweetening resistance.

11. The method of any one of claims 8-10, wherein said first potato plant is a plant of potato line NCIMB 41663, NCIMB 41664, NCIMB 41665, or NCIMB 41765, representative seeds of said line having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively.

12. The method of any one of claims 8-11, wherein said second potato plant is a plant of a second diploid, fertile, self-compatible and essentially homozygous potato line.

13. The method of any one of claims 8-11, wherein said second potato plant is a plant of a second diploid, fertile, self-incompatible potato line.

14. A diploid potato breeding line, more preferably an elite line, obtainable by the method of any one of claims 8-13.

15. A hybrid potato seed obtainable by crossing plants of a first and second diploid potato breeding line according to claim 14, wherein said plants of said first and second diploid potato breeding line contain at least 20 % contrasting homozygous loci as determinable by molecular marker analysis.

16. 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,

(b) providing a second potato plant, wherein said second potato plant is a plant of a second diploid, fertile, self-compatible and essentially homozygous potato line, wherein said first and second plant contain at least 20 % contrasting homozygous loci as determinable 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 an offspring generation in the form of a hybrid offspring seed.

17. The method of claim 16, wherein said first and second potato plant are from potato lines comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, preferably wherein said first and second potato plant are plants having a tuber yield of at least 200 grams fresh weight per plant.

18. Method according to claim 16 or 17, 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 (including but not limited to resistance to Scab caused by *Streptomyces* spp, Powdery scab, *Rhizoctonia*, Silver scurf, *Phytophthora infestans*), herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, and cold sweetening resistance.

19. The method of claim 16 to 18, wherein said first potato line is a diploid, self-compatible and essentially homozygous offspring potato plant comprising the *Sli*-gene, preferably wherein said first potato plant is a plant of potato lines NCIMB 41663, NCIMB 41664, NCIMB 41665, or NCIMB 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,.

20. The method of any one of claims 16-19, wherein said second potato plant is a plant of a second diploid, self-compatible and essentially homozygous potato line preferably said line comprising an additional agronomically desirable trait.

21. A seed of potato lines NCIMB 41663, NCIMB 41664, NCIMB 41665, or NCIMB 41765, representative seeds of said line having been deposited with the NCIMB, Aberdeen, Scotland.

22. A seed produced by the method of any one of claims 16-20.

23. A hybrid potato plant, or part thereof, produced by growing the seed of claim 16, 21 or 22.

24. Pollen or an ovule of the plant of claim 23.

25. A tuber from the plant of claim 23.

26. A potato plant having all of the physiological and morphological characteristics of the plant of claim 23.

27. A tissue culture of the plant of claim 23 or 26.

28. A potato plant regenerated from the tissue culture of claim 27, wherein said regenerated potato plant has all the physiological and morphological characteristics of a potato plant of claim 23.

29. A method for producing a hybrid potato seed wherein the method comprises crossing a first potato plant with a second potato plant and harvesting the resultant hybrid potato seed, wherein said first and/or second parent potato plant is the potato plant of claim 5, preferably wherein said first and second second parent potato have at least 20 % contrasting homozygous loci as determinable by molecular genetic marker analysis.

30. A method of producing a hybrid potato plant, said method comprising producing a seed according to a method of any one of claims 16-20 or 29 and growing said seed into a potato plant.

31. A potato plant produced by the method of claim 30, or a tuber thereof.

32. A set of at least 2 intercrossable homozygous diploid, fertile, self-compatible and essentially homozygous potato lines comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant according to anyone of claims 1-4, wherein each of said lines differ from another line in said set by having at least 20 % contrasting homozygous loci as determinable by molecular genetic marker analysis.

33. A diploid, fertile, self-compatible and essentially homozygous potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant obtainable by:

(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,

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid potato line 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 and allowing one of said parent plants to produce berries with seeds and collecting said seeds from said berries to provide an offspring generation in the form of a hybrid offspring seed,

(d) growing said hybrid offspring seed into a hybrid offspring potato plant,

(e) backcrossing said hybrid offspring potato plant to a potato plant of said line of said first potato plant, and selecting from the offspring plants thus generated a plant that is diploid, self-compatible and vigorous in that it produces tubers at a yield expressed in grams of fresh weight of at least 200 grams per plant, and

(f) selfing said diploid, self-compatible and vigorous plant for between 1 to 8 generations while selecting for self-compatibility and vigour as defined in (e).

34. A hybrid potato seed which seed, when sown produces a diploid, fertile, self-compatible and essentially heterozygous potato plant having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant, said plant being obtainable by:

(a) providing a first diploid, fertile, self-compatible and essentially homozygous potato line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant,

(b) providing a second diploid, fertile, self-compatible and essentially homozygous 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 determinable by molecular marker analysis, 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 an offspring generation in the form of a hybrid offspring seed.

Figure 1

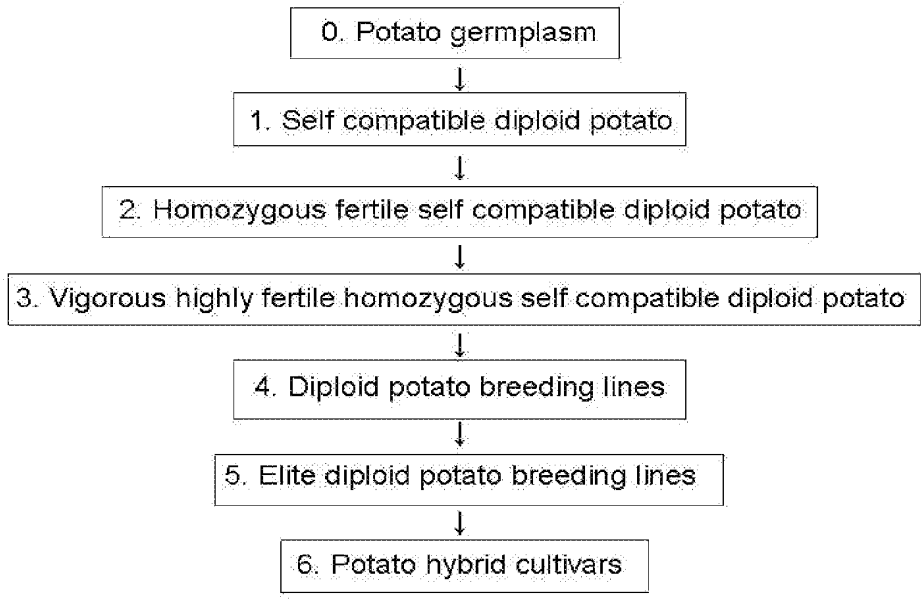
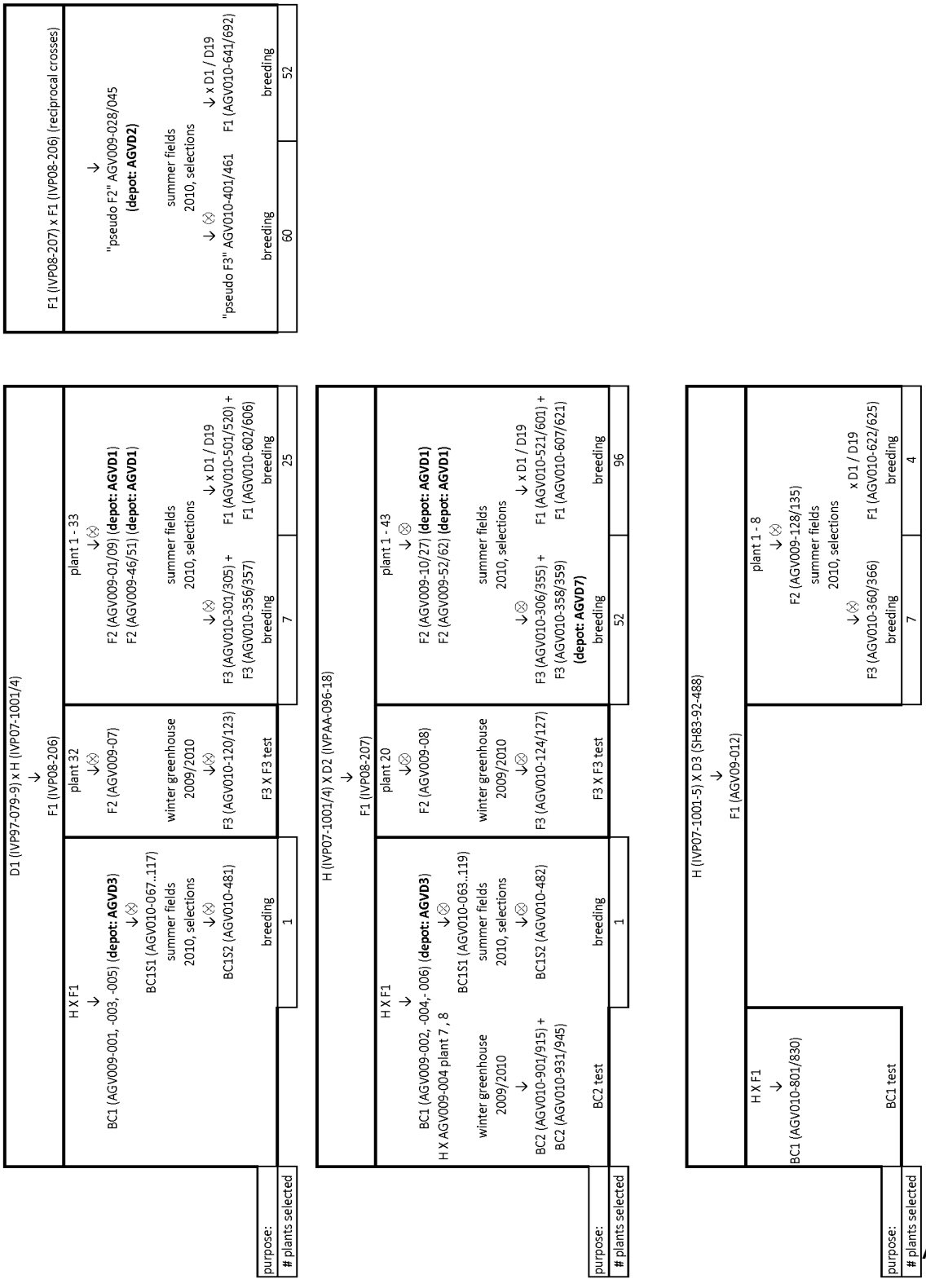

0. Potato germplasm
1. Self compatible diploid potato
2. Homozygous fertile self compatible diploid potato
3. Vigorous highly fertile homozygous self compatible diploid potato
4. Diploid potato breeding lines
5. Elite diploid potato breeding lines
6. Potato hybrid cultivars

Figure 2



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Figure 3

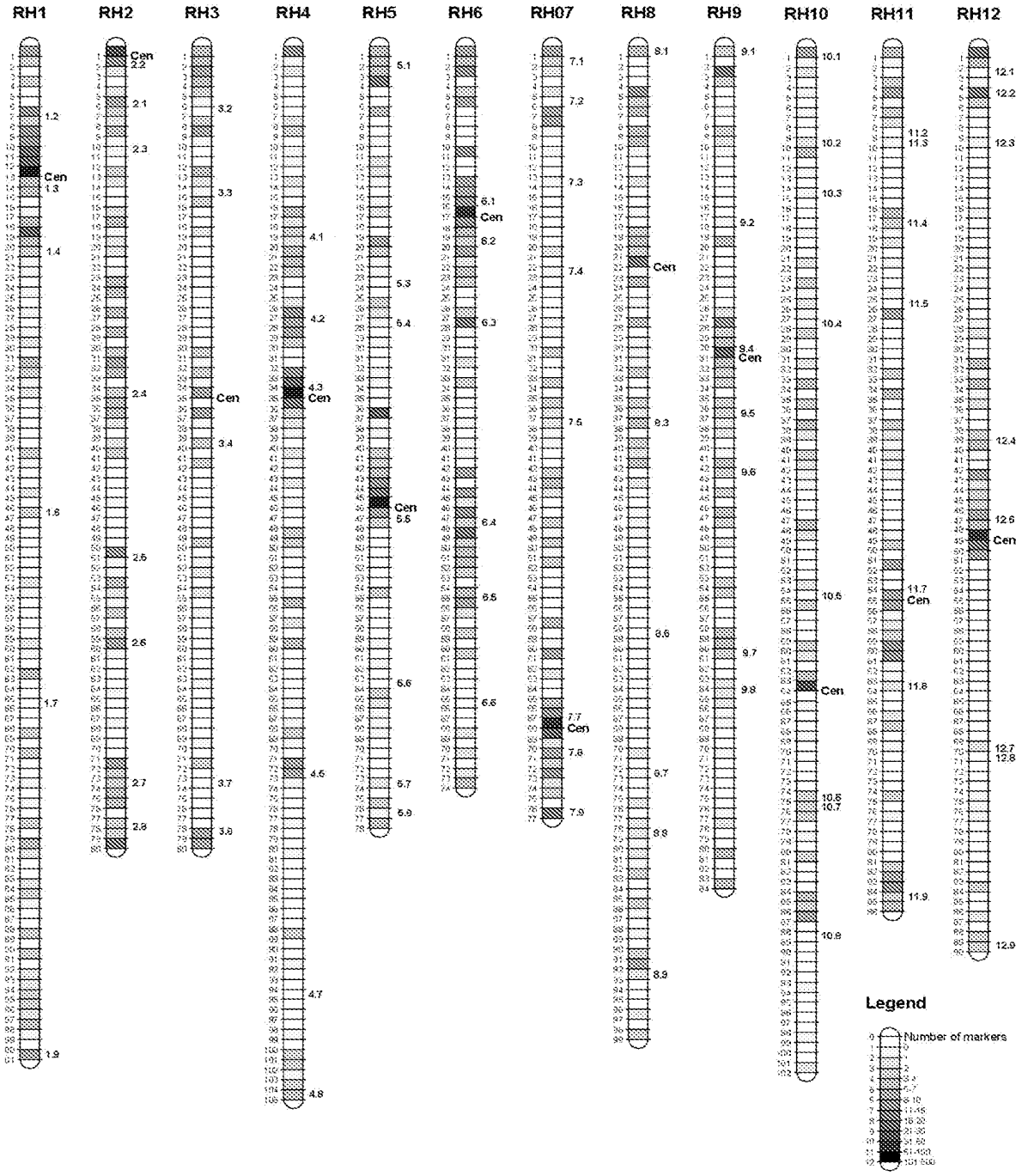
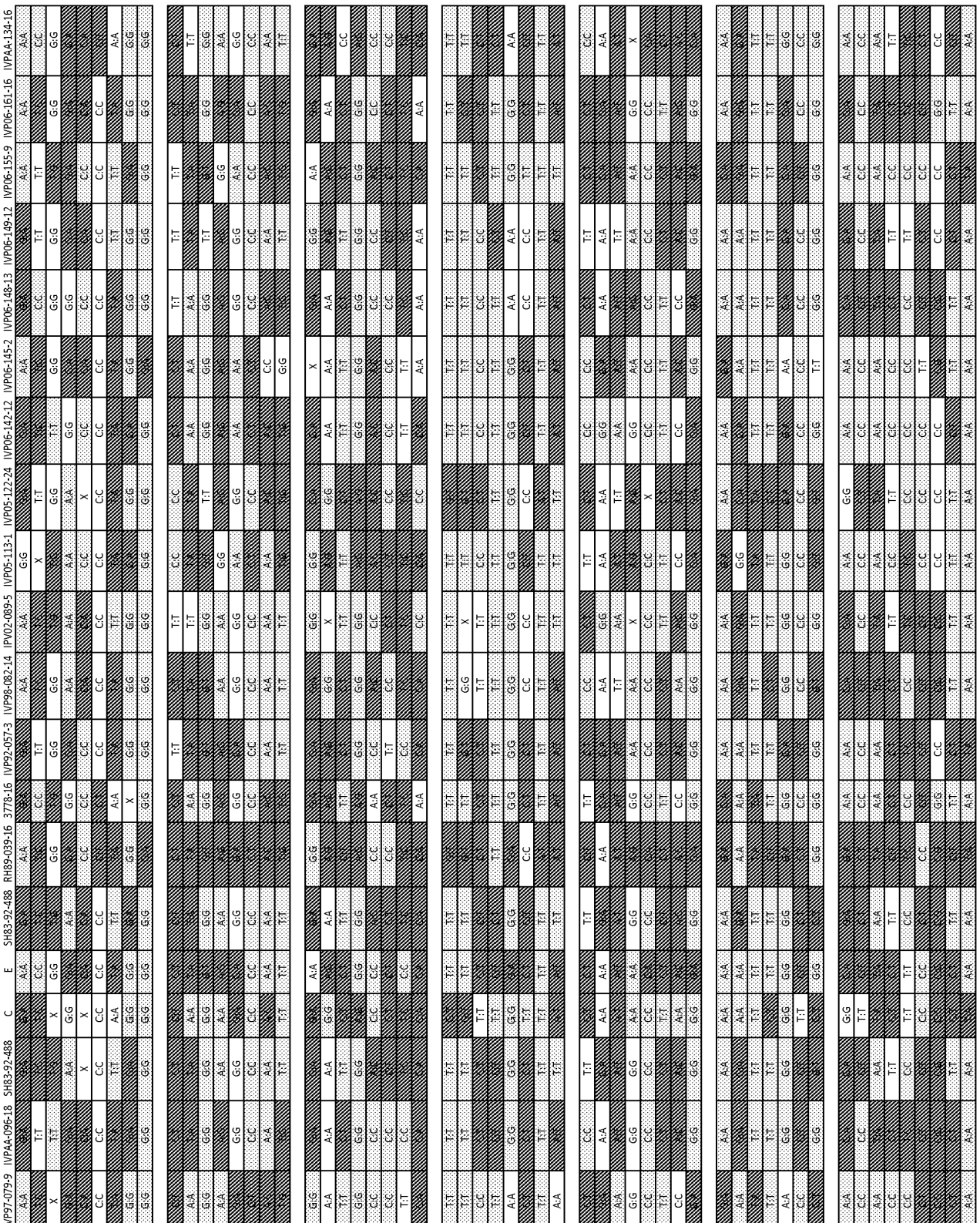
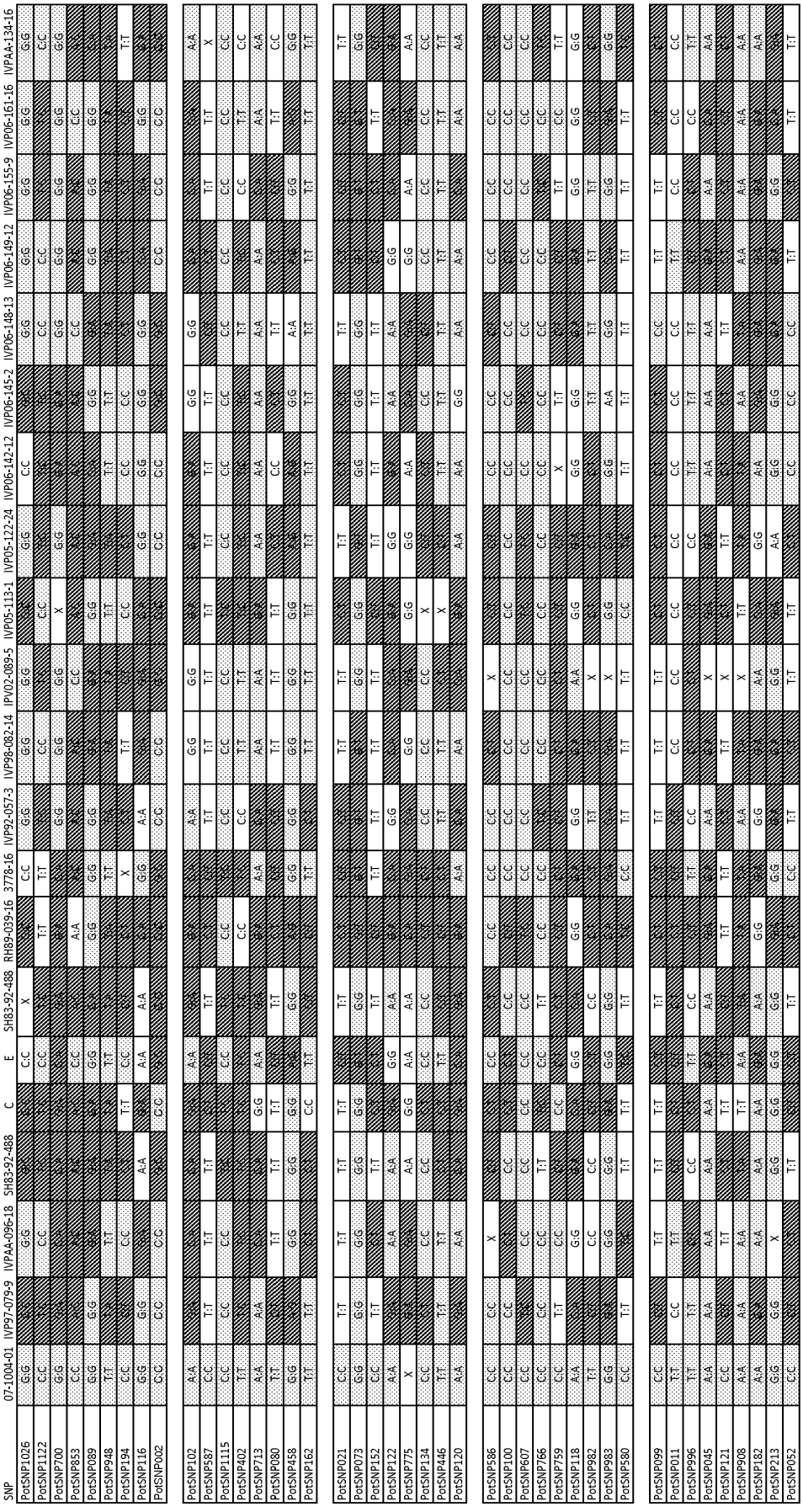

RH1
RH2
RH3
RH4
RH5
RH6
RH07
RH8
RH9
RH10
RH11
RH12
Cen
Legend
Number of markers

Figure 4



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Figure 4 continued



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Figure 5 A

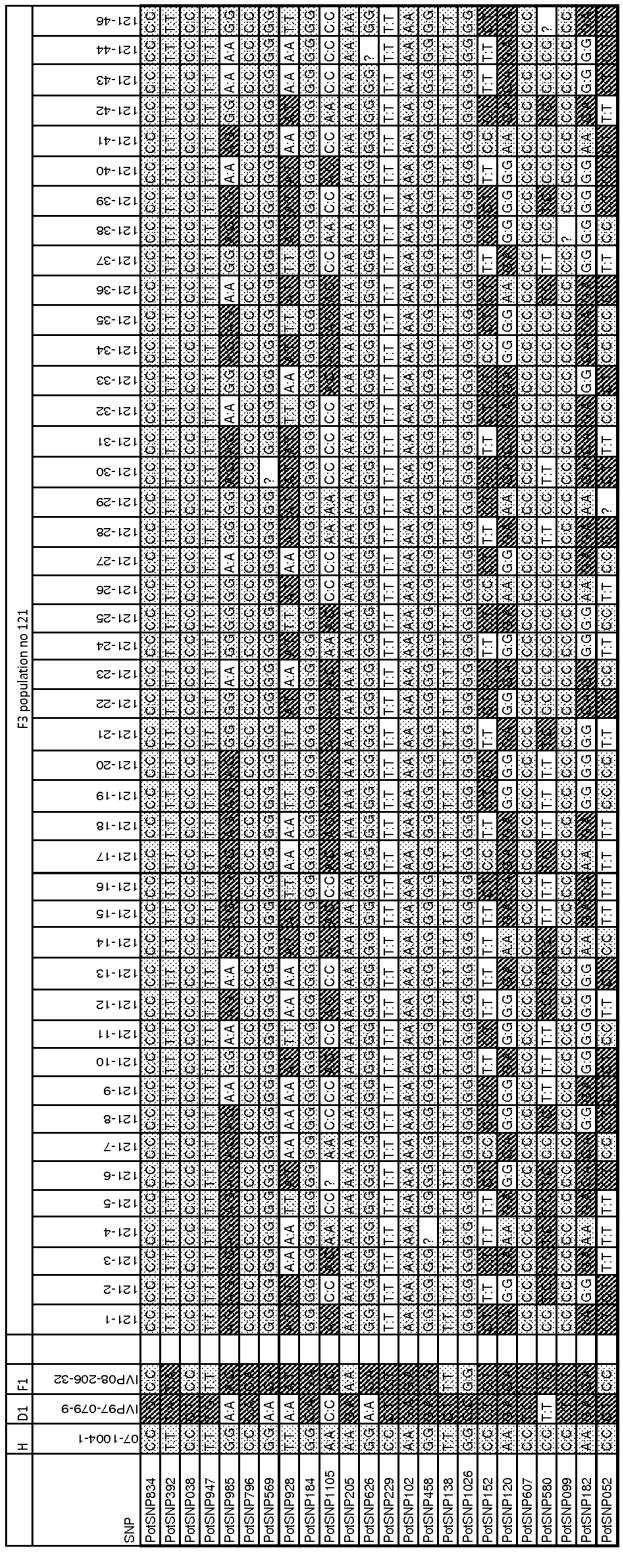

F3 population no 121
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H
D1
F1
07-1004-1
IVP97-079-9
IVP08-206-32
PotSNP834
PotSNP392
PotSNP038
PotSNP947
PotSNP985
PotSNP796
PotSNP569
PotSNP928
PotSNP184
PotSNP1105
PotSNP205
PotSNP626
PotSNP229
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PotSNP580
PotSNP099
PotSNP182
PotSNP052

Figure 5 B

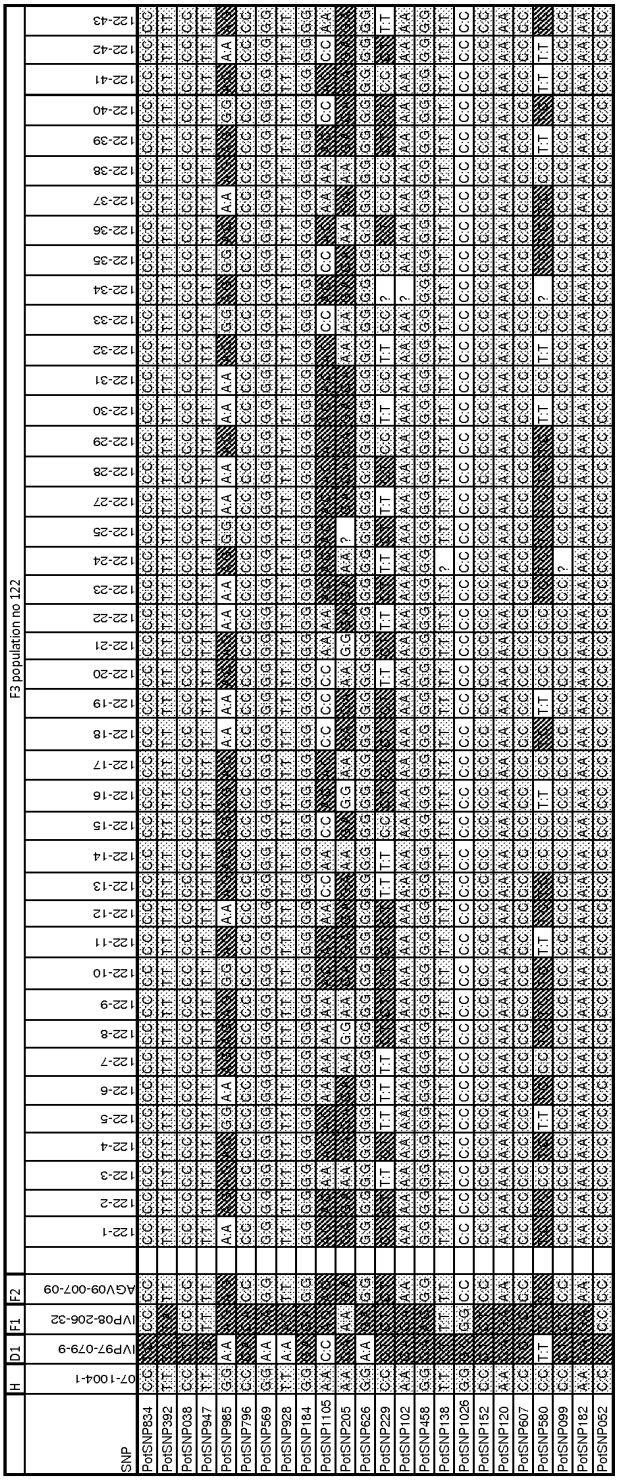

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F2
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IVP08-206-32
AGV09-007-09
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PotSNP038
PotSNP947
PotSNP985
PotSNP796
PotSNP569
PotSNP928
PotSNP184
PotSNP1105
PotSNP205
PotSNP626
PotSNP229
PotSNP102
PotSNP458
PotSNP138
PotSNP1026
PotSNP152
PotSNP120
PotSNP607
PotSNP580
PotSNP099
PotSNP182
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122-43

Figure 5 C

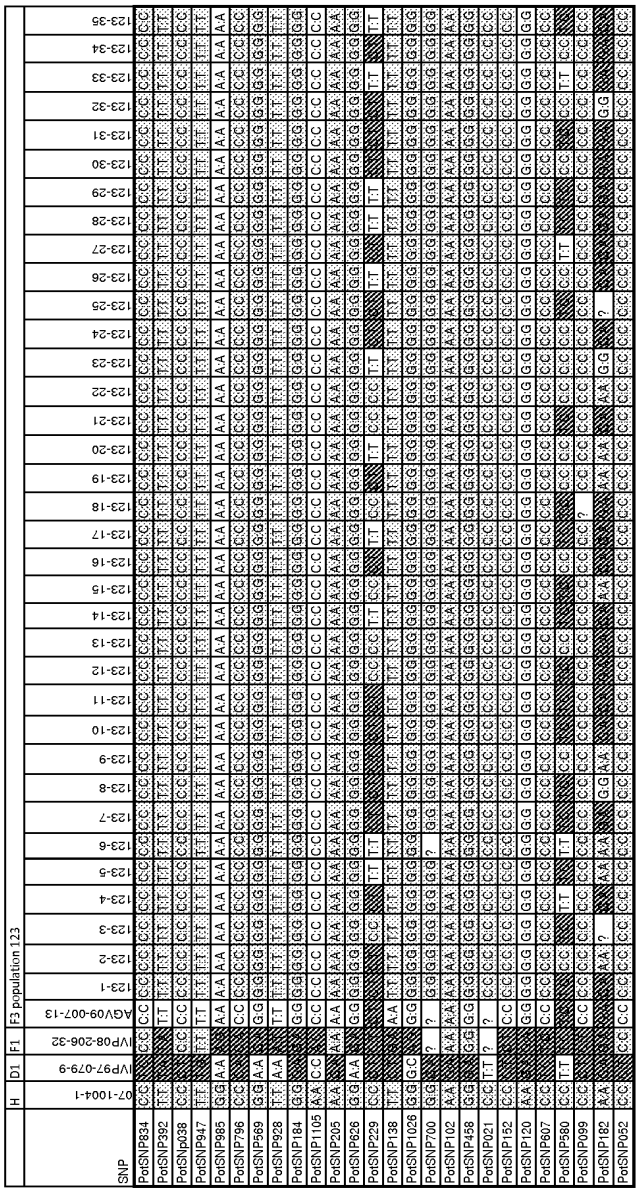

H
D1
F1
F3 population 123
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IVP97-079-9
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AGV09-007-13
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PotSNP1026
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PotSNP052

Figure 5 D

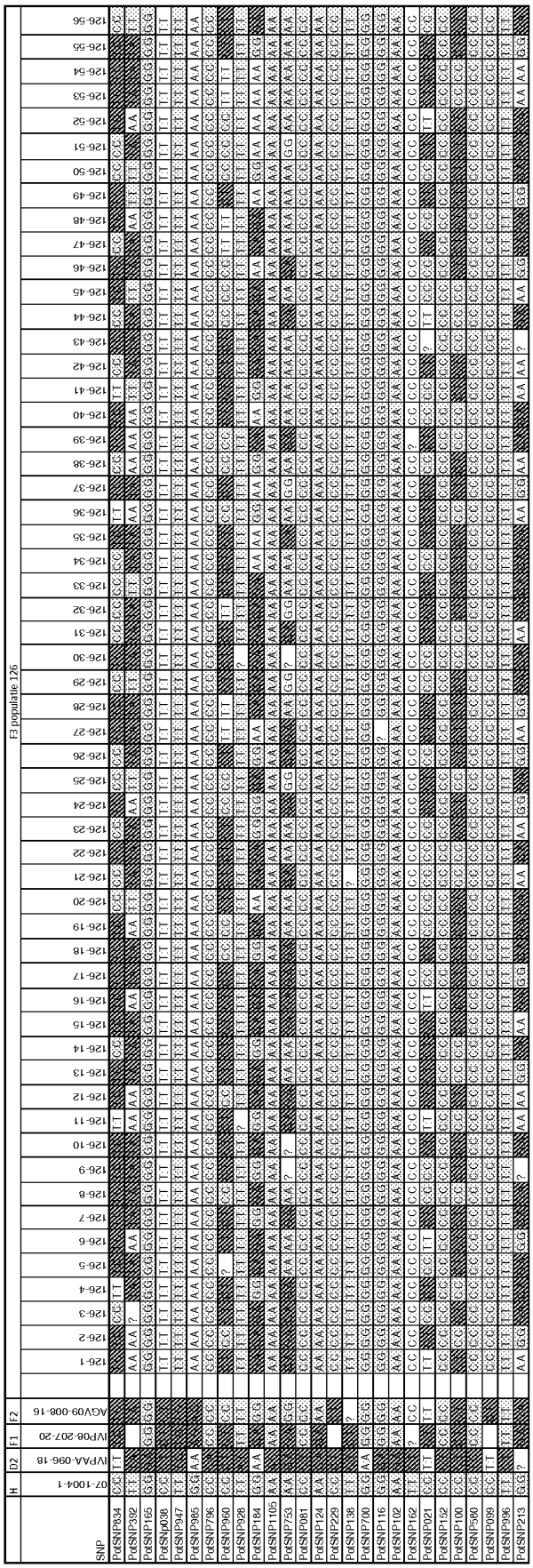

F3 populatie 126
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H
D2
F1
F2
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IVP08-207-20
AGV09-008-16
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126-2
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PotSNP796
PotSNP960
PotSNP926
PotSNP184
PotSNP1105
PotSNP753
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PotSNP124
PotSNP229
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PotSNP213

Figure 5 E

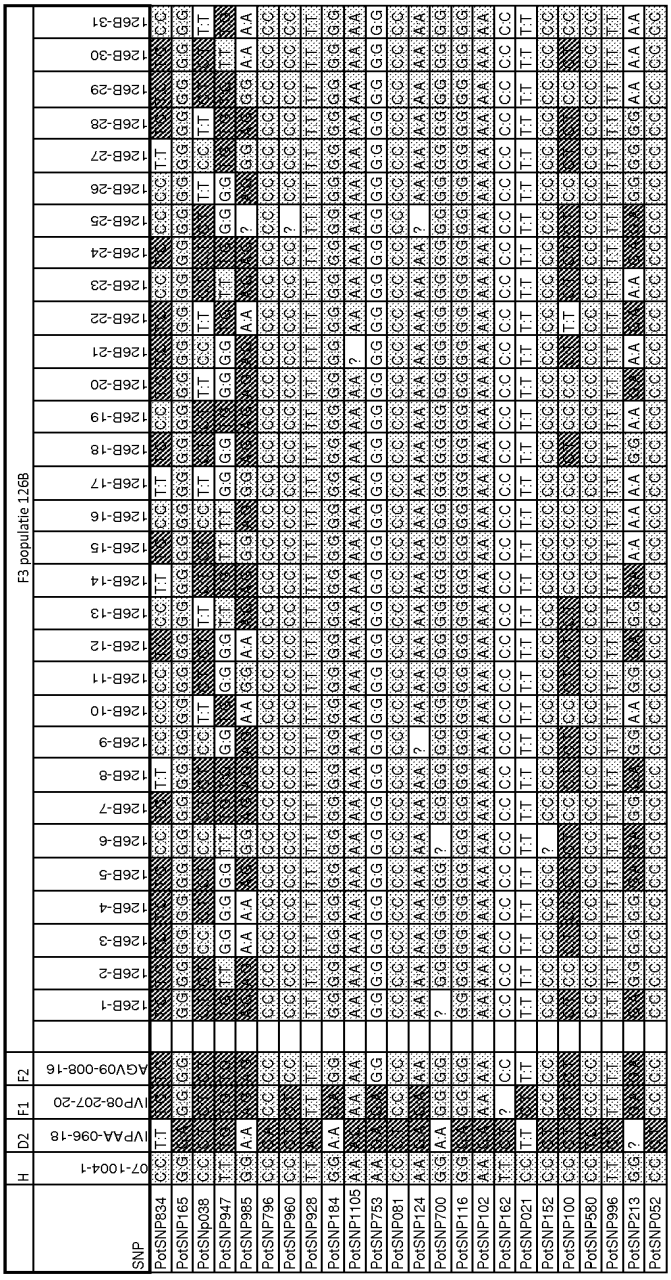
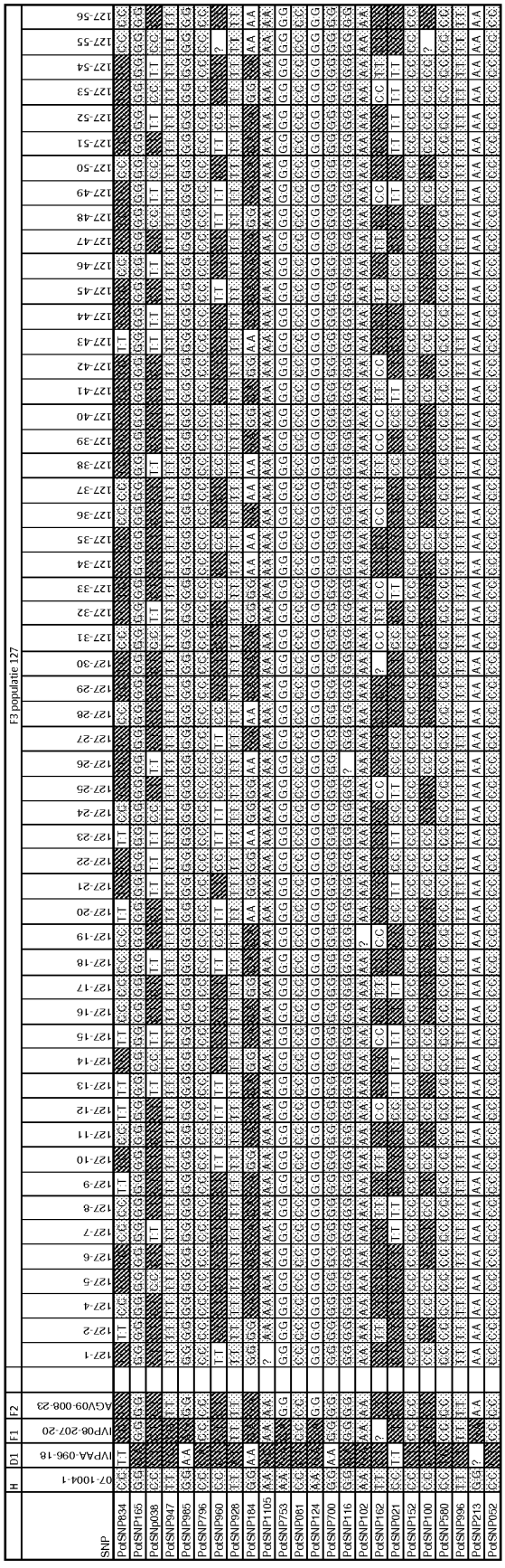

F3 populatie 1268
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F2
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AGV09-008-16
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126B-2
126B-3
126B-4
126B-5
126B-6
126B-7
126B-8
126B-9
126B-10
126B-11
126B-12
126B-13
126B-14
126B-15
126B-16
126B-17
126B-18
126B-19
126B-20
126B-21
126B-22
126B-23
126B-24
126B-25
126B-26
126B-27
126B-28
126B-29
126B-30
126B-31
PotSNP834
PotSNP165
PotSNp038
PotSNP947
PotSNP985
PotSNP796
PotSNP960
PotSNP928
PotSNP184
PotSNP1105
PotSNP753
PotSNP081
PotSNP124
PotSNP700
PotSNP116
PotSNP102
PotSNP162
PotSNP021
PotSNP152
PotSNP100
PotSNP580
PotSNP996
PotSNP213
PotSNP052

Figure 5 F


F3 populatie 127
SNP
07-1004-1
IVPAA-096-18
IVP06-207-20
AGV09-008-23
PotSNP834
PotSNP165
PotSNP038
PotSNP947
PotSNP985
PotSNP796
PotSNP960
PotSNP928
PotSNP184
PotSNP1105
PotSNP753
PotSNP061
PotSNP124
PotSNP700
PotSNP116
PotSNP102
PotSNP162
PotSNP021
PotSNP152
PotSNP100
PotSNP560
PotSNP996
PotSNP213
PotSNP052

Electronic Acknowledgement Receipt

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First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
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2	Foreign Reference	091876_0014_FR_WO2011053135.pdf	5131807 2a7651919e1539c1bc62dd4b974628c973813b30	no	85
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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	091876-0014	6337

23630 7590 06/13/2019

McDermott Will & Emery
The McDermott Building
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Washington, DC 20001

EXAMINER
BOGGS, RUSSELL T

ART UNIT	PAPER NUMBER
1663	

NOTIFICATION DATE	DELIVERY MODE
06/13/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ipdocketboston@mwe.com
mweipdocket@mwe.com

Office Action Summary	Application No. 13/504,156	Applicant(s) Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 30 January 2019.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1,3-6,8-9,11-13,16,18-25,29-30,32,35,37-39 and 42-43 is/are pending in the application.

5a) Of the above claim(s) 12 is/are withdrawn from consideration.

6) ☑ Claim(s) 1,3-6,11,16,18-21,29-30,32,35,37-39 and 42-43 is/are allowed.

7) ☑ Claim(s) 8-9,13 and 22-25 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first-to-invent provisions.

Continued Examination under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 30 January 2019 has been entered.

Status

1. Claims 1-34 were examined on the merits in the Office action mailed 14 October 2014 and rejected. Applicant responded on 14 January 2015 amending several claims and cancelling claims 2, 10 and 17. Claims 1, 3-9, 11-16 and 18-34 were examined and rejected in the final rejection mailed 18 May 2015. Applicant filed an RCE on 18 November 2015. Claims 1, 3-9, 11-16, 18-32 and 34-36 were examined and rejected on 8 March 2016. Applicant responded on 8 September 2016 cancelling claims 14-15 and adding claims 37-39. Claims 1, 3-9, 11-13, 16, 18-32 and 34-39 were examined and rejected in an Office action mailed 21 February 2017. Applicant filed a second RCE on 19 May 2017. Applicant amended claims and cancelled claim 26. Claims 1, 3-6, 8-9, 11-13, 16, 18-25, 27-32 and 34-39 were examined on 7 September 2017; most claims were rejected. Applicant responded on 27 December 2017, cancelling claims 34

and 36 and adding claims 40-43. Claims 1, 3-6, 8-9, 11-13, 16, 18-25, 27-32, 35, 37-39 and 40-43 were examined on 30 May 2018. Claims 21, 35 and 42-43 were allowed. Claims 1, 3-6, 8-9, 11-13, 16, 18-20, 22-25, 27-32, 37-39 and 40-41 were rejected. An interview was conducted on 30 November 2018.

Applicant filed a third RCE on 30 January 2018 ("Response") accompanied by a declaration from Dr. Lindhout ("Lindhout Decl."). Applicant canceled claims 27-28, 31 and 40-41. Claims 1, 3-6, 8-9, 11-13, 16, 18-25, 29-30, 32, 35, 37-39 and 42-43 are examined herein.

Withdrawal of Objections and Rejections

2. The objection to claim 35 is withdrawn in view of Applicant's amendments to the claim.

3. The rejection of claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39 and 40-41 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, is withdrawn in view of Applicant's amendments to the claims. In other words, the written description rejection mailed 30 May 2018 of some of the then-pending claims is withdrawn.

4. The rejection of claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39 and 41 under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, scope of enablement, is withdrawn in view of Applicant's amendments to the claims. In other words, the scope-of-enablement rejection mailed 30 May 2018 of some of the then-pending claims is withdrawn.

Regarding the *Sli* gene, Applicant's argument is accepted that the exact location of the gene is not required to practice the invention, nor is an exact description of the gene required in view of the prior part, for example, in view of the Phumichai et al. references of record. For example, a plant comprising the *Sli* gene can be readily selected for on the basis of compatibility.

5. The rejection of claims 1, 3-6, 12, 16, 18, 20, 29, 32, 37-39 and 41 under 35 USC 103(a) is withdrawn in view of Applicant's amendments to the claims.

6. Any objection to and rejection of a cancelled claim is rendered moot.

Claim Interpretation

7. Claim 1 reads on a potato line. Claiming a line is similar to claiming a plural subject matter such as if the claim read on a plurality of 'potato plants' even though the scope of the claim is interpreted in view of a discrete potato plant. In general, claims reading a plurality of compositions are disfavored because it raises the question of whether it reads on a single plant. In other words, if a potential infringer has a single plant, does it infringe claim 1?

Claim 1 recites the limitation "at least 25% of the homozygous genomic loci in a plant of said line" in line 12. The antecedent basis of this limitation is the occurrence of 'line' in line 10.

Claim 1 now requires a certain degree of relationship to the deposited lines. In view of Applicant's arguments, Dr. Lindhout's declaration, and a review of the prior art, claim 1 is found allowable herein, as well as several dependent claims.

Claim 16 is interpreted as requiring a plant that falls within the scope of claim 1 for both parents in the claimed cross, i.e., both the first plant and the second plant.

Applicant defines the term "essentially homozygous" as follows:

> The term "essentially homozygous" refers to a level of homozygosity of at least 25%, preferably at least 50%, more preferably at least 75%, still more preferably at least 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86,87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, or 100% homozygosity when testing 100, preferably 1000, more preferably 5 at least 10.000 loci.

Spec., p. 21.

Claim Objections

8. Claims 1, 8, 12, 19-20 and 42 are objected to because of the following informalities.

Claims 1 and 8 are objected to because they recite the limitation "S-locus inhibitor (*Sli*) gene." The objection is made because if a S-locus inhibitor gene is the same as a *Sli* gene then the limitation is redundant. If they are different, then it raises a question regarding the scope of the claim. Although using the limitation "S-locus inhibitor (*Sli*) gene" once in a claim set to establish the definition of a "*Sli* gene" the limitation is repeated in claim 8.

Claim 12 is objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim should refer to other claims in the alternative only. See MPEP § 608.01(n). Accordingly, the claim 12 not been further treated on the merits.

Claim 16 is objected to for several reasons. First, it recites the limitation "a plant" in line 2 and in line 5 in spite of referring to the plant of claim 1. Amendment to "the

plant" or "said plant" is requested. Second, it recites the limitation "tetraploid" in line 6 but the line of claim 1 cannot be tetraploid.

Claims 20 and 42 are also objected to because they recite the limitation "tetraploid" in references to a plant of claim 1 which is not tetraploid.

Claim 19 is objected to because it recites the limitation "lines" as the second word of the second line. It suggests that the claimed plant needs to be a member of each deposited line. Amendment to "line" is requested.

Appropriate correction is requested.

Claim Rejections - 35 USC § 112(b)

The following is a quotation of 35 U.S.C. 112(b):

> (B) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claims 8 and 13 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Claim 8 recites the limitation "the plant" in the second-to-last line. There are multiple antecedent bases for this limitation in the claim and therefore which plant is required to be 50% homozygous is indefinite.

Claim 13 recites the limitation "the plant" in line 1. There are multiple antecedent bases for this limitation in the claim. Amendment of “the” to “a” would obviate this rejection.

Claim Rejections - 35 USC § 112(a) / written description

10. Claims 22-25 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. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention.

Due to Applicant’s amendments to the claims, the rejection is modified from the rejection set forth in the Office action mailed 30 May 2018 as applied to the above-referenced claims. Applicant traverses the rejection in the paper filed 30 January 2019. Applicant’s arguments have been fully considered but are not persuasive.

The Claims

Claim 1, not rejected, is drawn to a diploid, fertile, self-compatible *S. tuberosum* potato line, where the potato line comprises a plant having a tuber yield of at least 200 grams; wherein at least 50% of genomic loci in said plant are homozygous; wherein self-compatibility originating from *S. chacoense* and is referred to as a S-locus inhibitor (Sli) gene, a copy of said gene is present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765; wherein at least 25% of the plants of said line

produce seed-carrying berries, each carrying at least 5 seeds; and wherein at least 25% of the homozygous loci are from one or more of the above deposits.

Dependent claim 16, not rejected, is a method claim drawn to producing a uniform hybrid potato seed starting with a first plant according to claim 1 and crossing the first plant with a second plant according to claim 1.

Dependent claim 22 is drawn to a produced by the method of claim 16. Dependent claims 23-25 are drawn to a plant or part thereof produced from the seed of claim 22.

Applicant's Description

Applicant describes the deposited lines by breeders reference: AGVD1 (NCIMB 41663), AGVD2 (NCIMB 41664), AGVD3 (NCIMB 41665) and AGVD17 (NCIMB 41765). Spec., pp. 33-34.

In the specification, Applicant describes a breeding process according to the instant invention starting with a self-compatible line, e.g. AGVD1-3 or AGVD17. *Id.*, p. 37. Applicant states that "[n]o or at least little, attention is paid to the agronomical appearance of the plants at this stage." *Id.* One aspect of the recited breeding steps includes the possibility of adding a desired trait, such as vigor. *Id.*, p. 38. Continuing this aspect, after adding the trait, the hybrid is backcrossed to the self-compatible line while selecting for, e.g. vigor. *Id.* After adding numerous traits, and performing test crosses, inbred elite diploid breeding lines can be obtained which can be used to produce commercially valuable hybrids. *Id.* Applicant reviews the steps: develop a "a vigorous fertile homozygous self-compatible diploid potato line;" "a diploid breeding line;" and then an "elite diploid potato breeding line." *Id.*, p. 40. On page 43, Applicant

concludes that "[t]he above method now provides a breeding process for the production of homozygous breeding lines or elite breeding lines based on the background of population AGVD1, AGVD2, AGVD3 or AGVDI7, to which background successively additional alleles are added, thereby providing elite breeding lines wherein desirable traits are stacked." *Id.*, p. 43.

In particular, in Example 1, Applicant describes obtaining the IVP07-1001/4 line from publically available germplasm where the IVP07-1001/4 plants contained the *Sli* gene after repeated selfing. *Id.*, p. 44. Applicant cites to the 2006 Euphytica publication by Phumichai et al. as well as the 2005 Genome publication by Phumichai et al. regarding the source of the *Sli* gene. *Id.*, p. 44 & p. 57 (citing to Phumichai et al. (2005) Genome 48:977-94 (2005) and Phumichai et al. (2006) Euphytica 148:227-34). Applicant describes that these plants are of no commercial value. *Id.* Applicant crossed these plants to three different diploid donor lines, D1, D2 and D3, in order to acquire the commercially valuable traits carried by the donor lines. *Id.*, pp. 44-45. The F1 cross with D1 was selfed and the progeny deposited as AGVD1, which was estimated as 50% homozygous. *Id.*, p. 45. The F1(D1) was crossed with F1(D2) and the progeny deposited under AGVD2, and this was estimated to be 25% homozygous with respect to alleles originating from IVP07-1001/4. *Id.* The F1(D1) was backcrossed to obtain progeny 25% homozygous with respect to alleles originating from IVP07-1001/4; these were deposited as AGVD3. *Id.*

In Example 2, Applicant describes crossing the *Sli* gene donor with various publically available potato clones designated: IVP97-079-9, IVPAA-096-I8 and SH83-92-488 to generate clones D1, D2 and D3. *Id.*, p. 47. Applicant describes this created

a diploid trait donor lines containing the *Sli* gene with enhanced agricultural quality. *Id.*, pp. 46-50. Applicant provides a more detailed description of the potato lines used in Table 6. *Id.*, pp. 57-58.

Applicant describes creating a molecular marker platform, i.e. SNPs, in Example 3. *Id.*, pp. 50-58.

In Example 4, Applicant describes the development of homozygous diploid potato plants and then F1 hybrid progeny, as well as subsequent generations. *Id.*, pp. 58-62. Applicant describes that it is "often stated" that potatoes are very prone to inbreeding depression. *Id.*, p. 60. A cause of this might be deleterious alleles; Applicant potentially identified a few such deleterious alleles, with one allele that was almost, but not quite, lethal. *Id.*

Applicant concludes, on page 62, that

> It was found that after two generations of selfings homozygous diploid potato plants were obtained comprising alleles from both parents. Not a single marker out of 36 markers tested provided proof for a lethal allele. Furthermore, plants with more than 84% homozygous loci can be successfully crossed to obtain hybrid plants with at least five heterozygous chromosome regions. This means that hybrid seeds that are essentially uniform and that represent true potato seed have now been produced.

Id., p. 62.

The Scope of the Claims

In contrast to the limited description – four deposited lines – the claimed genera are quite large. For example, the claimed genera include those set forth in the following exemplary claims:

Claim 22 reads on potato seed obtained from the method of claim 16 where claim 16 involves a cross between two plants of claim 1. Claim 1 only requires 50%

overall homozygosity of each plant where the plants are also required to have 25% homozygosity with the deposits. A cross between two plants falling within the scope of claim 1 could thus have a much lower level of homozygosity relative to the deposited lines.

In the record, Applicant argues that the plants of the invention are distinguishable from the prior art plants because they have a tuber yield in excess of 200 grams per plant even after inbreeding. Remarks, 14 Jan. 2015, p. 17 and Remarks, 8 Sept. 2016, pp. 28-29. Applicant offers a theory that, in the prior art, inbreeding to diploids was associated with severe inbreeding depression because of the presence of deleterious and lethal alleles. Remarks, 8 Sept. 2016, p. 24. Although Applicant is clearly not bound by this theory, Applicant fails to associate any structure, such as a combination of genes or conversely a lack of other genes, with the phenotype of superior tuber yield (at least 200 g per plant).

Claim 22 reads on all seeds produced by the method of claim 16 without further describing the seeds or requiring any specific structure. Claims 23-25 read on all plants, and parts thereof, produced from the seed of claim 22 without further describing the plants or requiring any specific structure. None of these claims require any identifying structure, even the *Sli* gene.

To claim a genus under the written description requirement, Applicant is required to describe a representative number of species to reflect the variation within the genus or structures sufficient to define the genus. The factors to be considered include disclosure of complete or partial structure, physical and/or chemical properties,

functional characteristics, structure/function correlation, methods of making the claimed product, or any combination thereof.

Applicant Fails to Describe a Representative Number of Species or Structural Features

Applicant clearly provides written description – by deposit – for the deposited lines. But does Applicant describe a representative number of species in comparison to the size of the all the genera claimed? In the instant application, Applicant only describes by deposit only four potato lines as compositions and for use in the claimed methods. All were created from the same *Sli* donor, the IVP07-1001/4 line, crossed to three diploid donor lines. Spec., p. 44 & pp. 57-58. Applicant cites to Phumichai et al. (2006) as to the source of the *Sli* gene line. Id., p. 44. The IVP07-1001/4 line does not appear to be a *S. tuberosum* line based on a review of the specification and Phumichai et al. (2005) and Phumichai et al. (2006), but its identity is not directly stated. Applicant does not further characterize or describe the *Sli* gene or describe any means to identify it.

The Art

The art describes basic the approach of Applicant's invention. For example, in a 2009 publication, Jansky describes first obtaining homozygous diploids using a self-incompatibility inhibitor. J Jansky, "Breeding, Genetics, and Cultivar Development," Advances in Potato Chemistry and Technology, ed. J. Singh & L. Kaur, pp. 27-62 (June 2009), p. 46. Jansky teaches that "[h]ighly homozygous inbreds could be also be used for heterosis breeding. Jansky, p. 46. Jansky describes that such an approach would be difficult. *Id.*

Phumichai et al. confirms the approach of Jansky, and documents the use of the *Sli* gene in the approach. Phumichai et al. (2005), abstract.

> Potato . . . is an auto- or segmental allo-tetraploid showing tetrasomic inheritance, which results in complicated genetic segregation. Since potatoes are propagated vegetatively, highly heterotic genotypes can be maintained, which facilitates the use of heterosis, an essential factor in potato breeding, particularly for tuber yield. Alternatively, open-pollinated true potato seed (TPS) can be used as a low-cost planting material for potato production.
>
> Highly homozygous inbreds, once amply produced, would be highly useful for the development of TPS varieties with genetic uniformity, as well as for the investigation of heterosis.
>
> A scheme for hybrid breeding using homozygous diploids and subsequent somatic hybridization has been proposed, for which the availability of highly homozygous diploid (or pure) lines is a key for success. In considering the use of pure lines for the development of genetically uniform [true potato seed] varieties, self-fertile, seed-propagated lines are highly desirable, and simple techniques to develop such lines are necessary.

Id., pp. 977-78 (citations omitted).

Admissions on the Record and by the Inventors

The claims read on broad genera of *S. tuberosum* diploid plants, but would all be active in the instant invention? What distinguishes a *S. tuberosum* diploid plant with a 200 gram tuber yield from one without such a high tuber yield? In the specification, Applicant states that

> It is often stated that repeated selfings in diploid potato will only result in weak plants due to inbreeding depression. This should be due to numerous deleterious alleles that reduce plant fitness, when these alleles are homozygously present. Therefore, we tested the segregation of 36 markers in the six F3 populations mentioned (see Figure 5).

Spec., p. 60. As discussed above, Applicant summarizes the result of the study as identifying some potentially, deleterious alleles, one of which is "very" deleterious, almost lethal. *Id.*

The declaration by Mr. Lindhout dated 15 August 2016 and supporting letters document how unique the potato lines used for the instant invention are. For example, one of the letters supporting Dr. Lindhout's declaration, by Dr. J.D.G. Jones states that

> "[I]n the mid 2000s we attempted to produce hybrid potato ourselves. . . . However, we never succeeded in developing any promising material in the form of fertile homozygotes that could be useful for hybrid breeding and that could tolerate recurrent selfing. . . . We considered that this was due to our inability to cross the Sli- self-compatibility locus into <u>good enough or diverse enough diploid *Solanum* germplasm</u>.

Letter from Dr. Jonathan D.G. Jones (2012), p. 1 (appended to Decl. of Dr. Lindhout 15 August 2016, ("Decl. (2016)")) (underlining added).

In his declaration, Dr. Lindhout summarizes the background art prior to the claimed invention. Decl. (2016), pp. 3-4. In particular, Dr. Lindhout states that

> That as soon as a genotype becomes homozygous for negative alleles of which the negative is not compensated by functional paralogues, such genotypes might show very poor performance and low viability;
> That inbreeding depression is manifested as a reduced fitness with a loss in both yield and fertility;
> That inbreeding depression is mainly due to the presence of many (semi) lethal alleles, and alleles with a deleterious effect, that become visible more frequently at the diploid level when the maximum number of possible alleles is reduced from four to two, resulting in homozygosity of such alleles.
> That the chance of obtaining a progeny plant, by crossing different genotypes, which is not suffering from inbreeding depression in potato is infinitesimally small, and that starting from a heterozygous diploid potato genotypes, the chance of identifying a plant without homozygous deleterious alleles is, in practice, impossible . . .

Decl. (2016), p. 4.

In a similar vein, in a paper filed with the EPO, Applicant also asserts that "every expert in the field can confirm that due to inbreeding depression, the chances of successfully attaining the plant of the invention are close to zero. Hence, the production of such plants is generally considered impossible." EPO Publication No. EP 2 493 286 A2, Remarks to EPO (21 Dec. 2012), p. 8.

Furthermore, on 15 December 2011, approximately two years after the filing date of the instant application, Lindhout et al. published a paper in the Potato Research journal which appears to correspond to the experiments set forth in the instant examples (all five inventors are listed as authors on the paper). Lindhout et al., Potato Res 54:301-12 (2011). The discussion in the paper is instructive. For example, Lindhout et al. describes that

> As a consequence of the high level of unfavourable alleles, techniques aimed at developing homozygotes in one step, although successful as a technology in various crops, certainly do not generate vigorous homozygous potatoes. For instance, if 20 of the 39,000 protein-encoding genes (PGSC 2011) on the potato genome harbor alleles causing severe fitness reduction, the chance to generate vigorous diploid selfed progenies without homozygous unfavourable loci from a parent genotype, that is heterozygous for these 20 loci, is only 0.3%.

Id., p. 303. Lindhout et al. concludes that "inbred lines were developed that combined self-compatibility with good agronomic performance. Although the number of such plants is still low, the progress made in this breeding programme is significant." Id., p. 304. As a possible reason for success, Id. offers "lethal alleles do not occur at high frequency in our diploid potato germplasm. Lindhout et al., pp. 308-09. The authors continue that

> there are many loci with minor effects involved in these traits (Quantitative Trait Locus, QTL). Our current research focuses on identifying the crucial QTLs for these traits. The results will be applied in breeding and allow to increase efficiencies by using diagnostic markers for these traits.

Id., p. 309.

Conclusion

Applicant's deposited lines are described and novel. However, in view of the above, especially including Applicant's assertion that "the production of such plants is generally considered impossible," there is nothing in the claims to distinguish Applicant's deposited lines from other *S. tuberosum* lines which fall outside the scope of the claimed tuber yield except for this tuber yield. Yet the claims read on a broad genus *S. tuberosum* lines, provided they have a yield of 200 g per plant and have the *Sli* gene. One of ordinary skill in the art is given no criteria in the claims to distinguish an "impossible" plant from and "possible" plant such as found in Applicant's deposited lines. Applicant fails to describe any distinguishing structure that is necessary and/or sufficient for the instant invention.

Therefore Applicant's invention appears to require both the *Sli* gene as represented by the deposits and other specific *S. tuberosum* diploid plants that are not described except potentially by reference to the deposit. Applicant fails to describe working examples of the broad genus of any other *S. tuberosum* lines, which, if combined with the *Sli* gene, that fall within the scope of the claims. Applicant only describes one *Sli* gene donor line together with only a few diploid donor lines by deposits. Thus, Applicant fails to describe a representative number of species in comparison to the size of the genus claimed. The claims also fail to require any structure / function relationship that may be necessary and/or sufficient for a potato line to successfully be included in the claimed genus.

The specification therefore fails to provide an adequate written description to support the breadth of the claims. Applicant has not demonstrated possession to one of skill in the art of the instant invention as broadly as claimed at the time of filing. Thus

one of skill in the art would not believe Applicant to be in possession of the genus as broadly as claimed especially in view of the discussion of the art by, e.g., Applicant before the EPO and the letter of Dr. Jones.

Dependent claims are included in this rejection because none provide further limitations obviating this rejection.

Applicant's Arguments

Applicant traverses the rejection on pages 11-12 of the response filed on 30 January 2019. Applicant argues that whole genome sequencing has shown that D1, D2 and D3 represent virtually all variation available in S. tuberosum, citing to the declaration of Dr. Lindhout. Response, pp. 11-12. In paragraph 16 of his declaration, Dr. Lindhout also asserts that "[r]ecent whole genotyping by sequencing (GBS) data showed that the genomic variation between diploid potato genotypes, including D1, D2 and D3 is extremely large and represents virtually all variation available in *S. tuberosum*." Lindhout Decl., para. 16.

Response to Applicant's Arguments

Given the broad scope of claim 1, claim 22 reads on any potato plant. Claim 22 does not even require the *Sli* gene.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

11. Claims 22-25 are rejected under 35 U.S.C. 102(b) as being anticipated by Colon et al. (1995) Theor Appl Genet 90:691-98.

Claim 22 reads on a potato seed produced by the method of claim 16. Claim 22 is evaluated for patentability as a product made by a process. See, e.g. MPEP § 2113.

Claim 22, however, fails to recite any particular characteristics. Even if claim 16 requires that the seed of claim 22 be diploid, diploid potato lines were known in the art. Although claim 23 requires that the plant be a hybrid, again, no identifying characteristics are recited as limitations.

Diploid potato plants were known in the art as shown by, for example, Colon et al.. The various parts of such plants, such as seed, tubers and pollen, are inherent to the plants. Therefore claims 22-25 are anticipated.

Applicant's Arguments & Response

Applicant's arguments submitted on 30 January 2019 focused on the special and unusual characteristics of the invented plants.

None of these characteristics are required by claims 22-25.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 8-9, 13 and 22-25 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Phumichai et al. (2006) Euphytica 148:227-34 in view of Phumichai et al. (2005) Genome 48:977-84 in view of Hosaka & Hanneman, Jr. (1998) Euphytica

99:191-97; Jong & Rowe (1971) Potato Res 14:74-83, 79, Table 4; in view of Lippman & Zamir (2006) Trends Genet 23(2):61-66 (2006); and in further view of Bradshaw et al. (2006) Potato Res 49:49-65.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

a. Determining the scope and contents of the prior art.

b. Ascertaining the differences between the prior art and the claims at issue.

c. Resolving the level of ordinary skill in the pertinent art.

d. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claim 8 is a method for producing a diploid, fertile and self-compatible potato plant where 50% of the genomic loci are homozygous using a first potato plant which has the Sli gene and a second plant from a diploid *S. tuberosum* potato line; obtaining a hybrid seed; growing the seeds into plants; then inbreeding self-compatible plants for 1-8 crosses and selecting during each generation for a plant producing a berry with at least 5 fertile seeds and 50% of the genomic loci are homozygous.

Phumichai et al. (2006) teaches inbred potato plants comprising the *Sli* gene from *S. chacoense* that are fertile. Phumichai et al. (2006), pp. 228-29. Phumichai et al. teaches that the aim of their research is heterosis in potatoes. *Id.*, p. 227.

The benefits of using heterosis from the cross of two inbred homozygous lines is well known in the art. See, e.g., Lippman & Zamir, p. 62 (Box 2).

This Phumichai et al. publication does not mention crossing to *S. tuberosum*. Bradshaw et al. however, teaches the value of obtaining genes from *S. chacoense* and crossing such genes into *S. tuberosum*. Bradshaw et al., p. 56. Furthermore, in an earlier publication, Phumichai et al. begins the article about developing highly homozygous diploid potato lines with a discussion of *S. tuberosum*.

Phumichai et al. does not specifically teach selecting for a fertile offspring plant producing a seed-carrying berry carrying at least 5 fertile seeds, but 5 berries per seed appears to be routine in the art. E.g., Hosaka & Hanneman, Jr., e.g., Table 1; and De Jong & Rowe p., 79, Table 4. Therefore this limitation appears to merely be a design choice. Therefore claim 8 is obvious.

Bradshaw et al. (p. 56) also teaches crossing in genes for, e.g. disease resistance, and thus claim 9 is obvious.

Phumichai et al. (205) (p. 977) teaches using diploid self-incompatible S. tuberosum plants and thus claim 13 is obvious.

Applicant's Arguments & Response

Applicant's arguments submitted on 30 January 2019 focused on the special and unusual characteristics of the invented plants. Response, pp. 12-15. Applicant's arguments focus on the successful production of plants by the instant inventors and on the deposited lines. *Id.* Applicant, on the other hand, does not present arguments as to why the above-rejected claims are not obvious.

In his declaration, Dr. Lindhout that it was not obvious to select diploid-cross progeny on the basis of fertility. Decl., Dr. Lindhout, para. 11. Dr. Lindhout's argument is not persuasive because, initially, it is difficult to understand how a breeding program

designed to take advantage of heterosis in potatoes would not involve selecting for fertility. Additionally, even if Dr. Lindhout's argument would be persuasive, it is not clear how the limitations and/or steps in claim 8 correlate with selecting for fertility as opposed to tuber yield.

Conclusion

13. Claims 1, 3-6, 11, 16, 18-21, 29-30, 32, 35, 37-39 and 42-43 are allowed. Claim 12 is not examined.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RUSSELL T BOGGS whose telephone number is (571)272-2805. The examiner can normally be reached on Monday - Friday, 0800 to 1830 Mtn.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shubo (Joe) Zhou can be reached on 571-272-0724. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for

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/RUSSELL T BOGGS/
Examiner, Art Unit 1663

Notice of References Cited	Application/Control No. 13/504,156	Applicant(s)/Patent Under Reexamination Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	Page 1 of 2

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*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
*	U	Phumichai et al. (2005) Genome 48:977-94
*	V	Phumichai et al. (2006) Euphytica 148:227-34
*	W	J Jansky, "Breeding, Genetics, and Cultivar Development," Advances in Potato Chemistry and Technology, ed. J. Singh & L. Kaur, pp. 27-62 (June 2009)
	X	Colon et al. (1995) Theor Appl Genet 90:691-98

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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*	U	Hosaka & Hanneman, Jr. (1998) Euphytica 99:191-97
	V	De Jong & Rowe (1971) Potato Res 14:74-83
*	W	Lippman & Zamir, Trends Genet 23(2):61-66
*	X	Bradshaw et al. (2006) Potato Res 49:49-65

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Page 1140**

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	Art Unit
	RUSSELL T BOGGS	1663

CPC - Searched*		
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CPC Combination Sets - Searched*		
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	RUSSELL T BOGGS	1663

Search Notes		
Search Notes	**Date**	**Examiner**
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STIC search	9/23/14	/RTB/
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discuss claims and rejections with A.M. Grunberg	5/8/15	/RTB/
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EAST search as per attached	1/6/17	/RTB/
discuss objection because amendment cannot be ORCed w/ A. Kubelik	08/23/2017	/RTB/
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13504156
Filing Date	2012-07-10
First Named Inventor	Willem Hendrik LINDHOUT
Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

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/R.T.B/	1	STOKSTAD, "The New Potato: Breeders seek a breakthrough to help farmers facing an uncertain future," Science, Vol. 363, Issue 6427, pp. 574-577, Feb. 8, 2019.	☐

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	Examiner Name	Russell T BOGGS
	Attorney Docket Number	091876-0014

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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Receipt date: 08/29/2018

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13504156
	Filing Date	2012-07-10
	First Named Inventor	Willem Hendrik Lindhout
	Art Unit	1663
	Examiner Name	Russell T. Boggs
	Attorney Docket Number	091876-0014

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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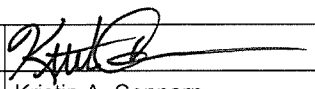
☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	2018-08-28
Name/Print	Kristin A. Connarn	Registration Number	57,025

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Receipt date: 02/01/2019

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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Art Unit	1663
Examiner Name	Russell T BOGGS
Attorney Docket Number	091876-0014

/R.T.B/	1	Birhman, R.K. and K. Hosaka, "Production of inbred progenies of diploid potatoes using an S-locus inhibitor (Sli) gene, and their characterization," Genome 43: 495-502 (2000).	☐
/R.T.B/	2	Jansky, S.H., et al., "M6: A Diploid Potato Inbred Line for Use in Breeding and Genetics Research," J. Plant Registrations (February 21, 2014).	☐
/R.T.B/	3	Hanneman, "Self Fertility in Solanum," Am Potato J 62: 428-429 (1985).	☐
/R.T.B/	4	Hosaka, K. and R.E. Hanneman, Jr., "Genetics of self-compatibility in a self-incompatable wild diploid potato species Solanum chacoense. 2. Localization of an S locus inhibitor (Sli) gene on the potato genome using DNA markers," Euphhytica 103:265-271 (1998).	☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/RUSSELL T BOGGS/	Date Considered	06/07/2019

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

Receipt date: 02/01/2019

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Signature	/Kristin A. Connarn/	Date (YYYY-MM-DD)	2019-02-01
Name/Print	Kristin A Connarn	Registration Number	57,025

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Receipt date: 04/23/2019

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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/R.T.B/	1	2011-053135	WO	A2	2011-05-05	Agventure B.V.		☐

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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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	1		☐

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EXAMINER SIGNATURE

Examiner Signature	/RUSSELL T BOGGS/	Date Considered	06/07/2019

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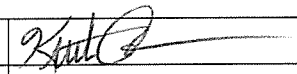
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1330	800/317.2.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2019/06/09 10:27
L2	95548	potato.ab. or tuberosum.ab.	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2019/06/09 10:27
L3	475	a01h5/04.cpc.	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2019/06/09 10:27
L4	96656	L1 or L2 or L3	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2019/06/09 10:27
L5	263	L4 and (inbred near line)	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2019/06/09 10:27
L6	25	L5 and heterosis	US-PGPUB; USPAT; EPO; JPO; DERWENT	ADJ	ON	2019/06/09 10:27

EAST Search History (Interference)

< This search history is empty>

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PTO/SB/96 (11-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Willem Hendrik Lindhout et al.

Application No./Patent No.: 13/504,156 Filed/Issue Date: July 10, 2012

Titled:
Hybrid Seed Potato Breeding

Agventure B.V., a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. ☒ the assignee of the entire right, title, and interest in;

2. ☐ an assignee of less than the entire right, title, and interest in
(The extent (by percentage) of its ownership interest is _____ %); or

3. ☐ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 028529, Frame 0059, or a copy* is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel_____, Frame_____, or a copy* is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel_____, Frame_____, or a copy* is attached.

3. From: _____ To: _____

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☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ *As required by 37 CFR 3.73(b)(1)(i), if a copy/copies is/are attached, the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Robert E. Hanson/ August 9, 2019
Signature Date

Robert E. Hanson 42,628
Printed or Typed Name Title or Registration Number

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/AIA/80 (07-12)
Approved for use through 03/31/2013. OMB 0651-0035
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[x] Practitioners associated with Customer Number: 125771

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used)

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[x] The address associated with Customer Number: 125771

OR

[ ] Firm or Individual Name

Address

City | State | Zip

Country

Telephone | Email

Assignee name and address: Agventure B.V.
Burg Assumweg 16
Deventer, Netherlands NL-7417 BM

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature [signature] Date 11-5-2014

Name [illegible] Telephone +31 (0)6 [illegible]

Title CEO

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	36837639
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
Filer:	Robert E. Hanson/LeRey Coker
Filer Authorized By:	Robert E. Hanson
Attorney Docket Number:	091876-0014
Receipt Date:	09-AUG-2019
Filing Date:	10-JUL-2012
Time Stamp:	17:47:02
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		VONL004US_373b.pdf	2283115 615736bb699d3b2041de560d8bc620be9b9ed3a7	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Assignee showing of ownership per 37 CFR 3.73	1	1
	Post Allowance Communication - Incoming	2	2
Warnings:			
Information:			
	Total Files Size (in bytes):	2283115	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/504,156	Filing Date 07/10/2012	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $30 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $125 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	08/30/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 34	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 7	Minus	*** 7	= 0		x $230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/GLORIA J TRAMMELL/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Willem Hendrik Lindhout *et al.*	Group Art Unit: 1663
Serial No.: 13/504,156	Examiner: Russell T. Boggs
Filed: July 10, 2012	Atty. Dkt. No.: VONL:004US
For: Hybrid Seed Potato Breeding	Confirmation No.: 6337

RESPONSE TO NON-FINAL OFFICE ACTION DATED JUNE 13, 2019

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

Commissioner:

This paper is submitted in response to the non-final Office Action dated June 13, 2019, for which the date for response is September 13, 2019. No fees are believed due in connection with the filing of the instant paper. However, should any such fees become due under 37 C.F.R. §§ 1.16 to 1.21 for any reason relating to the instant response, the Commissioner is authorized to deduct said fees from Dentons US LLP's Deposit Account No. 19-3140/VONL:004US.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 9 of this paper.

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1. (Previously Presented) A diploid, fertile and self-compatible *Solanum tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams; wherein at least 50% of genomic loci in said plant are homozygous;

wherein said self-compatibility originating from *Solanum chacoense* and is referred to as S-locus inhibitor (*Sli*) gene, a copy of said gene is 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 AGVDI, AGVD2, AGVD3, and AGVD17 respectively;

wherein at least 25% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds, and

wherein at least 25% of the homozygous genomic loci in a plant of said line are from one or more of NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765.

2. (Cancelled)

3. (Previously Presented) 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 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.

4. (Previously Presented) The potato line of claim 1, wherein said plant of said line, when

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Page 1166

mature, attains a fresh weight of the foliage and shoots of at least 500 grams.

5. (Previously Presented) A plant of the line according to claim 1.

6. (Previously Presented) A seed or tuber of the plant according to claim 5.

7-15. (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]] the plant of a first diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line according to

claim 1,

(b) providing a second potato plant, wherein said second potato plant is [[a]] the plant of a second diploid ~~or tetraploid~~, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line according to claim 1, 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 line[[s]] 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.

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 *Solanum tuberosum* potato line, 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. (Previously Presented) 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.

22-28. (Cancelled)

29. (Previously Presented) 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, 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. (Cancelled)

32. (Previously Presented) A set of 2 homozygous diploid, fertile, self-compatible and essentially homozygous potato lines according to claim 1, 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 loci in said plants are homozygous.

33-34. (Cancelled)

35. (Previously Presented) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, 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 Solanum tuberosum potato line, said potato line of said second potato plant having 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 at least one potato plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, for between 1 to 8 selfings or backcrosses, to thereby provide a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato breeding line, said potato breeding 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 loci in a plant provided in step (e) are homozygous.

36. (Cancelled)

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

38. (Previously Presented) A plant of the tetraploid potato line according to claim 37.

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

40-41. (Cancelled)

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

(a) providing a first potato 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,

(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 *Solanum tuberosum* potato line according to claim 1, 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.

43. (Previously Presented) A method for producing a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 grams, comprising:

(a) providing a first potato 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 NCIMI3, Aberdeen, Scotland,

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solarium tuberosum* potato line, 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 grains per plant;

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

(d) growing a multiplicity of 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 grains of fresh weight of at least 200 grams per plant, and

(e) selfing said hybrid offspring potato plants or backcrossing said hybrid offspring potato plants to at least one potato plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, for between 1 to 8 selfings or backcrosses, and selecting for plants that produce fertile offspring wherein at least 90% of the plants produce seed-carrying berries, each carrying 5-500 seeds, to thereby provide a diploid, fertile, self-compatible and essentially homozygous Solanum tuberosum potato breeding line, said potato line comprising a plant having a tuber yield expressed in grams of fresh weight of at least 200 gram and wherein at least 50% of loci in the plant are homozygous.

Agventure B.V. Ex. 2009
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Page 1172

REMARKS

A. Status of the Claims

Claims 1, 3-6, 8-9, 11-13, 16, 18-25, 29-30, 32, 35, 37-39 and 42-43 are pending in the application. Claims 8-9, 13 and 22-25 are rejected. Claim 12 is withdrawn. Claims 1, 3-6, 11, 16, 18-21, 29-30, 32, 35, 37-39 and 42-43 are allowed. Claims 8, 9, 11-13, and 22-25 are cancelled herein without prejudice or disclaimer. Claims 16, 19, 20, and 42 are amended herein. Support for the amendments can be found, at least, in the claims as originally filed. No new matter has been added.

B. Claims Objections

The Action objects to claims 1, 8, 12, 16, 19-20 and 42 are objected to due to informalities.

1) The Action states that claims 1 and 8 recite the limitation "S-locus inhibitor (*Sli*) gene" but that the definition of the "*Sli* gene" need not be repeated in claim 8. Applicants respectfully traverse, but note that claim 8 is cancelled herein without prejudice in the interest of advancing prosecution.

2) The Action objects to claim 12 as being in improper form. Applicants note that claim 12 is cancelled herein in the interest of advancing prosecution.

3) The Action objects to claim 16 over the limitation of "a plant" in line 2 and in line 5 in spite of referring to the plant of claim 1. The Action requests amendment of claim 16 to recite "the plant" instead. Applicants note that claim 16 is amended herein as requested in the Action in the interest of advancing prosecution.

4) It is also stated that the limitation "tetraploid" in claims 16, 20, and 42 should be removed. Applicants respectfully traverse, but note that claims 16, 20, and 42 are amended herein to remove the limitation "tetraploid" as requested in the Action in the interest of advancing prosecution.

5) The Action objects to claim 19 over recitation of the limitation "lines" as the second word in the second line and requests an amendment to recite "line". Applicants note that claim 19 is amended herein as requested in the Action in the interest of advancing prosecution.

The objections appear to be moot in view of the above and withdrawal thereof is respectfully requested.

C. Rejection Under 35 U.S.C. § 112, second paragraph

The Action rejects claims 8 and 13 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor regards as the invention. Applicants respectfully traverse, but note that claims 8 and 13 are cancelled herein without prejudice in the interest of advancing prosecution. The rejection is thus believed to be moot and withdrawal thereof is respectfully requested.

D. Rejection of Claims Under 35 U.S.C. § 112, First Paragraph - Written Description

The Action rejects claims 22-25 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse, but note that claims 22-25 are cancelled herein without prejudice in the interest of advancing prosecution. The rejection is thus believed to be moot and withdrawal thereof is respectfully requested.

E. Rejection of Claims Under 35 U.S.C. § 102

The Action rejects claims 22-25 under 35 U.S.C. § 102 over Colon *et al.* (*Theor Appl Genet*, 90:691-98, 1995). Applicants respectfully traverse, but note that claims 22-25 are cancelled herein without prejudice in the interest of advancing prosecution. The rejection is thus believed to be moot and withdrawal thereof is respectfully requested.

F. Rejection of Claims Under 35 U.S.C. § 103

The Action rejects claims 8-9, 13, and 22-25 under 35 U.S.C. § 103 over Phumichai *et al.* (*Euphytica*, 148:227-34, 2006), in view of Phumichai *et al.* (*Genome*, 48:977-84, 2005), in view of Hosaka & Hanneman, Jr. (*Euphytica,* 99:191-97, 1998); Jong & Rowe (*Potato Res,* 14:74-83, 79, Table 4, 1971); in view of Lippman & Zamir (*Trends Genet,* 23(2):61-66, 2006); and in further view of Bradshaw *et al.* (*Potato Res,* 49:49-65, 2006). Applicants respectfully traverse, but note that claims 8-9, 13, and 22-25 are cancelled herein without prejudice in the interest of advancing prosecution. The rejection is thus believed to be moot and withdrawal thereof is respectfully requested.

G. Conclusion

In light of the foregoing, Applicants submit that the case is in condition for allowance, and an early indication to that effect is earnestly solicited. The Examiner is invited to contact the undersigned at (214) 259-0933 with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

/Ashley Hamlett/

Ashley Hamlett
Reg. No. 62,569
Agent for Applicants

Dentons US LLP
2000 McKinney Avenue, Suite 1900
Dallas, Texas 75201
(214) 259-0933

Date: August 30, 2019

Electronic Acknowledgement Receipt

EFS ID:	37037138
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
Filer:	Ashley Greene Hamlett
Filer Authorized By:	
Attorney Docket Number:	091876-0014
Receipt Date:	30-AUG-2019
Filing Date:	10-JUL-2012
Time Stamp:	17:06:45
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		VONL004US_ROA.pdf	63473 f65a7620067a27f93c11926f49263bdf3803ce0e	yes	12

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	8
	Applicant Arguments/Remarks Made in an Amendment	9	12
Warnings:			
Information:			
	Total Files Size (in bytes):	63473	

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New Applications Under 35 U.S.C. 111

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Willem Hendrik Lindhout et al.	Group Art Unit: 1663
Serial No.: 13/504,156	Examiner: Russell T Boggs
Filed: July 10, 2012	Atty. Dkt. No.: VONL:004US
For: HYBRID SEED POTATO BREEDING	Confirmation No.: 6337

STATUS INQUIRY

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

Commissioner:

On August 9, 2019, Applicant submitted a Statement Under 3.73(b) with an executed Power of Attorney. Applicant has not yet received any correspondence to date in this regard. A copy of the Statement Under 3.73(b) with the executed Power of Attorney submitted August 9, 2019, is attached hereto.

Applicant respectfully requests an update on the status of the above-captioned application.

Respectfully submitted,

/Ashley Hamlett/

Ashley Hamlett
Reg. No. 62,569
Agent for Applicants

Dentons US LLP
2000 McKinney Avenue, Suite 1900
Dallas, Texas 75201
(214) 259-0933

Date: September 23, 2019

PTO/SB/96 (11-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Willem Hendrik Lindhout et al.

Application No./Patent No.: 13/504,156 Filed/Issue Date: July 10, 2012

Titled:
Hybrid Seed Potato Breeding

Agventure B.V., a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. ☒ the assignee of the entire right, title, and interest in;

2. ☐ an assignee of less than the entire right, title, and interest in
(The extent (by percentage) of its ownership interest is _____ %); or

3. ☐ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 028529, Frame 0059, or a copy* is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel_____, Frame_____, or a copy* is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel_____, Frame_____, or a copy* is attached.

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel_____, Frame_____, or a copy* is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ *As required by 37 CFR 3.73(b)(1)(i), if a copy/copies is/are attached, the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Robert E. Hanson/ August 9, 2019
Signature Date

Robert E. Hanson 42,628
Printed or Typed Name Title or Registration Number

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/80 (07-12)
Approved for use through 03/31/2012. OMB 0651-0035
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[x] Practitioners associated with Customer Number: 125771

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used)

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[x] The address associated with Customer Number: 125771

OR

[ ] Firm or Individual Name

Address

City | State | Zip

Country

Telephone | Email

Assignee name and address: Agventure B.V.
Burg Assumweg 16
Deventer, Netherlands NL-7417 BM

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature [signature] Date 11 Aug 2016

Name [illegible] Telephone +31 (0)6 [illegible]

Title CEO

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) the application or patent or document proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	37241824
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	23630
Filer:	Ashley Greene Hamlett/LeRey Coker
Filer Authorized By:	Ashley Greene Hamlett
Attorney Docket Number:	091876-0014
Receipt Date:	23-SEP-2019
Filing Date:	10-JUL-2012
Time Stamp:	14:39:51
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for status of Application	VONL004US_Status_Inquiry.pdf	2403688 f39f58f074fb2afc6688e5430711160c38a8b8d6	no	3

Warnings:

Agventure B.V. Ex. 2009
IPR2025-00136
Page 1182

Information:	
Total Files Size (in bytes):	2403688

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/504,156	07/10/2012	Willem Hendrik Lindhout	091876-0014

CONFIRMATION NO. 6337

POA ACCEPTANCE LETTER

125771
DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

OC000000111839130

Date Mailed: 10/15/2019

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 08/09/2019.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/rmjones/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/504,156	07/10/2012	Willem Hendrik Lindhout	091876-0014

CONFIRMATION NO. 6337

POWER OF ATTORNEY NOTICE

23630
McDermott Will & Emery
The McDermott Building
500 North Capitol Street, N.W.
Washington, DC 20001
UNITED STATES OF AMERICA

OC000000111839129

Date Mailed: 10/15/2019

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 08/09/2019.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/rmjones/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/504,156	07/10/2012	1663	1935	091876-0014	34	7

CONFIRMATION NO. 6337

CORRECTED FILING RECEIPT

125771
DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

OC000000111839131

Date Mailed: 10/15/2019

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Willem Hendrik Lindhout, Wageningen, NETHERLANDS;
Teunis Philippus Schotte, Hazerswoude-Dorp, NETHERLANDS;
Richard Gerardus Franciscus Visser, Bennekom, NETHERLANDS;
Herman Johannes van Eck, Wageningen, NETHERLANDS;
Ronaldus Cornelis Bernardus Hutten, Rhenen, NETHERLANDS;

Applicant(s)

Willem Hendrik Lindhout, Wageningen, NETHERLANDS;
Teunis Philippus Schotte, Hazerswoude-Dorp, NETHERLANDS;
Richard Gerardus Franciscus Visser, Bennekom, NETHERLANDS;
Herman Johannes van Eck, Wageningen, NETHERLANDS;
Ronaldus Cornelis Bernardus Hutten, Rhenen, NETHERLANDS;

Assignment For Published Patent Application

AGVENTURE B.V., Diepenveen, NL

Power of Attorney: The patent practitioners associated with Customer Number 125771

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/NL10/50716 10/26/2010
which claims benefit of 61/254,980 10/26/2009

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
EUROPEAN PATENT OFFICE (EPO) 09013474.3 10/26/2009

Permission to Access Application via Priority Document Exchange: No

Permission to Access Search Results: No

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 07/31/2012
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/504,156**
Projected Publication Date: Not Applicable
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

Hybrid Seed Potato Breeding

Preliminary Class

800

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications:

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor

community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

Agventure B.V. Ex. 2009
IPR2025-00136
Page 1189

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

125771 7590 10/24/2019

DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

EXAMINER
BOGGS, RUSSELL T

ART UNIT	PAPER NUMBER
1663	

DATE MAILED: 10/24/2019

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	VONL:004US	6337

TITLE OF INVENTION: Hybrid Seed Potato Breeding

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	01/24/2020

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

Aventure B.V. Ex. 2009
IPR2025-00136

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

125771 7590 10/24/2019
DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	VONL:004US	6337

TITLE OF INVENTION: Hybrid Seed Potato Breeding

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	01/24/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
BOGGS, RUSSELL T	1663	800-317200

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

Agventure B.V. Ex. 2009
IPR2025-00136

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	VONL:004US	6337

125771 7590 10/24/2019

DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

EXAMINER	
BOGGS, RUSSELL T	
ART UNIT	PAPER NUMBER
1663	

DATE MAILED: 10/24/2019

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

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Page 1192

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 13/504,156	Applicant(s) Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the amendments filed on 30 August 2019.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1,3-6,16,18-21,29-30,32,35,37-39 and 42-43 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☑ All b) ☐ Some *c) ☐ None of the:

   1. ☑ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☑ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☑ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/RUSSELL T BOGGS/
Examiner, Art Unit 1663

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first-to-invent provisions.

EXAMINER'S AMENDMENT

An Examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this amendment was given by voice-mail by Ashley Hamlett on 18 October 2019.

The application is amended as follows:

Claim 16. A method for producing a uniform hybrid potato seed, comprising:
(a) providing a first potato plant, which first potato plant is a [[the]] plant of [[a]] the first diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line according to claim 1,
(b) providing a second potato plant, wherein said second potato plant is a [[the]] plant of [[a]] the second diploid, fertile, self-compatible and essentially homozygous Solanum tuberosum potato line according to claim 1,
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 off spring seed.

Claim 18. The method ~~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.

Claim 29. 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, and wherein said first and second parent potato have at least 20 % contrasting homozygous loci as determined by molecular genetic marker analysis.

Claim 32. A set of 2 homozygous diploid, fertile, self-compatible and essentially homozygous potato lines according to claim 1, wherein each of said lines differ from each other ~~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 loci in said plants are homozygous~~.

Claim 35. A method for producing a diploid, fertile, self-compatible and essentially homozygous Solanum tuberosum potato line, 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 Solanum tuberosum potato line, said potato line of said second potato plant having 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 at least one potato plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession

number 41765, for between 1 to 8 selfings or backcrosses, to thereby provide a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato breeding line, said potato breeding 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 loci in the [[a]] plant provided by [[in]] step (e) are homozygous.

EXAMINER'S STATEMENT OF REASONS FOR ALLOWANCE

The following is an examiner's statement of reasons for allowance.

The allowed claims appear to be free of the prior art of record which does not teach 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 each of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RUSSELL T BOGGS whose telephone number is

(571)272-2805. The examiner can normally be reached on Monday - Friday, 0800 to 1830 Mtn.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shubo (Joe) Zhou, can be reached on 571-272-0724. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/RUSSELL T BOGGS/
Examiner, Art Unit 1663

Examiner-Initiated Interview Summary	Application No. 13/504,156	Applicant(s) Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	AIA (FITF) Status No

All participants (applicant, applicant's representative, PTO personnel):

(1) RUSSELL T. BOGGS. (3) _____.

(2) ASHLEY HAMLETT. (4) _____.

Date of Interview: 18 October 2019.

Type: ☑ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☐ No.
If Yes, brief description: _____.

Issues Discussed ☐ 101 ☐ 112 ☐ 102 ☐ 103 ☑ Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 16,18,29,32 and 35.

Identification of prior art discussed: _____.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Ashley Hamlett gave permission for the accompanying examiner's amendment.

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/RUSSELL T BOGGS/ Examiner, Art Unit 1663	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	Art Unit
	RUSSELL T BOGGS	1663

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

	/RUSSELL BOGGS/ Examiner.Art Unit 1638

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	Art Unit
	RUSSELL T BOGGS	1663

Search Notes		
Search Notes	**Date**	**Examiner**
STIC search of STN	8/12/14	/RTB/
STN, EAST and Google search as per attached	9/28/14	/RTB/
STIC search	9/23/14	/RTB/
EAST search as per attached	5/11/15	/RTB/
discuss claims and rejections with A.M. Grunberg	5/8/15	/RTB/
EAST search as per attached	1/31/16	/RTB/
extensive literature search by cross-referencing, Google Scholar & PubMed	1/19 to 2/2/16	/RTB/
EAST search as per attached	1/6/17	/RTB/
discuss objection because amendment cannot be ORCed w/ A. Kubelik	08/23/2017	/RTB/
Google Scholar search up to	08/25/2017	/RTB/
EAST & STN search as per attached	08/25/2017	/RTB/
discuss rejections w. C. Worley	09/02/2017	/RTB/
EAST search as per attached	04/13/2018	/RTB/
discuss 103 rejection with A. Abraham & C. Worley	May,2018	/RTB/
EAST search as per attached	06/09/2019	/RTB/
Google / PubMed search for prior art	06/07/2019	/RTB/
inventor search in PALM	10/18/2019	/RTB/

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
A01H	5/04 (as per attached notes)	10/18/2019	/RTB/

	/RUSSELL BOGGS/ Examiner.Art Unit 1638

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	**Art Unit**
	RUSSELL T BOGGS	1663

CPC						
Symbol					**Type**	**Version**
A01H	/	5	/	04	F	2013-01-01
A01H	/	6	/	827	I	2018-05-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/RUSSELL T BOGGS/ Examiner, Art Unit 1663	19 October 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	none

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	**Art Unit**
	RUSSELL T BOGGS	1663

INTERNATIONAL CLASSIFICATION					
CLAIMED					
A01H5/04	/	5	/	04	
A01H6/82	/	6	/	82	

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/RUSSELL T BOGGS/ Examiner, Art Unit 1663	19 October 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	none

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13/504,156	Lindhout et al.
	Examiner	**Art Unit**
	RUSSELL T BOGGS	1663

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1		10	8	19		28	15	37						
	2		11	9	20	11	29	16	38						
2	3		12	10	21	12	30	17	39						
3	4		13		22		31		40						
4	5		14		23	13	32		41						
5	6		15		24		33	18	42						
	7	6	16		25		34	19	43						
	8		17		26	14	35								
	9	7	18		27		36								

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	19	
/RUSSELL T BOGGS/ Examiner, Art Unit 1663	19 October 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	none

Bibliographic Data

Application No: 13/504,156

Foreign Priority claimed: (•) Yes ( ) No

35 USC 119 (a-d) conditions met: [✓] Yes [ ] No [ ] Met After Allowance

Verified and Acknowledged: /RUSSELL T BOGGS/ Examiner's Signature [ ] Initials

Title: Hybrid Seed Potato Breeding

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/10/2012	800	1663	091876-0014
RULE			

APPLICANTS

INVENTORS

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CONTINUING DATA

This application is a 371 of PCT/NL10/50716 10/26/2010

PCT/NL10/50716 has PRO of 61254980 10/26/2009

FOREIGN APPLICATIONS

EPO 09013474.3 10/26/2009 /R.T.B/

IF REQUIRED, FOREIGN LICENSE GRANTED**

07/31/2012

**** SMALL ENTITY ****

STATE OR COUNTRY

NETHERLANDS

ADDRESS

DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606
UNITED STATES

FILING FEE RECEIVED

$1,480

EAST Search History

EAST Search History (Prior Art)

< This search history is empty>

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	358	a01h5/04.cpc.	US-PGPUB; USPAT	ADJ	ON	2019/10/18 09:38
L3	90	L2 and (potato.ab. or tuberosum.ab.)	US-PGPUB; USPAT	ADJ	ON	2019/10/18 09:38
L4	2	L3 and heterosis	US-PGPUB; USPAT	ADJ	ON	2019/10/18 09:39
L5	48	L3 and diploid	US-PGPUB; USPAT	ADJ	ON	2019/10/18 09:39
L6	46	L5 not L4	US-PGPUB; USPAT	ADJ	ON	2019/10/18 09:40

10/ 18/ 2019 9:43:48 AM
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY.DOCKET NO./TITLE	REQUEST ID
13/504,156	07/10/2012	Willem Hendrik Lindhout	VONL:004US	99118

Acknowledgement of Loss of Entitlement to Entity Status Discount

The entity status change request below filed through Private PAIR on 11/05/2019 has been accepted.

CERTIFICATIONS:

Change of Entity Status:

X Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be notification of loss of entitlement to small or micro entity status, as applicable.

This portion must be completed by the signatory or signatories making the entity status change in accordance with 37 CFR 1.4(d)(4).

Signature:	/Ashley Greene Hamlett/
Name:	Ashley Greene Hamlett
Registration Number:	62569

Document Description: Issue Fee Payment (PTO-85B)

Issue Fee Transmittal Form

Application Number	Filing Date	First Named Inventor	Atty. Docket No.	Confirmation No.
13504156	10-Jul-2012	Willem Lindhout	VONL:004US	6337

TITLE OF INVENTION :

Hybrid Seed Potato Breeding

Entity Status	Application Type	Art Unit	Class - Subclass	EXAMINER
Regular Undiscounted	U.S. National Stage under 35 USC 371	1663	317200	RUSSELL BOGGS

Issue Fee Due	Publication Due	Total Fee(s) Due	Date Due	Prev. Paid Fee
$1000	$0	$1000	24-Jan-2020	$0

1.Change of Correspondence Address and/or Indication Of Fee Address (37 CFR 1.33 & 1.363)

Current Correspondence Address:	Current Indicated Fee Address :
125771 DENTONS US LLP P.O. Box 061080 Chicago IL 60606 UNITED STATES 312-876-7925 patents.us@dentons.com	
☐ Change of correspondence address requested, system generated AIA/122-EFS form attached	☐ Fee Address indication requested, system generated SB/47-EFS form attached

2.Entity Status

Change in Entity Status

○ Applicant certifying micro entity status; system generated Micro Entity certification form attached. See 37 CFR 1.29.
Note: Absent a valid certification of micro entity status, issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment. If this box is checked, you will be prompted to choose a micro entity status on the gross income basis (37 CFR 1.29(a)) or the institution of higher education basis (37 CFR 1.29(d)), and make the applicable certification online.

○ Applicant asserting small entity status. See 37 CFR 1.27.
Note: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

◉ Applicant changing to regular undiscounted fee status.
Note: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

Document Description: Issue Fee Payment (PTO-85B)

3.The Following Fee(s) Are Submitted:

☒ Issue Fee	☐ I authorize USPTO to apply my previously paid issue fee to the current fees due
☐ Publication Fee	☐ The Director is hereby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number _____
☐ Advance Order - # of copies _____	☒ If **in addition to** the payment of the issue fee amount submitted with this form, there are any discrepancies in any amount(s) due, the Director is authorized to charge any deficiency or credit any overpayment, to Deposit Account Number 19-3140. The **issue fee must be submitted** with this form. **If payment of the issue fee does not accompany this form, checking this box and providing a deposit account number will NOT be effective to satisfy full payment of the fee(s) due.**

4.Firm and/or Attorney Names To Be Printed

NOTE: If no name is listed, no name will be printed
For printing on the patent front page, list to be displayed as entered

1. DENTONS US LLP
2.
3.

5.Assignee Name(s) and Residence Data To Be Printed

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

Name	City	State	Country	Category
AGVENTURE B.V.	Diepenveen		netherlands	corporation

6.Signature

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application. I also certify that this Fee(s) Transmittal form is being transmitted to the USPTO via EFS-WEB on the date indicated below.

Signature	/Ashley Greene Hamlett/	**Date**	11-05-2019
Name	Ashley Greene Hamlett	**Registration Number**	62569

Electronic Patent Application Fee Transmittal

Application Number:	13504156
Filing Date:	10-Jul-2012
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Filer:	Ashley Greene Hamlett/LeRey Coker
Attorney Docket Number:	VONL:004US

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1000**

Electronic Acknowledgement Receipt

EFS ID:	37660293
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	125771
Filer:	Ashley Greene Hamlett/LeRey Coker
Filer Authorized By:	Ashley Greene Hamlett
Attorney Docket Number:	VONL:004US
Receipt Date:	05-NOV-2019
Filing Date:	10-JUL-2012
Time Stamp:	15:26:10
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1000
RAM confirmation Number	E2019A5F26082363
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	Web85b.pdf	45859 8d2e0b02197ac4f9f1f4acf70d0f8f51f891a17e	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	31956 d763315d85d7710d998ab5fcde4ceb48e7a9ceaf	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	77815		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	VONL:004US	6337

125771 7590 11/12/2019

DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

EXAMINER
BOGGS, RUSSELL T

ART UNIT	PAPER NUMBER
1663	

NOTIFICATION DATE	DELIVERY MODE
11/12/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents.us@dentons.com

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United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 13504156
Applicant : Lindhout
Filing Date : 07/10/2012
Date Mailed : 11/12/2019

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Kam Sin/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 13504156

NON-COMPLIANT ILLUSTRATIONS IN SPECIFICATION OR CLAIMS

☐ **The illustration(s) in the location(s) referenced below do not come within the exceptions of 37 CFR 1.58(a). Please delete the illustration(s) from the specification or claims, provided the illustration(s) as part of the formal drawing(s) in accordance with 37 CFR 1.84, and amend the specification to provide a brief description of the drawings in accordance with 37 CFR 1.74. Please see the following item(s):**

- ☐ Specification document coded dated , page(s) .
- ☐ Claims document coded dated , claim(s) .
- ☐ Amendment document coded dated .
- ☐ Other: .

☒ **The chemical formula(s), mathematical formula(s), or table(s) in the location(s) referenced below contain shading (color/grayscale) and therefore do not comply with 37 CFR 1.52 and do not come within the exceptions of 37 CFR 1.58(a). Please delete chemical formula(s), mathematical formula(s), or table(s) with shading from the specification or claims, provide them as formal color drawing(s) in accordance with 37 CFR 1.84, including petition, fee, and amendment in accordance with 37 CFR 1.84(a)(2), and amend the specification to provide a brief description of the drawings in accordance with 37 CFR 1.74. Please see the following item(s):**

- ☒ Specification document coded SPEC dated 04/26/2012, page(s) 63.
- ☐ Claims document coded dated , claim(s) .
- ☐ Amendment document coded dated .
- ☐ Other: .

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	VONL:004US	6337

125771 7590 11/14/2019

DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

EXAMINER	
BOGGS, RUSSELL T	

ART UNIT	PAPER NUMBER
1663	

NOTIFICATION DATE	DELIVERY MODE
11/14/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents.us@dentons.com

Examiner-Initiated Interview Summary	Application No. 13/504,156	Applicant(s) Lindhout et al.	
	Examiner RUSSELL T BOGGS	Art Unit 1663	AIA (FITF) Status No

All participants (applicant, applicant's representative, PTO personnel):

(1) RUSSELL T. BOGGS. (3) _____.

(2) ASHLEY HAMLETT. (4) _____.

Date of Interview: 07 November 2019.

Type: ☑ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☐ No.
If Yes, brief description: _____.

Issues Discussed ☐ 101 ☐ 112 ☐ 102 ☐ 103 ☑ Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: _____.

Identification of prior art discussed: _____.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Applicant gave permission for attached examiner's amendment to the specification to correct an inconsistency in the amendment to the specification filed on 8 September 2016.

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/RUSSELL T BOGGS/ Examiner, Art Unit 1663	

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first-to-invent provisions.

EXAMINER'S AMENDMENT

An Examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this amendment was given over the telephone by Ashley Hamlett on 7 November 2019.

The amendment to the specification made on 8 September 2016 on page 52, lines 19-23 is amended 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 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).

Thus a marked up version of the specification as filed on page 52, lines 19-23 is as follows:

All markers showed a high frequency of occurrence in the diploid potato germplasm used in this experiment ~~(Appendix III)~~. The heterozygote frequency in the germplasm by using ~~suing~~ 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).

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Examiner's Amendment."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RUSSELL T BOGGS whose telephone number is (571)272-2805. The examiner can normally be reached on Monday - Friday, 0800 to 1830 Mtn.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shubo (Joe) Zhou, can be reached on 571-272-0724. The fax phone

number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/RUSSELL T BOGGS/
Examiner, Art Unit 1663

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Willem Hendrik Lindhout *et al.*	Group Art Unit: 1663
Serial No.: 13/504,156	Examiner: Russell T Boggs
Filed: July 10, 2012	Atty. Dkt. No.: VONL:004US
For: Hybrid Seed Potato Breeding	Confirmation No.: 6337

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS AND AMENDMENT UNDER 37 C.F.R. §1.312

MS Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Commissioner:

Applicant respectfully submits this Amendment under 37 C.F.R. § 1.312 in the above-referenced application, in response to Notice to File Corrected Application Papers dated November 12, 2019. A copy of the Notice is attached herewith for the convenience of the Patent Office.

Amendment to the Specification begins on page 2;

Remarks begin on page 4.

Agventure B.V. Ex. 2009
IPR2025-00136
Page 1223

AMENDMENT TO THE SPECIFICATION

Please amend the specification by deleting Table 9, starting on page 63 of the specification, and inserting Table 9 as follows:

Table 9. Allele frequencies of genome wide SNP markers in diploid germplasm and F3 populations.

SNP marker	chrom	allele frequencies											
code	no	diploid germplasm				F3 from H X D1				F3 from H x D2			
		HH**	HD	DD	HD	HH	HD	DD	HD	HH	HD	DD	HD
		#*	#	#	%***	#	#	#	%	#	#	#	%
PotSNP834	1	4	9	5	50	47	79	17	55	122	0	0	0
PotSNP392	1	5	11	3	58	9	32	14	58	122	0	0	0
PotSNP165	*1*	*13*	*5*	*0*	*28*	*142*	*0*	*0*	*0*	n.i.			
PotSNP038	2	2	12	5	63	15	48	80	34	122	0	0	0
PotSNP947	2	8	9	1	50	118	13	12	9	122	0	0	0
PotSNP985	3	3	8	6	47	62	17	63	12	18	46	58	38
PotSNP796	3	2	12	5	63	142	0	0	0	122	0	0	0
PotSNP960	4	6	10	3	53	59	61	20	44	n.i.			
PotSNP569	4	13	2	4	11	n.i.				121	0	0	0
PotSNP928	4	5	13	1	68	141	0	0	0	88	19	15	16
PotSNP184	5	2	7	10	37	61	59	23	41	122	0	0	0
PotSNP1105	5	2	12	5	63	140	0	0	0	19	40	62	33
PotSNP205	*6*	*13*	*6*	*0*	*32*	n.i.				*91*	*27*	*3*	*22*
PotSNP753	*6*	*9*	*10*	*0*	*53*	*28*	*20*	*91*	*14*	n.i.			
PotSNP626	6	9	8	2	42	n.i.				122	0	0	0
PotSNP081	6	12	6	1	32	142	0	0	0	n.i.			
PotSNP124	7	8	9	2	47	85	0	55	0	n.i.			
PotSNP229	7	7	11	1	58	56	0	0	0	15	37	69	31
PotSNP138	*7*	*9*	*10*	*0*	*53*	*55*	*0*	*0*	*0*	*121*	*0*	*0*	*0*
PotSNP1026	8	10	6	3	32	n.i.				80	0	42	0
PotSNP700	*8*	*9*	*9*	*0*	*50*	*140*	*0*	*0*	*0*	*34*	*0*	*0*	*0*
PotSNP116	8	7	9	3	47	140	0	0	0	n.i.			
PotSNP102	9	3	12	2	71	141	0	0	0	122	0	0	0
PotSNP458	9	11	7	1	37	n.i.				122	0	0	0
PotSNP162	9	14	4	1	21	11	31	98	22	n.i.			
PotSNP021	10	0	10	9	53	33	55	53	39	35	0	0	0
PotSNP152	10	0	8	11	42	141	0	0	0	82	23	17	19
PotSNP120	10	9	9	1	47	n.i.				48	23	51	19
PotSNP100	*11*	*14*	*5*	*0*	*26*	*53*	*89*	*1*	*62*	n.i.			
PotSNP607	*11*	*14*	*5*	*0*	*26*	n.i.				*122*	*0*	*0*	*0*

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PotSNP580	11	2	5	12	26	142	0	0	0	43	53	24	44
PotSNP099	12	1	10	8	53	56	0	0	0	120	0	0	0
PotSNP996	12	7	8	4	42	142	0	0	0	n.i.			
PotSNP182	12	6	10	3	53	n.i.				56	43	21	36
PotSNP213	12	9	8	1	44	22	38	80	27	n.i.			
PotSNP052	12	4	8	7	42	142	0	0	0	89	18	14	15

#: number of plants; HH: homozygous *Sli*-donor locus; DD: homozygous donor locus; HD: heterozygous locus; % is percentage heterozygous plants, low numbers indicate high level of homozygosity in F3.

Agventure B.V. Ex. 2009
IPR2025-00136
Page 1225

REMARKS

The specification has been amended herein to replace Table 9. Specifically, Table 9 is replaced to remove the shading (color/grayscale) pursuant to 37 C.F.R. § 1.52. No new matter is added by the amendment.

CONCLUSION

No fees are believed to be due in connection with the filing of this document. However, should any fee under 37 C.F.R. §§ 1.16 to 1.21 be deemed necessary for any reason related to this document, the Commissioner is hereby authorized to deduct the appropriate fee from Dentons US LLP Account No. 19-3140/VONL:004US.

The Office is invited to contact the undersigned at (214) 259-0933 with any questions relating to the referenced patent application.

Respectfully submitted,

/Ashley Hamlett/

Ashley Hamlett
Reg. No. 62,569
Agent for Applicants

Dentons US LLP
2000 McKinney Avenue, Suite 1900
Dallas, Texas 75201
(214) 259-0933

Date: November 15, 2019

Agventure B.V. Ex. 2009
IPR2025-00136
Page 1226

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	VONL:004US	6337

125771 7590 11/12/2019

DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

EXAMINER
BOGGS, RUSSELL T

ART UNIT	PAPER NUMBER
1663	

NOTIFICATION DATE	DELIVERY MODE
11/12/2019	ELECTRONIC

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Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 13504156
Applicant : Lindhout
Filing Date : 07/10/2012
Date Mailed : 11/12/2019

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

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See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Kam Sin/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 13504156

NON-COMPLIANT ILLUSTRATIONS IN SPECIFICATION OR CLAIMS

☐ **The illustration(s) in the location(s) referenced below do not come within the exceptions of 37 CFR 1.58(a). Please delete the illustration(s) from the specification or claims, provided the illustration(s) as part of the formal drawing(s) in accordance with 37 CFR 1.84, and amend the specification to provide a brief description of the drawings in accordance with 37 CFR 1.74. Please see the following item(s):**

- ☐ Specification document coded dated , page(s) .
- ☐ Claims document coded dated , claim(s) .
- ☐ Amendment document coded dated .
- ☐ Other: .

☒ **The chemical formula(s), mathematical formula(s), or table(s) in the location(s) referenced below contain shading (color/grayscale) and therefore do not comply with 37 CFR 1.52 and do not come within the exceptions of 37 CFR 1.58(a). Please delete chemical formula(s), mathematical formula(s), or table(s) with shading from the specification or claims, provide them as formal color drawing(s) in accordance with 37 CFR 1.84, including petition, fee, and amendment in accordance with 37 CFR 1.84(a)(2), and amend the specification to provide a brief description of the drawings in accordance with 37 CFR 1.74. Please see the following item(s):**

- ☒ Specification document coded SPEC dated 04/26/2012, page(s) 63.
- ☐ Claims document coded dated , claim(s) .
- ☐ Amendment document coded dated .
- ☐ Other: .

Electronic Acknowledgement Receipt

EFS ID:	37762618
Application Number:	13504156
International Application Number:	
Confirmation Number:	6337
Title of Invention:	Hybrid Seed Potato Breeding
First Named Inventor/Applicant Name:	Willem Hendrik Lindhout
Customer Number:	125771
Filer:	Ashley Greene Hamlett/LeRey Coker
Filer Authorized By:	Ashley Greene Hamlett
Attorney Docket Number:	VONL:004US
Receipt Date:	15-NOV-2019
Filing Date:	10-JUL-2012
Time Stamp:	12:01:13
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		VONL004US_Response_to_Notice_and_Rule_312_Amendment.pdf	255456 0bd2f84d20a01ce0667f6eeb59a4c6bc795638ef	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment after Notice of Allowance (Rule 312)	1	1
	Specification	2	3
	Applicant Arguments/Remarks Made in an Amendment	4	7
Warnings:			
Information:			
	Total Files Size (in bytes):	255456	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	07/10/2012	Willem Hendrik Lindhout	VONL:004US	6337

125771 7590 11/26/2019

DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

EXAMINER	
BOGGS, RUSSELL T	

ART UNIT	PAPER NUMBER
1663	

NOTIFICATION DATE	DELIVERY MODE
11/26/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents.us@dentons.com

Response to Rule 312 Communication	Application No. 13/504,156	Applicant(s)
	Examiner	Art Unit

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

1. ☒ The amendment filed on *15 November 2019* under 37 CFR 1.312 has been considered, and has been:

a) ☒ entered.

b) ☐ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.

Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/504,156	01/07/2020	10524436	VONL:004US	6337

125771 7590 12/18/2019

DENTONS US LLP
P.O. Box 061080
Chicago, IL 60606

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 418 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

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