

Declaration of Shelley Jansky in Support of
Petition for *Inter Partes* Review of
U.S. Patent No. 11,140,841 B2

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AARDEVO NORTH AMERICA, LLC,
Petitioner

v.

AGVENTURE B.V.,
Patent Owner

U.S. Patent No. 11,140,841 B2
Issue Date: October 12, 2021

Title: HYBRID SEED POTATO BREEDING

DECLARATION OF SHELLEY JANSKY, PH.D.

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I, Shelley Jansky, declare as follows:

I. INTRODUCTION AND QUALIFICATIONS

1. I am over the age of eighteen and otherwise competent to make this declaration.

2. I have been retained by counsel for Petitioner to provide my expert opinion in connection with the above-captioned proceeding (“IPR”) as set forth herein.

3. I am being compensated for my time in connection with this IPR at my consulting rate of \$500 per hour. My compensation is not dependent on the outcome of, or the content of my testimony in, the present IPR.

4. This declaration sets forth my opinion that Claims 1-10 of U.S. Patent No. 11,140,841 B2 (the “’841 patent”) are anticipated by the prior art and would have been obvious to a person of ordinary skill in the art before October 26, 2009. The claims of the ’841 patent recite nothing more than methods for inbreeding and hybrid seed generation that were already well-known in the prior art, using potato plant germplasm that was also known in the art.

A. Qualifications and Experience

5. My Curriculum Vitae, which contains information pertaining to my education, experience, and qualifications in plant breeding and genetics, including

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potato breeding and genomics, as well as a list of my publications, and publications on relevant subject matter, is attached as **Exhibit A**.

6. I reside in Amherst Junction, Wisconsin.

7. I earned my M.S. (1984) and Ph.D. (1986) degrees in Plant Breeding and Plant Genetics at the University of Wisconsin-Madison, under the direction of Dr. Stanley J. Peloquin. Dr. Peloquin's program focused on analytic breeding, which is described later in this declaration. My research activities centered on the development and characterization of diploid hybrids between cultivated potato and its wild relatives.

8. My first professional appointment (1986-1990) was a tenure-track faculty position at North Dakota State University, where I developed diploid germplasm in support of the potato cultivar breeding program. I then moved to another tenure-track faculty position (1990-2004), this time at the University of Wisconsin-Stevens Point. While there I taught courses, served one term as department chair, and continued my diploid potato breeding research. I moved to Madison, Wisconsin in 2004 when I was hired to replace Dr. Robert Hanneman, Jr., who had established an internationally recognized potato germplasm enhancement program. I inherited his germplasm, which included self-compatible homozygous diploids important for hybrid potato breeding. I served as a Research Geneticist for

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the USDA-ARS and tenure-track/tenured faculty member in the University of Wisconsin-Madison Department of Horticulture from 2004 until I retired in 2020.

9. From 1985 through 2009, I published 46 peer-reviewed research articles, focused mainly on potato germplasm enhancement using analytical breeding. Specifically, during this time, I developed diploid cultivated potato germplasm, evaluated wild relatives for traits of interest to the potato industry, created diploid hybrids between cultivated and wild potato, and provided superior hybrids to potato breeders.

B. Materials Considered

10. The analysis that I provide in this declaration is based on my education, research, and experience, as well as the documents I have considered. In forming my opinions, I have read and considered U.S. Patent No. 11,140,841 B2 (“’841 patent”) (**EX1001**) and its prosecution history (**EX1010**). I have also cited or considered the following documents in my analysis below:

Exhibit No.	Description of Document
1001	U.S. Patent No. 11,140,841 B2 issued to Willem Hendrik Lindhout et al. (filed Aug. 14, 2019, issued Oct. 12, 2021) (“’841 patent”)
1003	Declaration of David Douches, Ph.D. (“Douches Decl.”)
1004	H. de Jong and P.R. Rowe, <i>Inbreeding in cultivated diploid potatoes</i> , Potato Res., 14(1):74-83 (1971) (“Jong”)

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Exhibit No.	Description of Document
1005	Chalermpol Phumichai et al., <i>Toward the development of highly homozygous diploid potato lines using the self-compatibility controlling Sli gene</i> , Genome, 48(6):977-984 (2005) (“Phumichai”)
1006	David M. Spooner et al., <i>Extensive simple sequence repeat genotyping of potato landraces supports a major reevaluation of their gene pool structure and classification</i> , PNAS, 104(49):19398-19403 (2007) (“Spooner”)
1007	Sherret S. Chase, <i>Analytical Breeding in Solanum Tuberosum L. – A Scheme Utilizing Parthenotes and Other Diploid Stocks</i> , Can. J. Genet. Cytol., 5(4):359-363 (1963) (“Chase”)
1008	Nathan M. Springer and Robert M. Stupar, <i>Allelic variation and heterosis in maize: How do two halves make more than a whole?</i> , Genome Res., 17:264-275 (2007) (“Springer”)
1009	John B. Bamberg et al., <i>Elite Selections of Tuber-bearing Solanum Species Germplasm</i> , Inter-Regional Potato Introduction Station, NRSP-6 (1994) (“Bamberg”)
1010	Certified Prosecution History for U.S. Patent No. 11,140,841 B2 (“’841 patent file history”)
1011	Shelley Jansky, <i>Chapter 2: Breeding, Genetics, and Cultivar Development</i> ,” Advances in Potato Chemistry and Technology, pp. 27-62 (“Jansky 2009”)
1012	Zósimo Huamán and David M. Spooner, <i>Reclassification of Landrace Populations of Cultivated Potatoes (Solanum sect. Petota)</i> , Am. J. of Botany, 89(6):947-965 (2002) (“Huaman”)
1013	Hans Ross, <i>Potato Breeding - Problems and Perspectives</i> ,” Advances in Plant Breeding (Supplement 13 to Journal of Plant Breeding), (1986) (“Ross”)
1014	Kingsley R. Stern et al., <i>Chapter 13: Genetics, Chapter 14: Plant Breeding and Propagation, and Chapter 23: Seed Plants:</i>

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Exhibit No.	Description of Document
	<i>Angiosperms</i> , Introductory Plant Biology, pp. 224-265, 428-447 (11th ed. 2008) (“Stern”)
1015	F. L. Lauer et al., <i>Potato Improvement Through Parental Line Breeding - A Five Year Report of the North Central 35 Regional Project, NC-35</i> , Am. Potato J., 39:282-287 (1962) (“Lauer”)
1016	Rodomiro Ortiz, <i>Analytical Breeding</i> , Acta Hortic. 622:235-247 (2003) (“Ortiz”)
1017	T.R. Tarn et al., <i>Chapter 8: Breeding Potatoes for Long-day, Temperate Climates</i> , Plant Breeding Reviews, 9:217-332 (1992) (“Tarn”)
1018	U.S. Department of Agriculture (USDA), <i>Potatoes 2008 Summary</i> , Agricultural Statistics Board, NASS Report, Pot 6 (2009) (“USDA 2009”)
1019	H. De Jong and G. C. C. Tai, <i>Analysis of tetraploid-diploid hybrids in cultivated potatoes</i> , Potato Res., 20:111-121 (1977) (“Jong and Tai 1977”)
1020	H. De Jong and G. C. C. Tai, <i>Evaluation of Potato Hybrids Obtained from Tetraploid-Diploid Crosses, I. Parent-Offspring Relationships</i> , Plant Breeding, 107:177-182 (1991) (“Jong and Tai 1991”)
1021	J.A. Buso et al., <i>Tuber yield and quality of 4x-2x (FDR) potato progenies derived from the wild diploid species Solanum berthaultii and Solanum tarijense</i> , Plant Breeding, 122:229-232 (2003) (“Buso”)
1022	M.J. DeMaine, <i>The effects of inbreeding on the parental values of potato dihaploids</i> , Ann. Appl. Biol., 127:151-156 (1995) (“DeMaine”)
1023	A.R. Hallauer et al., <i>Chapter 8: Corn Breeding</i> , Corn and Corn Improvement, Agronomy Monograph, No. 18:463-564 (3rd ed. 1988) (“Hallauer”)

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Exhibit No.	Description of Document
1024	Chalermopol Phumichai et al., <i>Expression of S-locus inhibitor gene (Sli) in various diploid potatoes</i> , Euphytica, 148:227-234 (2006) (“Phumichai 2006”)
1025	R. Eijlander et al., <i>Selection of vigorous and fertile S-homo- and heterozygous tester clones from self-incompatible diploid potato, Solanum tuberosum L.</i> , Euphytica, 97:97-111 (1997) (“Eijlander”)
1026	D.S. Falconer, <i>Chapter 14: Inbreeding and Crossbreeding I. Changes of Mean Value, Chapter 15: Inbreeding and Crossbreeding II. Changes of Variance, and Chapter 16: Inbreeding and Crossbreeding III. The Utilisation of Heterosis</i> , Introduction to Quantitative Genetics, pp. 247-291 (1960; 1967) (“Falconer”)
1027	T.J. Riggs, <i>Breeding F₁ hybrid varieties of vegetables</i> , Journal of Horticultural Science, 63(3):369-382 (1988) (“Riggs”)
1028	Svenja Meyer et al., <i>PoMaMo—a comprehensive database for potato genome data</i> , Nucleic Acids Research, 33:D666-D670 (2005) (“Meyer”)
1029	M. W. Bonierbale et al., <i>A test of the maximum heterozygosity hypothesis using molecular markers in tetraploid potatoes</i> , Theor Appl Genet, 86:481-491 (1993) (“Bonierbale”)
1030	Kazuyoshi Hosaka and Robert E. Hanneman, Jr., <i>Genetics of self-compatibility in a self-incompatible wild diploid potato species Solanum chacoense. 1. Detection of an S locus inhibitor (Sli) gene</i> , Euphytica, 99:191-197 (1998) (“Hosaka 1998a”)
1031	Kazuyoshi Hosaka and Robert E. Hanneman, Jr., <i>Genetics of self-compatibility in a self-incompatible wild diploid potato species Solanum chacoense. 2. Localization of an S locus inhibitor (Sli) gene on the potato genome using DNA markers</i> , Euphytica, 103:265-271 (1998) (“Hosaka 1998b”)

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Exhibit No.	Description of Document
1032	R.K. Birhman and K. Hosaka, <i>Production of inbred progenies of diploid potatoes using an S-locus inhibitor (Sli) gene, and their characterization</i> , Genome, 43:495-502 (2000) (“Birhman”)
1033	Pim Lindhout et al., <i>Towards F₁ Hybrid Seed Potato Breeding</i> , Potato Res., 54:301-312 (2011) (“Lindhout 2011”)
1034	Hielke De Jong, <i>Inbreeding in Cultivated Diploid Potatoes</i> , Univ. of Wisconsin, PhD dissertation Univ. of Wisconsin Library (1971) (“Jong thesis”)
1035	J.F. Crow, <i>90 Years Ago: The Beginning of Hybrid Maize</i> , Perspectives: Anecdotal, Historical and Critical Commentaries on Genetics, Genetics Society of America, 148:923-928 (1998) (“Crow 1998”)
1036	Corentin Clot et al., <i>The origin and widespread occurrence of Sli-based self-compatibility in potato</i> , Theoretical and Applied Genetics, 133:2713-2728 (2020) (“Clot”)
1037	Chalermpol Phumichai and Kazuyoshi Hosaka, <i>Cryptic improvement for fertility by continuous selfing of diploid potatoes using Sli gene</i> , Euphytica, 149:251–258 (2006) (“Phumichai and Hosaka”)
1038	R. K. M. Hay, <i>Harvest index: a review of its use in plant breeding and crop physiology</i> , Ann. Appl. Biol., 126:197-216 (1995) (“Hay”)
1039	N. Richard Knowles and Gabor I. Botar, <i>Effect of altering the physiological age of potato seed-tubers in the fall on subsequent production in a short-season environment</i> , Can. J. Plant. Sci., 72:275-287 (1992) (“Knowles”)
1040	U.S. Provisional Application Serial No. 61/254,980
1041	James F. Crow, <i>Alternative Hypotheses of Hybrid Vigor</i> , Genetics, 33:477-487 (1948) (“Crow 1948”)

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Exhibit No.	Description of Document
1042	R.H. Moll et al., <i>The Relationship of Heterosis and Genetic Divergence in Maize</i> , Genetics, 52:139-144 (1965) (“Moll”)
1043	S.K. Luthra et al., <i>Genetic Divergence and Its Relationship with Heterosis in Potato</i> , Potato J., 32(1-2):37-42 (2005) (“Luthra”)
1044	Yanli Lu et al., <i>Molecular characterization of global maize breeding germplasm based on genome-wide single nucleotide polymorphisms</i> , Theor. Appl. Genet., 120:93-115 (2009) (“Lu 2009”)
1045	Shelley Jansky, <i>Chapter 4: Breeding for Disease Resistance in Potato</i> , Plant Breeding Reviews, 19:69-155 (2000) (“Jansky 2000”)
1046	Kenneth S. Dodds and G. J. Paxman, <i>The Genetic System of Cultivated Diploid Potatoes</i> , Evolution, 16:154-167 (1962) (“Dodds”)
1047	S.J. Peloquin and R.W. Hougas, <i>Genetic Variation Among Haploids of the Common Potato</i> , Am. Potato J., 37:289-297 (1960) (“Peloquin”)
1048	N.J. Van Suchtelen, <i>Investigation of Dihaploid Potatoes in the Netherlands</i> , Eur. Potato J., 9(2):64-68 (1966) (“Van Suchtelen”)
1049	Juan Alejandro Landeo, <i>Breeding Potential of Group Andigena Haploid Potatoes</i> , Univ. of Wisconsin-Madison, PhD dissertation, Xerox University Microfilms (1979) (“Landeo”)
1050	Shelley Hermundstad and S.J. Peloquin, <i>Tuber yield and tuber traits of haploid-wild species F₁ hybrids</i> , Potato Res., 29:289-297 (1986) (“Hermundstad”)
1051	Nov. 18, 2015 Response to Final Office Action, U.S. Application No. 13/504,156 (U.S. Patent No. 10,524,436) (“11-18-2015 Resp. to FOA”)
1052	Sept. 8, 2016 Amendment in Response to Non-Final Office Action Under 37 C.F.R. §1.111, U.S. Application No. 13/504,156 (U.S. Patent No. 10,524,436) (“9-8-2016 Am. Resp. to NFOA”)

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Exhibit No.	Description of Document
1053	Jan. 30, 2019 Declaration of Willem Hendrik Lindhout Under 37 C.F.R. §1.132, U.S. Application No. 13/504,156 (U.S. Patent No. 10,524,436) (“436 Lindhout Decl.”)
1054	Mar. 8, 2016 Non-Final Office Action, U.S. Application No. 13/504,156 (U.S. Patent No. 10,524,436) (“3-8-2016 NFOA”)
1055	Aug. 29, 2018 Amendment Submitted with Request for Continued Examination, U.S. Application No. 13/504,156 (U.S. Patent No. 10,524,436) (“8-29-2018 Am. Req. Cont’d Examination”)
1056	M.T. Jackson et al., <i>Inbreeding and True Potato Seed Production</i> , Innovative Methods for Propagating Potatoes, Report of the XXVIII Planning Conference, CIP (Dec. 10-14, 1984)
1057	European Patent Office, Opposition to European Patent No. 3 536 146, Decision of Opposition Division Revoking Patent (Aug. 1, 2024)
1058	John B. Bamberg and Max W. Martin, <i>Inventory of Tuber-bearing Solanum Species</i> , Catalog of Potato Germplasm (1993)
1059	João Vasco Silva et al., <i>Yield gaps in Dutch arable farming systems: Analysis at crop and crop rotation level</i> , Agricultural Sys., 158:78-92 (2017)
1060	<i>Exhibit Number Not Used</i>
1061	U.S. Department of Agriculture (USDA), <i>Potatoes 2009 Summary</i> , Agricultural Statistics Board, NASS Report (2010)
1062	U.S. Department of Agriculture (USDA), <i>Potatoes 2010 Summary</i> , Agricultural Statistics Board, NASS Report (2011)
1063	U.S. Department of Agriculture (USDA), <i>Potatoes 2011 Summary</i> , Agricultural Statistics Board, NASS Report (2012)
1064	U.S. Department of Agriculture (USDA), <i>Potatoes 2012 Summary</i> , Agricultural Statistics Board, NASS Report (2013)

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Exhibit No.	Description of Document
1065	U.S. Department of Agriculture (USDA), <i>Potatoes 2014 Summary</i> , Agricultural Statistics Board, NASS Report (2015)
1066	U.S. Department of Agriculture (USDA), <i>Potatoes 2017 Summary</i> , Agricultural Statistics Board, NASS Report (2018)
1067	USDA National Plant Germplasm System, Details for: GS 2, <i>Solanum tuberosum</i> L., US-W4, available at https://npgsweb.ars-grin.gov/gringlobal/accessiondetail?id=1000069
1068	USDA National Plant Germplasm System, Details for: PI 675351, <i>Solanum tuberosum</i> L., ‘RH89-039-16’, available at https://npgsweb.ars-grin.gov/gringlobal/accessiondetail?id=1660370
1069	Norma C. Manrique-Carpintero et al., <i>Genetic Map and QTL Analysis of Agronomic Traits in a Diploid Potato Population using Single Nucleotide Polymorphism Markers</i> , Crop Sci., 55:2566-2579 (2015)
1070	J. Rouppe van der Voort et al., <i>Mapping of the cyst nematode resistance locus Gpa2 in potato using a strategy based on comigrating AFLP markers</i> , Theor. Appl. Genet., 95:874-880 (1997) (“Voort”)
1071	Hans van Os et al., <i>Construction of a 10,000-Marker Ultradense Genetic Recombination Map of Potato: Providing a Framework for Accelerated Gene Isolation and a Genomewide Physical Map</i> , Genetics, 173:1075-1087 (2006)
1072	Ling Ma et al., <i>A nonS-locus F-box gene breaks self-incompatibility in diploid potatoes</i> , Nature Communications, 12:4142 (2021)
1073	Kimberly J. Felcher et al., <i>Integration of Two Diploid Potato Linkage Maps with the Potato Genome Sequence</i> , PLoS One, 7(4):e36347 (2012)
1074	John P. Hamilton et al., <i>Single nucleotide polymorphism discovery in elite north american potato germplasm</i> , BMC Genomics, 12:302 (2011)

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Exhibit No.	Description of Document
1075	Peter G. Vos et al., <i>Development and analysis of a 20K SNP array for potato (Solanum tuberosum): an insight into the breeding history</i> , Theor. Appl. Genet., 128:2387-2401 (2015)
1076	Potato Pedigree Database – RH89-039-16, Pedigree Image Map, available at https://www.plantbreeding.wur.nl/PotatoPedigree/pedigree_imagemap.php?id=6839&showjaar=0&depth=8

11. To the extent I am provided additional documents or information, including any expert declarations in this proceeding, I may offer further opinions.

II. PERSON OF ORDINARY SKILL IN THE ART

12. I am informed by counsel that, under the patent laws in effect before the America Invents Act (“AIA”) of 2011, an assessment of claims of a patent filed before the AIA took effect should be undertaken from the perspective of a person of ordinary skill in the art (“POSA”) as of the earliest claimed priority date (i.e., the “time the invention was made”). For purposes of the ’841 patent, I have been asked to assume that date to be October 26, 2009, which is the filing date of the earliest provisional application in the patent family from which the ’841 patent issued (Prov. Appl. No. 61/254,980), without regard to whether the issued claims of the ’841 patent are entitled to claim priority to that provisional application. I am not aware of any claim by the patent owner that the claims of the ’841 patent are entitled to a

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date of invention earlier than Oct. 26, 2009, but I reserve the right to supplement this opinion if the patent owner were to later claim that the '841 patent was entitled to an earlier priority date.

13. I understand that a POSA is a hypothetical individual who is presumed to have known the relevant art at the time of the invention. I have been advised that to determine the appropriate level of a POSA, I may consider the following factors: (1) the types of problems encountered by those working in the field and prior art solutions thereto; (2) the sophistication of the technology in question, and the rapidity with which innovations occur in the field; (3) the educational level of active workers in the field; and (4) the educational level of the inventor. I am also informed that a person of ordinary skill in the art is presumed to be aware of all of the pertinent prior art.

14. The subject matter of the '841 patent relates to potato plants and methods for inbreeding and hybrid seed generation. (*See, e.g.,* EX1001 ('841 patent), Abstract.) I provide a more complete overview of the '841 patent in Section V below. As noted above, I have extensive education and experience in the field of plant breeding and specifically potato breeding. Having been active as a researcher and educator in this field for more than 35 years, I am familiar with the relevant skill set that would have been possessed by a POSA at the time of the invention of the

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'841 patent (October 2009).

15. Based on my assessment, the ordinary skill in this field was high. Specifically, a POSA would have knowledge of the scientific literature and have skills relating to potato breeding and the use of marker-assisted breeding before October 26, 2009 as well as knowledge of field, greenhouse, and laboratory techniques and strategies used in potato breeding, including practical applications of the same. A POSA would typically have a doctorate degree, or equivalent, in plant breeding and would have possessed particular experience with potato breeding. Alternatively, a POSA would be a plant breeder with relatively less educational background but commensurately greater experience working in the field of plant breeding, including potato breeding. Either way, a POSA would have been familiar with and able to understand the information known in the art relating to plant breeding and particularly potato breeding.

16. As reflected in my Curriculum Vitae (**Exhibit A**) and my qualifications set forth above, I qualified as a POSA at the time of the alleged invention (i.e., before October 26, 2009). Indeed, although my qualifications and experience may be viewed as exceeding those of the hypothetical person having ordinary skill in the art defined above, my analysis and opinions regarding the '841 patent are based on the perspective of a POSA as of October 2009.

III. STATEMENT OF LEGAL PRINCIPLES

A. Claim Construction

17. I understand from counsel that the law recognizes that a purpose of claim construction is to determine what a POSA would have understood the claim terms to mean. Claim terms are generally given their ordinary and customary meaning, which is the meaning that the term would have to a POSA as of the earliest claimed priority date.

18. I understand that, in Inter Partes Review (“IPR”) proceedings, a claim of a patent shall be construed using the same claim construction standard that would be used to construe the claim in a civil action filed in a U.S. district court (which I understand is called the “*Phillips*” claim construction standard), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the specification and prosecution history pertaining to the patent. I have been instructed by counsel to apply the “*Phillips*” claim construction standard for purposes of interpreting the claims in this proceeding, to the extent they require an explicit construction. I have interpreted all the claim terms in accordance with the ordinary and customary meaning of such terms as understood by one of ordinary skill in the art in 2009, reading the claims in light of the disclosures in the specification and prosecution

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history.

B. Anticipation

19. I understand that a claim is anticipated if its subject matter was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention, which for the '841 patent I have assumed is October 26, 2009. I understand that in an IPR proceeding such as this, anticipation arguments are only permitted to the extent they are based on patents and/or printed publications.

20. I also understand that a prior art reference can anticipate a claim “inherently.” I understand that an inherent disclosure is that which necessarily discloses the claimed subject matter. I understand that evidence from after the priority date of the invention can be relevant as proof of inherency, and that a POSA need not have recognized the inherent disclosure as of the time of the invention.

C. Obviousness

21. I understand from counsel that the law recognizes a concept called “obviousness.” I understand that a patent claim is obvious if the differences between the subject matter sought to be patented (as recited in the claims) and the prior art are such that the subject matter as a whole would have been obvious to a POSA at the time of the invention.

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22. I understand that the following factors should be considered in analyzing obviousness: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; and (3) the level of ordinary skill in the pertinent art. I also understand that certain other facts known as “secondary considerations” such as commercial success, unexplained results, long felt but unsolved need, industry acclaim or praise, simultaneous invention, copying by others, skepticism by experts in the field, and failure of others may be utilized as indicia of non-obviousness. I understand, however, that, in order to be relevant to the obviousness inquiry, secondary considerations evidence must be connected, or have a “nexus,” with the novel aspects of the invention claimed in the patent at issue.

23. I understand that a reference qualifies as prior art for obviousness purposes when it is analogous to the claimed invention. The test for determining what art is analogous is: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor’s endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved. I understand that a POSA is assumed to have knowledge of all prior art.

24. I understand that either a single reference or a combination of references can render a claimed invention obvious. To do so, a POSA must have

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been able to arrive at the claims by modifying or combining the prior art references.

I understand that a POSA can combine various prior art references based on the teachings of those prior art references, the general knowledge present in the art, or common sense.

25. I further understand that for a combination of references, there must be a motivation to combine the references and that a POSA must have had a reasonable expectation of success that making the combination will make the invention work.

26. I understand that a motivation to combine references may be implicit in the prior art, and there is no requirement that there be an actual or explicit teaching to combine two references. Thus, one may take into account the inferences and creative steps that a POSA would employ to combine the known elements in the prior art in the manner claimed by the patent at issue. I understand that one should avoid “hindsight bias” and ex post reasoning in performing an obviousness analysis. But this does not mean that a POSA for purposes of the obviousness inquiry does not have recourse to common sense.

27. I understand one way that a patent can be found obvious is if there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent’s claims. I understand that a motivation to combine various prior art references to solve a particular problem may come from a

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variety of sources, including market demand or scientific literature. I understand that a need or problem known in the field at the time of the invention can also provide a reason to combine prior art references and render a patent claim invalid for obviousness. I understand that familiar items may have obvious uses beyond their primary purpose, and that a POSA will be able to fit the teachings of multiple prior art references together like the pieces of a puzzle. I understand that a POSA is also a person of at least ordinary creativity. I understand when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this finite number of predictable solutions leads to the anticipated success, I understand that the invention is likely the product of ordinary skill and common sense, and not of any sort of innovation.

28. I understand that the fact that a combination was obvious to try might also show that it was obvious, and hence invalid, under the patent laws. I understand that if a patent claims a combination of familiar elements according to known methods, the combination is likely to be obvious when it does not yield more than predictable results. Thus, if a person of ordinary skill in the art can implement a predictable variation, an invention is likely obvious. I understand that combining embodiments disclosed near each other in a prior art reference would not ordinarily

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require a leap of inventiveness.

29. I understand that obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. Obviousness may also be shown by demonstrating that it would have been obvious to combine the teachings of more than one item of prior art. I understand that a claimed invention may be obvious if some teaching, suggestion, or motivation exists that would have led a POSA to combine the invalidating references. I also understand that this suggestion or motivation may come from the knowledge of a POSA, or from sources such as explicit statements in the prior art.

30. I understand the following are examples of approaches and rationales that may be considered in determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a person having ordinary skill in the art:

- (1) Some teaching, motivation, or suggestion in the prior art that would have led a person of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;
- (2) Known work in one field of endeavor may prompt variations of it for use in the same field or a different field based on design incentives or other market forces if the variations would have been predictable to a person of ordinary skill in the art;

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- (3) Combining prior art elements according to known methods to yield predictable results;
- (4) Applying a known technique to a known device, method, or product ready for improvement to yield predictable results;
- (5) Applying a technique or approach that would have been “obvious to try” (choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success);
- (6) Simple substitution of one known element for another to obtain predictable results; or
- (7) Use of a known technique to improve similar products, devices, or methods in the same way.

D. Product-By-Process Claims

31. I understand from counsel that some of the challenged claims are product-by-process claims. (*See* EX1001 ('841 patent), Claim 7.) I understand that product-by-process claims are claims reciting a product made by a process that includes the process steps recited in the claim.

32. I understand that, for product-by-process claims, if the product produced by the claimed process is in the prior art, even if the prior art product was produced by a different method, then the claims are invalid. Thus, a product-by-process claim is invalid if the claimed product is described in the prior art, regardless of whether the prior art product was produced by the claimed process.

IV. TECHNOLOGY AND FACTUAL BACKGROUND

33. Potato is a valuable food crop that plays a vital role in feeding the world's population. Behind only corn, rice, and wheat, potato is the world's fourth largest food crop while its protein production per unit area and time is superior to all other basic food crops. (EX1013 (Ross), 0008.) In large part due to its value as a food crop, breeders have for decades selectively bred potatoes for increased yield and improved processing quality as well as to impart disease resistance, storage quality, and day length adaptations. (EX1011 (Jansky 2009), 0007.)

34. As I described below, by 2009, the taxonomy, breeding, and genetics of potatoes had also been extensively researched and described.

A. Potato Taxonomy

35. Cultivated varieties of potatoes or "cultivars" are potatoes with characteristics useful for agriculture and which are grown for commercial production of the crop.

36. All potatoes belong to the genus *Solanum*. Further classification of potatoes into groups, species, or subspecies has been the subject of a long history and comprehensive research dating back decades. (Summarized in EX1006 (Spooner) and EX1012 (Huaman).) As I explain below, by 2009, these efforts resulted in the development of a practical taxonomy for the potato that was in

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common use by breeders.

37. Long before 2009, older taxonomic approaches had variously grouped cultivated potatoes into as few as one and as many as 21 distinct species. (EX1006 (Spooner), 0009; *see also* EX1012 (Huaman), 0001-03.) For example, in the 1960s, Dodds classified cultivated potato species under the International Code of Nomenclature of Cultivated Plants (“ICNCP”), which allowed the identification of “cultivar-groups” based on traits of interest to the agricultural community. (EX1012 (Huaman), 0001-02.) Using comparative morphology, reproductive biology, cytological characteristics, genetics, and cultural practices, Dodds classified cultivated potatoes as *S. ×curtilobum*, *S. ×juzepczukii*, and *S. tuberosum*, with five cultivar-groups in *S. tuberosum*. (*Id.*) In 1971, Bukasov and Lechnovich recognized 21 cultivated potato species. (*Id.*, 0001.) In 1990, using the International Code of Botanical Nomenclature (“ICBN”), Hawkes identified seven cultivated potato species—*S. ajanhuiri*, *S. chaucha*, *S. curtilobum*, *S. juzepczukii*, *S. phureja*, *S. stenotomum*, and *S. tuberosum*. (*Id.*, 0001-03, Table 1.)

38. Building on this work, in 2002, Huaman re-examined the morphological support for previous taxonomic treatments and concluded that all cultivated potatoes actually belong to a single species, *S. tuberosum*. (*Id.*, 0001.)

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Within this group, Huaman described eight “cultivar-groups” of *S. tuberosum*:¹ Ajanhuiri Group, Andigenum Group, Chaucha Group, Chilotanum Group, Curtilobum Group, Juzepczukii Group, Phureja Group, and Stenotomum Group. (*Id.*) Huaman did not assign modern cultivars to a cultivar-group. (*Id.*)

39. Relevant here, all commercial cultivated potatoes are collectively designated as *Solanum tuberosum*. (*Id.*) In 2002, Huaman placed *S. phureja* within the species *S. tuberosum* as cultivar-group Phureja. (*Id.*) By 2007, however, it was clear that even this level of distinction for Phureja was not warranted, and as Spooner stated, “recognition of *S. phureja* as either a species or Cultivar Group (Phureja Group), [] is no longer tenable[.]” (EX1006 (Spooner), 0012.)

40. The taxonomy of potatoes discussed above, and in particular the classification of Phureja into a single species *S. tuberosum*, was widely known and accepted by the plant breeding community before 2009. Indeed, the ’841 patent recognizes and uses the *S. tuberosum* classification for Phureja, describing the first

¹ Cultivar Groups associate plants with characteristics that are useful to agriculturists, but they do not necessarily define species according to any classification philosophy. (EX1006 (Spooner), 0009.) Further, although Spooner’s 2007 work called for their retirement, they are still sometimes used in the literature as of today. Indeed, even as of today some authors in the field will use the nomenclature *S. phureja*, but by 2009 a POSA would have understood and recognized that the use of this nomenclature did not reflect any species-level distinction between Phureja and Tuberosum potatoes.

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sequenced potato genome as *Solanum tuberosum* Group Phureja DM1-3 516R44 (C1P801092). (EX1001 ('841 patent), 33:57-61.) Thus, a POSA in 2009 would have known that *S. phureja* was not a distinct species but was within the species *S. tuberosum*. A POSA also would have known that prior art describing *S. phureja* was describing the *S. tuberosum* potato species.

B. Propagation

41. Some plants may reproduce asexually through vegetative propagation. Cultivated potatoes are most commonly propagated vegetatively through tubers, and the propagule (*i.e.*, the structure that can give rise to a new potato plant) is known as a “seed tuber” or “seed potato.” When a potato seed tuber is planted, the mature potato plant that arises from the seed tuber is a clone of, or genetically identical to, the tuber from which it was derived. (EX1013 (Ross), 0011, 0104-07.)

42. Plants typically also reproduce sexually. In potato, “true potato seed” (“TPS”) or “botanical potato seed” refers to the seeds harvested from the potato berry (which is a type of fruit) that results from sexual reproduction. TPS is produced sexually through pollination, where pollen (containing the male gamete) from the stamen of the flower is moved to the flower’s pistil (containing the female gamete), resulting in pollen germination, pollen tube growth, fertilization, and embryo development within a seed. Seeds are contained within berries. As I describe in the

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botany textbook I co-wrote, unlike seed tubers and the plants that arise from them, true seeds are not typically genetically identical to their parent. (EX1014 (Stern), 0056-60.) TPS are genetically different from either parent unless they result from selfing a homozygous plant. (*Id.*, 0046-47.)

43. Fertilization is necessary for sexual reproduction in plants, including potatoes. Self-fertilization or “selfing” of potatoes results when a potato plant’s own pollen fertilizes its own ovule while cross fertilization results when pollen from one potato plant fertilizes the ovule of another, genetically different, potato plant. (*Id.*, 0038.) Selfing can occur spontaneously in the wild as the result of a fertilization event on a single plant, or intentionally by plant breeders as a form of inbreeding, as explained further below.

C. Tetraploid Potato Breeding

44. Ploidy refers to the number of sets of chromosomes in each biological cell of an organism. Organisms may be monoploid (having one set of chromosomes in a cell), diploid (two sets), triploid (three sets), tetraploid (four sets), and so on, with “polyploidy” describing an organism with more than two sets of chromosomes. Commonly, the letter “n” is used to denote the gametophyte (gamete-producing) generation in the plant life cycle, “2n” is used to denote the sporophyte generation (the plant, which is the product of fertilization), and “x” is used to denote the level of

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ploidy. Thus, a diploid plant is $2n=2x$ while a tetraploid plant is $2n=4x$. A gamete (sperm or egg) in the diploid plant life cycle is $n=x$.

45. Many levels of ploidy are known in potato. As I explain below, ploidy can affect breeding strategies, and in general, the higher the ploidy, the more difficult it is to make directed genetic improvements. The majority of cultivated potatoes sold for food, particularly in North America and Europe, are tetraploid and propagated vegetatively, with the seed tubers being genetically identical to their original parents. Long before 2009, however, methods for simplifying breeding by creating diploid potatoes were well-known.

46. To breed tetraploids, two parental clones are intercrossed (sexually crossed) and seeds are collected. These hybrid seeds are often called an “F₁ generation.” The F₁ seeds are sown to generate a family of plants, each of which produces tubers. (EX1011 (Jansky 2009), 0025; EX1013 (Ross), 0026-27.) Breeders will collect a single tuber from each plant in a family to create a family bag. (EX1011 (Jansky 2009), 0025.) The tubers are then planted in a field as single “hills,” and thus the plant produced by the seed tuber is known as a hill. (*Id.*) Breeders will then select for traits at the level of single hills. (*Id.*)

47. Because tetraploid potatoes have four sets of chromosomes, selective breeding in these potatoes is complex and can be difficult and slow. All four sets of

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chromosomes are capable of associating with each other in meiosis, resulting in tetrasomic inheritance. For breeders, this creates difficulty in performing statistics for genetic analyses as well as in predicting the physical characteristics (phenotypes) that may result. (EX1011 (Jansky 2009), 0021-22.) Moreover, due to tetraploidy, the potatoes have a higher genetic load, meaning they have a higher proportion of deleterious alleles than diploid plants. (*Id.*, 0022.) These deleterious alleles are typically recessive and thus are hidden by dominant alleles, allowing them to accumulate in the genome. But when a tetraploid clone is self-pollinated, the offspring may become homozygous for some deleterious recessive alleles. Thus, these deleterious alleles will be expressed, which can result in poor vigor or fertility. (*Id.*)

48. As a result of the complexity in breeding tetraploid potatoes, breeders often cross dozens of parental clones and grow 100,000 (or more) seedlings annually. (*See id.*, 0025); *see also* EX1013 (Ross), 0027-28 (reporting breeding programs that show 70,000-150,000 seeds each year.) During propagation, the clonal selections then often undergo intensive observation and screening tests for 10 years or more before release as a cultivar. (EX1011, 0025.) It has been estimated that breeders must evaluate over two million seedlings to identify one with a marketable combination of traits. (EX1015 (Lauer), 0001.)

D. Diploid Potato Breeding

49. By virtue of having only two, rather than four, sets of chromosomes, diploid potatoes are comparatively much easier to breed and select for desirable traits. The offspring of a sexual cross between two diploid potatoes will only inherit two variants (alleles) of a gene, greatly simplifying inheritance patterns. (EX1013 (Ross), 0031; EX1016 (Ortiz), 0001-03.)

50. By 2009, several diploid potato lines and methods for breeding diploid potatoes had been described. For example, Jong described studying “inbreeding in cultivated diploid potatoes . . . by using self-fertile hybrids from crosses between Group Phureja and Group Stenotomum and haploids of Group Tuberosum.” (EX1004 (Jong), Abstract.) Moreover, diploid varieties are widely grown in South America, further motivating their production. (EX1006 (Spooners), 0012.)

51. Diploid potatoes are of tremendous value in potato breeding programs. By 2009, their usefulness for imparting valuable traits and for expanding the genetic diversity in breeding programs was well-known and widely appreciated. (See EX1013 (Ross), 0015 (explaining the diploid potato *S. phureja* has “long been utilized in breeding”); EX1045 (Jansky 2000), 0005, 0011, 0013-14, 0018, 0020, 0023, 0025, 0026, 0028, 0030-31.)

52. By 2009, breeders also routinely created diploid potatoes from

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commercial tetraploid cultivated potato varieties. (*See* EX1013 (Ross), 0030-35.) Moreover, the breeders could do so with relative ease, as moving up and down the ploidy ladder was well understood and often used. (*See, e.g.*, EX1007 (Chase), 0004, 0007.) Diploid offspring could be created by applying pollen from haploid inducers (referring to specific clones of *S. tuberosum* Group Phureja) to the stigma of tetraploid potato varieties. This would induce gynogenesis,² which is the production of an embryo from an unfertilized egg cell. Diploid potatoes created through this process have genetic material only from the mother tetraploid potato and, in the potato community, have been referred to as either “dihaploids” or “haploids.” Both terms refer to sporophytes with the gametophytic chromosome number, meaning the plants have two sets of chromosomes instead of four. (EX1011 (Jansky 2009), 0014-16; EX1013 (Ross), 0015, 0033-34; EX1017 (Tarn), 0010.)

53. Breeders used the haploids in breeding programs, whereby they crossed the haploids with a host of cultivated diploid breeding clones from all over the world as well as wild diploid clones. (*Id.*)

E. Yield of Tetraploid Cultivars and Diploid Breeding Selections

54. At the time of the filing of the '841 patent, potato production in the U.S.

² Gynogenesis, or parthenogenesis, happens when an unfertilized egg cell develops into a plant. (EX1013 (Ross), 0033, 0045.)

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was 415 million cwt.³ (EX1018 (USDA 2009), 0005.) Commercial tetraploid potatoes yielded on average 396 cwt/acre. (*Id.*) Based on the following calculations, this equates to 1111 g/plant:⁴ Assuming a standard density of 40,000 plants per hectare (EX1013 (Ross), 0060), or 16,187 plants per acre, then the average yield is 1111 grams per plant (1 cwt = 45.4 kg, so $396 \text{ cwt} \times 45.4 \text{ kg} = 17,978 \text{ kg/acre} \div 16,187 \text{ plants/acre} = 1.111 \text{ kg/plant}$ or 1111 g/plant).

55. Some diploid clones produce yields similar to successful tetraploid cultivars. For example, diploids in published yield trials produced up to 970 g/plant (EX1021 (Buso), 0002 (Table 2)); 774 g/plant (EX1022 (DeMaine) 0003 (Table 1)); 1000 g/plant (EX1019 (Jong and Tai 1977) 0001, 0007-08, Table 4), and ~1420 g/plant (EX1020 (Jong and Tai 1991), 0003 (Table 3)).⁵ Thus, by 2009, a POSA would have known that diploid potato selections were capable of producing yields similar to those of commercial tetraploids, and in some cases, diploid yields were actually greater.

³ A “cwt” corresponds to a “hundredweight,” or 100 pounds (45359.2 grams).

⁴ “g” means grams, while “kg” means kilograms.

⁵ These calculations were determined as follows: Buso: Mean Total Tuber Yield (“TTY”) = 0.97 kg/hill x 1000 = 970 g/hill; DeMaine: mean tuber yield per plant reported as 774 g/plant; Jong and Tai 1977: 5 kg and 5 plants per plot, so $5 \text{ kg/plot} \div 5 \text{ plants} = 1 \text{ kg/plant} = 1000 \text{ g/plant}$; Jong and Tai 1991: 15 plants per plot, so $21.3 \text{ kg/plot} \div 15 \text{ plants} = 1.42 \text{ kg/plant} = 1420 \text{ g/plant}$.

F. Inbred Creation and Hybrid Vigor in Commercial Crops Were Well Known Before 2009

56. In plant breeding programs, breeders routinely seek to introduce new traits and, particularly for commercial varieties, improve agronomic performance (e.g., fertility, vigor, and yield). Both heterosis and inbreeding, explained further below, advance those goals.

57. Hybrid vigor (or heterosis) is enhanced vigor or superior performance of offspring compared to their parents. Hybrid vigor is a fundamental concept in plant breeding. For centuries, humans have recognized that inbreeding can lead to poor vigor and that hybrids can exhibit superior performance compared to their parents. Hybrid vigor has further been described in the literature for more than 100 years. (EX1041 (Crow 1948), 0001; EX1035 (Crow 1998), 0001, 0004; EX1026 (Falconer), 0032-47; EX1027 (Riggs), 0004.) For example, heterosis in corn had been described in the early 1900s. (EX1041 (Crow 1948).) In agriculturally relevant plants, like potato, corn, and rice, plant breeders exploit heterosis to improve yields and confer other desirable traits to the hybrid offspring. A POSA would have been well familiar with hybrid vigor and motivated to elicit hybrid vigor in the offspring of inbred plants in order to improve agriculturally beneficial traits in the offspring.

58. The degree of heterozygosity in the offspring of two parents plays a fundamental role in heterosis. Hybrid vigor is typically most apparent when two

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homozygous, but genetically different, parents are crossed, producing a high proportion of heterozygous loci in the offspring. Homozygosity is when a plant has the same variant of a gene or “allele” at a given locus on each of its chromosomes (e.g., in a diploid, both copies of the flower color gene code for red color). Heterozygosity is the converse, in which a plant has different alleles at a locus (e.g., one copy codes for red and the second copy codes for white flowers). (EX1014 (Stern), 0025.)

59. High degrees of homozygosity in a plant may be created through inbreeding. While there are multiple ways to inbreed plants across generations, the methods generally involve sib mating (when a progeny is crossed with its sibling plants), selfing (when a plant is crossed with itself), or some combination of selfing and sib mating. (See EX1023 (Hallauer), 0009-21; *see also* EX1014 (Stern), 0038-39.) As plants are repeatedly inbred, they become more homozygous across their genomic loci. Still another method of producing inbred potatoes is through the parthenogenetic production of haploids from tetraploids, as described above. (EX1047 (Peloquin), 0007 (“About seven generations of selfing a diploid are required to approximate the amount of inbreeding obtained through the extraction of haploids.”).) In this context, highly homozygous diploids can be created in one generation. It is also known that such haploids (which are diploid) are capable of

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yielding tubers in the range of 200 to 700 grams per plant. (EX1050 (Hermundstad), 0003.)

60. Ploidy can influence how quickly homozygosity is reached following inbreeding. In diploid plants, each round of selfing reduces heterozygosity by 50%; conversely, homozygosity increases by 50% with each round of selfing. (EX1004 (Jong), 0007.) In contrast, nearly four generations of selfing are required to achieve the same effect in tetraploids. (*Id.*) Consequently, in diploids, the approach to homozygosity following inbreeding can be rapid. When two inbred plants (i.e. those with a high degree of homozygosity) are crossed, the resulting hybrid offspring do not “segregate” into a variable population where some plants have certain traits and others have different traits. Instead, the hybrid population is very uniform.

61. As plants are continuously inbred across generations, inbreeding depression, characterized by reduced survival and fertility, is frequently encountered by breeders – especially early in an inbreeding program. Inbreeding depression, however, need not be fatal to a breeding program, and would not be considered an insurmountable obstacle by any POSA. Long before 2009, breeders knew that they could “push through” inbreeding depression and continue to self potato plants to achieve higher homozygosity. DeMaine, for example, discloses that “inbreeding depression [in potato] is largely spent on the initial unmasking of deleterious

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recessives, whether it be by selfing or by dihaploidisation. Subsequent generations, on average, do not show such a large reduction in vigour.” (EX1022 (DeMaine), 0006.) Several groups had also reasoned that despite initial inbreeding depression, a plant breeding program could rebound. Due to the elimination of harmful recessive alleles through selection, subsequent rounds of selfing would produce plants with acceptable vigor and fertility. (EX1037 (Phumichai and Hosaka), 0006-07 (explaining the authors “hypothesized that continuous selfing may eliminate undesirable recessive alleles as they become homozygous, and may recover fertility with advancing generations”); EX1025 (Eijlander), 0014 (“From the point of view of the good performance of the progenies of the basic F1s and some of the inbred lines, it should be concluded that the establishment of inbred lines of diploid potato, comparable to those of maize, might be possible.”).) It was also well known in maize that, after successive rounds of inbreeding, it was possible to obtain inbreds with higher yield even than hybrids of an earlier period. (EX1035 (Crow 1998), 0003.)

62. Moreover, as I explained above, crossing highly inbred plants could result in heterotic offspring that show high degrees of heterozygosity and improved performance, including for fertility and vigor, over their inbred parents. (See EX1026 (Falconer), 0032-47.) Similarly, van Suchtelen intercrossed haploids (which are highly inbred) and noted that the offspring demonstrated marked

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improvements in vigor and fertility. This led to the conclusion that “it is thus clear that a breeding programme can be conducted at the diploid level.” (EX1048 (Van Suchtelen), 0002.)

63. Hybrids between inbreds are highly uniform since their parents produce genetically uniform gametes. (EX1027 (Riggs), 0003 (explaining “hybrids represent a fundamentally different type of crop population, with enhanced uniformity”); EX1035 (Crow), 0002 (describing hybrids as having “greater uniformity” which “was useful for machine harvesting”).) By 2009, breeding programs regularly exploited the creation and crossing of highly inbred parental lines (“elite” inbreds) to create heterotic offspring. (EX1023 (Hallauer), 0001-21; EX1026 (Falconer), 0033; EX1027 (Riggs), 0002-04.)

64. By 2009, it was also well-known that potato exhibited strong hybrid vigor. Further, breeders typically aimed to maximize hybrid vigor in potato as “high potato yield and vigor depend on interlocus and intralocus interactions[.]” (EX1011 (Jansky 2009), 0026.) Breeders appreciated that to achieve heterosis, they should implement a breeding strategy “to develop highly inbred clones at the diploid level and then combine genetically diverse diploids to produce heterotic hybrids.” (*Id.*) When seeking to improve upon a trait like tuber yield, for example, they would create a cross between two highly inbred diploid parental potato lines that are

sufficiently genetically distant with an expectation that the resulting offspring would exhibit heterosis and have a higher tuber yield than either parent. (EX1026 (Falconer), 0013, 0020, 0035; EX1011 (Jansky 2009), 0026.)

G. Molecular Markers and Their Use in Achieving Heterosis in Potato Breeding

65. Molecular markers are molecules, typically fragments of DNA, that are associated with a particular part of the genome and that can be used to help identify, or act as a “marker” for, a particular variant or to distinguish between variants. By 2009, several molecular marker techniques were in use, including restriction fragment length polymorphism (RFLP) and single nucleotide polymorphism (SNP)-based platforms. (EX1028 (Meyer), 0001; *see also* EX1011 (Jansky 2009), 0027-28.) Then, as well as now, breeders and geneticists relied on these tools to select plants, evaluate homozygosity and heterozygosity, and to confirm the presence of genes underlying agronomically desirable traits in breeding stock. (*See* EX1011 (Jansky 2009), 0027-28.)

66. Before 2009 and still today, breeders used molecular markers to make informed predictions about whether two parents are sufficiently similar or different, such that they are likely to produce vigorous and highly heterotic offspring upon crossing. (EX1029 (Bonierbale), 0001, 0008-10.) A POSA would have been motivated to use molecular markers to determine the appropriate level of genetic

distance between parents because breeders understood that a heterotic state and maximizing heterosis depends upon breeding parental lines that have sufficient, but not too divergent, genetic differences with respect to each other. (*Id.*) For example, if a POSA crossed two genetically identical homozygous plants, she would not expect heterosis as the offspring would be the same as their parents. On the other hand, if a POSA bred lines that were too genetically different, then the heterotic effect may be reduced due to interspecies interactions. These well-known molecular marker techniques would have thus been valuable for characterizing genetic similarity or divergence. Given that the techniques were well-known and widely used, a POSA would have been able to implement and optimize them to characterize parental lines and hybrid offspring and thus inform studies of heterosis.

H. Potato Breeding Methods for the Creation of Diploid Homozygous Inbred Lines for Subsequent Crossing to Generate Heterosis and True Potato Seed Were Known Before 2009

67. Decades before 2009, hybrid breeding methods had successfully been implemented in several crops including corn and other *Solanum* crops like tomato and eggplant. Spurred on by the success in these plants, potato breeders also sought to develop hybrid breeding with diploids in potato. As I explain below, several factors motivated them to implement this breeding method with a reasonable expectation that they could successfully do so, and before 2009, breeders had

successfully implemented such methods in diploid potato.

1. Breeding with Inbred Diploids Was Touted as Beneficial

68. As an initial matter, breeders were motivated to create inbred lines of diploid potato because they recognized that “the rate of progress towards homozygosity following selfing is much faster” in diploid potatoes than in tetraploids. (EX1004 (Jong), 0007.)

69. In fact, long before 2009, a systematic approach—known as analytical breeding—had been developed for the purpose of creating hybrids between inbred lines to achieve and maximize heterosis in potato. The analytical breeding method consisted of several key steps in the following scheme:

1. Reduction of tetraploid commercial germplasm to the diploid level (dihaploid induction);
2. Crossing the dihaploids with other diploids to produce F₁ progeny lines known in the art to be “remarkably vigorous” and that are “increasing their heterotic diversity” for later hybrid crossing;
3. “Inbreeding of the diploid F₁ crosses [] with selection under appropriate stress ... to fix desirable genetic material ... [which] presents the plant breeder no problems of an unusual nature”; and
4. Intercrossing the lines that have been “inbred...to homozygosity for genes controlling attributes of economic importance” to “maximize the heterotic interaction in the final combination” to create “diploid hybrids.”

(EX1007 (Chase), 0006; *see also* EX1016 (Ortiz), 0003; EX1056 (Jackson), 0009.)

This breeding scheme, which was an application of well-known schemes long used

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in maize, met the potato breeders’ goals of both introgressing new characteristics into a potato line (through crossing and inbreeding the resultant offspring to fix the trait) and then creating heterosis through the crossing of inbred lines.

70. This analytic breeding scheme is not novel. Instead, it reflects fundamental knowledge that breeders have known for decades about how to breed plants. According to Chase—published decades before the ’841 patent—all the relevant steps in the breeding scheme “have in one or another line of research already been accomplished.” (EX1007 (Chase), 0007.) Thus, Chase said, “it is not unreasonable to expect that these operations can be carried out in stepwise fashion.” (*Id.*) The inventors of the ’841 patent claim to have created a novel approach to breeding in potatoes, but in fact, Chase’s scheme from several decades earlier is nearly identical to the breeding scheme in the ’841 patent as shown in the following chart:

Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in ’841 Patent and Characterized in the Prosecution History
(1)	“The first operation, step	Parental lines D1-D3, as further explained by the inventors’ breeding history disclosed during

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
	#1, is the selection of the [tetraploid] source material , that is, the clone or set of clones of the commercial potato..." ⁶	prosecution, are dihaploids derived from tetraploid commercial cultivar source material. (EX1001 ('841 patent), 11:9-26, 22:16-23:3, 29:62-30:7, 31:39-62, 46:1-47:12 (Table 6), Fig. 2; EX1010 ('841 patent file history), 0537-39.) "Diploid potato lines D1, D2, and D3 (IVP97-079-9, IVPAA-096-18, and SH83-92-488, respectively, as indicated in Table 6 of the application) are heterozygous lines of a diploid potato breeding program...initiated using a wide range of dihaploids generated from tetraploid potato cultivars... " (EX1010 (Lindhout Declaration), 0537, ¶7.) "In the pedigree, the original tetraploid ($2n = 4x = 48$) <i>Solanum tuberosum</i> cultivars are shown in green, the dihaploids ($2n = 2x = 24$) generated from these tetraploids are shown in red...." (<i>Id.</i> , ¶9.)
(2)	"Through reduced parthenogenesis , step #2, a series of diploid derivatives of the tetraploid	Parental lines D1-D3, as further explained by the inventors' breeding history disclosed during prosecution, are dihaploids produced by gynogenesis from tetraploid commercial cultivar source material. (EX1001, 11:9-26, 22:16-23:3, 29:62-30:7, 31:39-62, 46:1-47:12 (Table 6), Fig. 2; EX1010, 0532, 0537-39.) " D1-D3 represent dihaploid clones ($2n = 2x = 24$) produced by haploidization of cultivated tetraploid <i>S. tuberosum</i> using conventional methods of

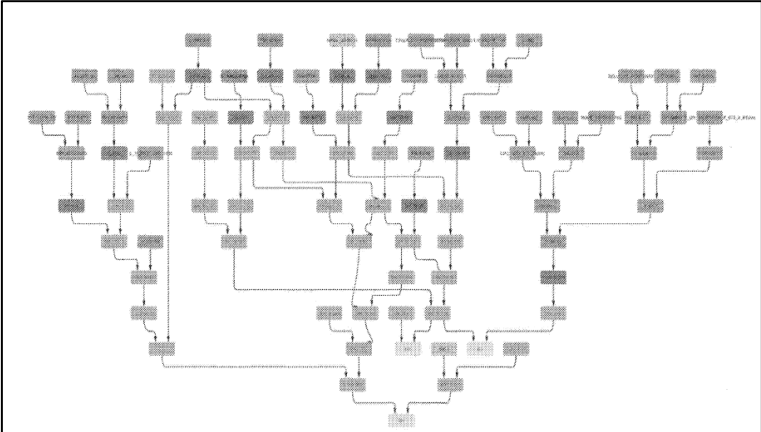
⁶ Unless otherwise noted, all annotations or emphasis are added.

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
	source is created.”	gynogenesis , ^[7] wherein haploidization occurs via the ‘maternal,’ or the seed parent’s genome. In this process, specific <i>S. phureja</i> ($2n = 2x = 24$) selections, known as ‘haploid inducers,’ contribute the paternal gametes for pollination of the desired haploid progenitor. Lines D1-D3 were produced through gynogenesis, also referred to as ‘prickle pollination’.” (EX1010 (Agventure NFOA Response, May 5, 2020), 0532.)
(3)	“Next, step #3, comes the selection and clonal propagation from among the array of parthenotes of one or, preferably, several plants...”	D1, D2, and D3 were selected from multiple choices, e.g., from among the D1-D19 of Table 6 of the '841 patent. (EX1001, 11:9-26, 22:16-23:3, 29:62-30:7, 31:39-62, 46:1-47:12 (Table 6); EX1010, 0538, 1052.) Further, <i>see</i> FIG. 1 from Lindhout Declaration (reproduced below) demonstrating choosing of D1, D2, and D3 from multiple choices. (EX1010 (Lindhout Declaration), 0538.)

⁷ Gynogenesis is a type of parthenogenesis.

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
		 Figure 1. Pedigree of the diploid breeding lines D1, D2 and D3 (yellow) as described in the Application.
(4)	“This is followed by step #4 wherein the selected parthenote or parthenotes are crossed to a series of diploid species, varieties or selections.”	FIG 2. of the '841 patent (reproduced below) provides the applicable diploid crosses and resulting F1 progeny. (EX1001, 11:9-39, 22:16-23:3, 29:62-30:7, 31:39-66, Fig. 2; EX1010, 0531-33, 0545.) These are shown below in red boxes. D1 (IVP97-079-9) x H (IVP07-1001/4) → F1 (IVP08-206) H (IVP07-1001/4) x D2 (IVPAA-096-18) → F1 (IVP08-207) H (IVP07-1001-5) x D3 (SH83-92-488) → F1 (AGV09-012)

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
		FIG. 2 FIG. 2 (CONTINUED)
		D1, D2, and D3 appear to have been derived from dihaploids (<i>i.e.</i> parthenotes) and H is a diploid potato

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
		used as a <i>Sli</i> gene donor and derived from clone F1-1, a <i>S. chacoense</i> x <i>S. tuberosum</i> Group Phureja hybrid. “Seed of the <i>Sli</i> gene donor ‘H’ was a gift.... [S]eeds are progeny of the <i>Sli</i>-donor F1-1 as described in Phumichai <i>et al.</i> (2005) <i>Genome Vol.</i> 48:977-984, Phumichai and Hosaka (2006) <i>Euphytica</i> 149:251-258, and Phumichai <i>et al.</i> (2006) <i>Euphytica</i> 148: 227-234.” (EX1010 (Agventure NFOA Response, May 5, 2020), 0531.) Further, see Lindhout Declaration, at paragraph 24, providing: “I point to Example 2 of the Application, where the self-compatible diploid <i>Sli</i>-gene donor (H, for Hosaka – the same <i>Sli</i>-gene donor to which Dr. Jones refers) was crossed with the three self-incompatible diploid potato clones D1, D2, and D3.” (EX1010 (Lindhout Declaration), 0545 ¶24.)
(5)	“Inbreeding of the diploid F₁ crosses, step #5...to fix desirable genetic material...[which] presents the plant breeder no problems of an unusual nature.”	FIG 2. of the '841 patent provides for inbreeding <i>via</i> selfing of diploid F₁ plants that leads to F₂ seeds deposited as AGVD1; inbreeding of diploid F₁ plants <i>via</i> sib-mating (<i>i.e.</i> F₁ (IVP08-207) X F₁ (IVP08-206)) that leads to “pseudo F₂” seeds deposited as AGVD2; and inbreeding <i>via</i> selfing of diploid F₂ plants that leads to F₃ deposited as AGVD17. (EX1001, 11:9-26, 22:16-23:3, 29:62-30:7, 31:39-62, Fig. 2; EX1010, 0533.) FIG 2. of the '841 patent provides for inbreeding <i>via</i> selfing of diploid F₁ plants that leads to F₂ deposited as AGVD1, which is shown below in red boxes.

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History																														
		FIG. 2 <table><tr><td colspan="3">D1 (IVP97-079-9) x H (IVP07-1001/4)</td></tr><tr><td colspan="3">F1 (IVP08-206)</td></tr><tr><td>H X F1 BC1 (AGV009-001, -003, -005) (depot: AGVD3) ⊗ BC1S1 (AGV010-067..117) summer fields 2010, selections ⊗ BC1S2 (AGV010-481) breeding</td><td>plant 32 F2 (AGV009-07) winter greenhouse 2009/2010 ⊗ F3 (AGV010-120/123) F3 X F3 test</td><td>plant 33 F2 (AGV009-01/09) (depot: AGVD1) F2 (AGV009-46/51) (depot: AGVD1) summer fields 2010, selections ⊗ F3 (AGV010-301/305) + F3 (AGV010-356/357) breeding</td></tr><tr><td></td><td></td><td>x D1 / D19 F1 (AGV010-501/520) + F1 (AGV010-602/606) breeding</td></tr><tr><td>purpose: # plants selected</td><td>1</td><td>725</td></tr></table> <table><tr><td colspan="3">H (IVP07-1001/4) x D2 (IVPAA-096-18)</td></tr><tr><td colspan="3">F1 (IVP08-207)</td></tr><tr><td>H X F1 BC1 (AGV009-002, -004, -006) (depot: AGVD3) ⊗ BC1S1 (AGV010-063..119) winter greenhouse 2009/2010 ⊗ BC2 (AGV010-901/915) + BC2 (AGV010-931/945) BC2 test</td><td>plant 20 F2 (AGV009-08) winter greenhouse 2009/2010 ⊗ F3 (AGV010-124/127) F3 X F3 test</td><td>plant 1 - 43 F2 (AGV009-10/27) (depot: AGVD1) F2 (AGV009-52/62) (depot: AGVD1) summer fields 2010, selections ⊗ F3 (AGV010-306/355) + F3 (AGV010-358/359) breeding</td></tr><tr><td></td><td></td><td>x D1 / D19 F1 (AGV010-521/601) + F1 (AGV010-607/621) breeding</td></tr><tr><td>purpose: # plants selected</td><td>1</td><td>5296</td></tr></table> FIG 2. of the '841 patent provides for inbreeding of diploid F₁ plants <i>via</i> sib-mating (<i>i.e.</i> F₁ (IVP08-207) X F₁ (IVP08-206)) that leads to “pseudo F₂” seeds deposited as AGVD2, which is shown below in a red box.	D1 (IVP97-079-9) x H (IVP07-1001/4)			F1 (IVP08-206)			H X F1 BC1 (AGV009-001, -003, -005) (depot: AGVD3) ⊗ BC1S1 (AGV010-067..117) summer fields 2010, selections ⊗ BC1S2 (AGV010-481) breeding	plant 32 F2 (AGV009-07) winter greenhouse 2009/2010 ⊗ F3 (AGV010-120/123) F3 X F3 test	plant 33 F2 (AGV009-01/09) (depot: AGVD1) F2 (AGV009-46/51) (depot: AGVD1) summer fields 2010, selections ⊗ F3 (AGV010-301/305) + F3 (AGV010-356/357) breeding			x D1 / D19 F1 (AGV010-501/520) + F1 (AGV010-602/606) breeding	purpose: # plants selected	1	725	H (IVP07-1001/4) x D2 (IVPAA-096-18)			F1 (IVP08-207)			H X F1 BC1 (AGV009-002, -004, -006) (depot: AGVD3) ⊗ BC1S1 (AGV010-063..119) winter greenhouse 2009/2010 ⊗ BC2 (AGV010-901/915) + BC2 (AGV010-931/945) BC2 test	plant 20 F2 (AGV009-08) winter greenhouse 2009/2010 ⊗ F3 (AGV010-124/127) F3 X F3 test	plant 1 - 43 F2 (AGV009-10/27) (depot: AGVD1) F2 (AGV009-52/62) (depot: AGVD1) summer fields 2010, selections ⊗ F3 (AGV010-306/355) + F3 (AGV010-358/359) breeding			x D1 / D19 F1 (AGV010-521/601) + F1 (AGV010-607/621) breeding	purpose: # plants selected	1	5296
D1 (IVP97-079-9) x H (IVP07-1001/4)																																
F1 (IVP08-206)																																
H X F1 BC1 (AGV009-001, -003, -005) (depot: AGVD3) ⊗ BC1S1 (AGV010-067..117) summer fields 2010, selections ⊗ BC1S2 (AGV010-481) breeding	plant 32 F2 (AGV009-07) winter greenhouse 2009/2010 ⊗ F3 (AGV010-120/123) F3 X F3 test	plant 33 F2 (AGV009-01/09) (depot: AGVD1) F2 (AGV009-46/51) (depot: AGVD1) summer fields 2010, selections ⊗ F3 (AGV010-301/305) + F3 (AGV010-356/357) breeding																														
		x D1 / D19 F1 (AGV010-501/520) + F1 (AGV010-602/606) breeding																														
purpose: # plants selected	1	725																														
H (IVP07-1001/4) x D2 (IVPAA-096-18)																																
F1 (IVP08-207)																																
H X F1 BC1 (AGV009-002, -004, -006) (depot: AGVD3) ⊗ BC1S1 (AGV010-063..119) winter greenhouse 2009/2010 ⊗ BC2 (AGV010-901/915) + BC2 (AGV010-931/945) BC2 test	plant 20 F2 (AGV009-08) winter greenhouse 2009/2010 ⊗ F3 (AGV010-124/127) F3 X F3 test	plant 1 - 43 F2 (AGV009-10/27) (depot: AGVD1) F2 (AGV009-52/62) (depot: AGVD1) summer fields 2010, selections ⊗ F3 (AGV010-306/355) + F3 (AGV010-358/359) breeding																														
		x D1 / D19 F1 (AGV010-521/601) + F1 (AGV010-607/621) breeding																														
purpose: # plants selected	1	5296																														

FIG 2. of the '841 patent provides for inbreeding of diploid F₁ plants *via* sib-mating (*i.e.* F₁ (IVP08-207) X F₁ (IVP08-206)) that leads to “pseudo F₂” seeds deposited as AGVD2, which is shown below in a red box.

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
		FIG. 2 (CONTINUED) FIG 2. of the '841 patent provides for inbreeding <i>via</i> selfing of diploid F₂ plants that leads to F₃ seeds deposited as AGVD7 [<i>sic</i>: AGVD17], which is shown below in a red box.

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
		FIG. 2 D1 (IVP97-079-9) x H (IVP07-1001/4) ↓ H X F1 BC1 (AGV009-001, -003, -005) (depot: AGVD3) ↓ BC1S1 (AGV010-067..117) summer fields 2010, selections ↓ BC1S2 (AGV010-481) breeding F1 (IVP08-206) plant 32 ↓ F2 (AGV009-07) winter greenhouse 2009/2010 ↓ F3 (AGV010-120/123) F3 X F3 test plant 33 ↓ F2 (AGV009-01/09) (depot: AGVD1) F2 (AGV009-46/51) (depot: AGVD1) summer fields 2010, selections ↓ F3 (AGV010-301/305) + F3 (AGV010-356/357) breeding F1 (AGV010-501/520) + F1 (AGV010-602/606) breeding purpose: # plants selected 1 7 25 H (IVP07-1001/4) x D2 (IVPAA-096-18) ↓ H X F1 BC1 (AGV009-002, -004, -006) (depot: AGVD3) ↓ BC1S1 (AGV010-063..119) summer fields 2010, selections ↓ BC1S2 (AGV010-482) breeding F1 (IVP08-207) plant 20 ↓ F2 (AGV009-08) winter greenhouse 2009/2010 ↓ F3 (AGV010-124/127) F3 X F3 test plant 1-43 ↓ F2 (AGV009-10/27) (depot: AGVD1) F2 (AGV009-52/62) (depot: AGVD1) summer fields 2010, selections ↓ F3 (AGV010-306/355) + F3 (AGV010-358/359) (depot: AGVD7) breeding F1 (AGV010-521/601) + F1 (AGV010-607/621) breeding purpose: # plants selected 1 52 96 For further elaboration, see EX1010 (Agventure NFOA Response, May 5, 2020), 0533 - although, as I have noted elsewhere, there are inconsistencies between the text discussion in the patent, the breeding diagram shown in Fig. 2, and the statements in the Lindhout Declaration.

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		As further explanation of this method (in red in the figure above), the middle part of Figure 2 is provided wherein the breeding program starts with a cross between diploid self-compatible <i>Sli</i>-donor IVP07-1001/4 and dihaploid <i>S. tuberosum</i> line IVPAA-096-18. The resulting F1 seed (IVP08-207) is grown into plants numbered 1–43. These plants are selfed, indicated by “⊗”, resulting in an F2. From these F2 populations (representative F2 seeds having been deposited under breeders reference AGVD2), fertile and self-compatible plants are selected and either selfed (left leg of right column) resulting in F3 populations (representative F3 seeds having been deposited under breeders reference AGVD17), or crossed (right leg of right column) with a plant of yet another dihaploid <i>S. tuberosum</i> line (D1-D19), resulting in an F1. Further breeding included steps of improving for agronomical traits through conventional breeding, using crossings, backcrossings and/or selfings.
(6) & (7)	Selecting (6) and then crossing (7) the inbred lines that have been “inbred...to homozygosity for genes controlling attributes of economic importance” to “maximize the heterotic interaction in	The selecting (6) and crossing (7) steps are taught in Example 5 of the '841. (EX1001, 52:30-52, 54:4-9.) The selecting (6) step of Chase is taught in “3. Evaluations and Selection” (EX1001, 52:30-52, reproduced below.)

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
	the final combination” to create “diploid hybrids”	3. Evaluations and Selection 30 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 35 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. 40 ated. Leaf samples of all self-compatible plants of the selected populations are collected for DNA marker testing. 45 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, 50 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. The crossing (7) step of Chase is taught in “7. Testcrosses with F4 Seeds and Field Trials” (EX1001, 54:4-9, reproduced below.)

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
		thereafter. Evaluations and selections as described above are 5 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 10 contrasting loci to produce test hybrids (F4×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 15 genetic diversity of the breeding germplasm. Further, at least
(8)	The “diploid hybrids are then manipulated to double their chromosome complements”	Example 5 further discloses diploid doubling to form tetraploids. (EX1001, 54:17-21.) The step (8) of Chase involving bringing the diploids back up to tetraploid level is taught in “7. Testcrosses with F4 Seeds and Field Trials” (EX1001, 54:17-21, reproduced below.) 15 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 20 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/ 25 crossed

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Chase Breeding System Steps	Chase Breeding System Instructions (EX1007 (Chase), 0006.)	Breeding System Disclosed in '841 Patent and Characterized in the Prosecution History
(9)	The “resulting tetraploids are crossed...to establish the heterotic tetraploid hybrid.”	Example 5 further teaches crossing those tetraploids. (EX1001, 54:21-23, 54:34-35.) The step (9) of Chase involving crossing the tetraploids to create a tetraploid hybrid is taught in “7. Testcrosses with F4 Seeds and Field Trials” (EX1001, 54:21-23, 54:34-35, reproduced below.) 15 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 20 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/ 25 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 30 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 35 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.

2. The *Sli* Gene Imparting Self-Compatibility Was Known as Useful for Inbreeding and True Potato Seed Production

71. Most diploid potatoes and their related wild cousins are self-incompatible. (EX1031 (Hosaka 1998b), 0001.) Long before 2009, however, several self-compatible diploid potato variants had been described, including in *Solanum chacoense* and the dihaploid US-W4, and POSAs knew that self-compatibility in these variants had a genetic basis. (EX1030 (Hosaka 1998a), 0001; EX1031 (Hosaka 1998b), 0001; EX1032 (Birhman), 0002; EX1011 (Jansky 2009), 0010; EX1004 (Jong), 0006.) Breeders had crossed these variants to other diploid potatoes, including *S. tuberosum*. (EX1030 (Hosaka 1998a), 0004; EX1032 (Birhman), 0007; EX1011 (Jansky 2009), 0010; EX1004 (Jong), 0006; *see also* EX1005 (Phumichai), 0006.)

72. In fact, diploid potato variants that were self-compatible had been described for decades. In the 1960s, Hielke de Jong, then at the University of Wisconsin, described US-W4, a haploid that produced self-fertile offspring. (*See, e.g.,* EX1004 (Jong), 0006 (explaining “crosses involving haploids from an inbred Minnesota seedling, *Minn.* 20-20-34, (primarily US-W4) were found to be self-fertile”).) Jong further showed that US-W4 could be crossed with diploid *S. tuberosum* Group Phureja or Group Stenotomum to produce fertile, self-compatible

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offspring. (EX1004 (Jong), 0007-13.) Jong selfed the offspring of the cross between US-W4 and *S. tuberosum* Group Phureja several times, creating S₅ generation plants that were “fairly vigorous,” “about 97% homozygous,” and that had a “high degree of uniformity.” (*Id.*, 0012-13.) Several of the inbred lines had tuber yields of more than 200 grams per hill. (*See id.*, 0009 (describing S₂ US-W5315 yield of 415g per hill).) Jong’s creation of S₅ generation plants was described as “probably represent[ing] the greatest degree of inbreeding ever imposed upon potatoes.” (*Id.*, 0013.) In order to take his lines to the S₅ level, Jong must have been able to preserve fertility and self-compatibility over five generations.

73. Furthermore, by 2009, the genetic basis for self-compatibility in diploid potatoes—the gene *Sli* (referring to the *S* locus inhibitor)—was well-known and had been characterized. Researchers had identified the *Sli* gene in the wild relative *S. chacoense*, and the dominant allele of this gene could transform self-incompatible plants into self-compatible ones. (EX1030 (Hosaka 1998a), 0001; EX1031 (Hosaka 1998b), 0001; *see also* EX1005 (Phumichai), 0006.) They exploited the *Sli* gene in breeding schemes to create diploid, homozygous, highly inbred lines which they taught (and a POSA would recognize) could be propagated by true potato seed. (*See, e.g.*, EX1005 (Phumichai), 0005.) Phumichai, for example, describes the successful creation of highly inbred diploid potatoes, with S₅ diploid inbreds that were more

than 90% homozygous as well as highly-inbred plants with “considerable tuber yields.” (*Id.*, 0010.)

74. Using donor plants carrying the *Sli* gene, breeders could create self-compatible diploids that contributed to advances in both breeding and genetics. (*See id.*, 0010 (“[T]hese advanced inbreds may be valuable genetic stocks for studying the mechanism of heterosis and for producing hybrid variety at the diploid level.”); *id.* (“Because of the simple procedure (crossing with a *Sli* gene donor, then continued selfings), the *Sli* gene method may be a better alternative in obtaining such inbreds.”).)

3. By 2009, All That Was Left for Breeders to Practice These Methods Was Routine Breeding Work

75. Given the extensive teachings in the prior art, a POSA would have found it simple to design and implement a breeding scheme to create other diploid, fertile, self-compatible, and highly homozygous potatoes and/or cross these potatoes to create uniform heterotic hybrid true potato seed. Hosaka, Hanneman, Birhman, and Phumichai had all published on *Sli*-based self-compatibility and demonstrated the utility of the gene when incorporated into an inbred diploid breeding program for the creation of hybrid offspring and the production of true potato seed. (EX1005 (Phumichai); EX1030 (Hosaka 1998a); EX1031 (Hosaka 1998b); EX1032 (Birhman).) A POSA would have applied the teachings to their own varieties, using

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the disclosures from Chase on analytical breeding and Phumichai on exploiting *Sli*, and have been further motivated by the proof from Jong that diploid potatoes with the desired traits, including high tuber yield, could be produced. (See EX1004 (Jong); EX1005 (Phumichai); EX1007 (Chase).) As I discuss in this declaration, the '841 inventors claim to have been the first to perform such work, but they were not. The work described in the '841 patent is anticipated by the prior art, or was at least obvious in view of that art. I note that inventor Lindhout stated in a 2011 publication, shortly after the 2009 filing of the '841 patent, that such a breeding scheme was “not new.” (EX1033 (Lindhout 2011), 0001.) I agree with this assessment.

V. THE '841 PATENT

A. Issued Claims

76. The '841 patent is titled “Hybrid Seed Potato Breeding.” The '841 patent has ten claims as follows (letters in brackets were added for ease in referencing subparts of individual claims):

#	Claim Limitation
1[a]	A plant of a potato line, wherein said potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to <i>Solanum tuberosum</i> ,
1[b]	wherein said potato line is diploid, fertile, self-compatible,
1[c]	produces at least 200 grams fresh weight of tubers per plant, and

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#	Claim Limitation
1[d]	at least 75% of the genomic loci in said potato line are homozygous,
1[e]	wherein said self-compatibility in said potato line is conferred by the S-locus inhibitor (<i>Sli</i>) gene, and wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively.
2	The potato plant of claim 1, wherein said plant comprises at least one agronomically desirable trait selected from the group consisting of: insect tolerance, nematode tolerance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, flooding tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.
3	The potato plant of claim 1, wherein said potato plant has a fresh weight of the foliage and shoots of at least 500 grams per plant at maturity.
4	A seed or tuber that produces the plant of claim 1.
5[pre]	A method of producing a plant of a potato line, wherein said potato line is diploid, fertile, self-compatible, produces at least 200 grams fresh weight of tubers per plant, and at least 75% of the genomic loci in said plant line are homozygous, comprising the steps of:
5[a]	(a) providing a first potato plant, wherein said first potato plant is the plant according to claim 1;
5[b]	(b) providing a second potato plant, wherein said second potato plant is a diploid plant, and wherein said potato plant comprises any level of homozygosity;
5[c]	(c) cross-pollinating said first potato plant and said second potato plant to produce seeds and collecting said seeds to thereby provide hybrid offspring seeds;

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#	Claim Limitation
5[d]	(d) growing said hybrid offspring seeds to provide a population of hybrid offspring potato plants and selecting from said population a self-compatible potato plant;
5[e]	(e) inbreeding said self-compatible potato plant by selfing said self-compatible potato plant for between 1 to 8 selfings to thereby increase the degree of homozygosity in each successive generation; and
5[f]	(f) selecting within each generation of inbreeding for a fertile offspring plant, and providing a diploid, fertile, self-compatible potato plant, wherein at least 75% of the genomic loci in said plant are homozygous.
6	The method of claim 5, wherein said second potato plant is a donor for an agronomically desirable trait selected from the group consisting of: insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, flooding tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.
7	A potato plant produced by the method of claim 5, wherein said potato plant is diploid, fertile, self-compatible, produces at least 200 grams fresh weight of tubers per plant, wherein at least 75% of the genomic loci in said potato plant are homozygous, and wherein said self-compatibility in said potato plant is conferred by the <i>Sli</i> gene.
8[pre]	A method of producing a uniform diploid hybrid <i>Solanum tuberosum</i> potato seed, which seed, when sown produces a diploid, fertile, and self-compatible potato plant having a tuber yield expressed in grams of fresh weight of at least 200 grams and wherein said self-compatibility trait is due to the presence of the <i>Sli</i> gene, said method comprising
8[a]	(a) providing a first potato plant, wherein said first potato plant is a plant of a first potato line, wherein said first potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to <i>Solanum tuberosum</i> , wherein said first potato line is diploid, fertile, self-compatible and wherein at least 75% of the genomic loci in said first potato line are homozygous, and wherein

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#	Claim Limitation
	said self-compatibility in said first potato line is conferred by the <i>Sli</i> gene, wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively, and wherein said first potato plant has a tuber yield expressed in grams of fresh weight of at least 200 grams;
8[b]	(b) providing a second potato plant, wherein said second potato plant is a plant of a second potato line, wherein said second potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to, wherein said second potato line is diploid fertile, self-compatible and wherein at least 75% of the genomic loci in said second potato line are homozygous, wherein said self-compatibility in said second potato line is conferred by <i>Sli</i> gene, wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively, wherein said second potato plant has a tuber yield expressed in grams of fresh weight of at least 200 grams, and wherein said second potato plant contains at least 20% contrasting homozygous loci as determined by molecular marker analysis when compared to said first potato plant;
8[c]	(c) cross-pollinating said first and said second potato plant and allowing said potato plant to produce berries with seeds; and
8[d]	(d) collecting said seeds from said berries to provide hybrid potato seeds.
9	The method according to claim 8, wherein at least one of said first and said second potato plant 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, flooding tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.

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#	Claim Limitation
10	A uniform hybrid F1 potato seed produced according to the method of claim 8.

B. Overview of the Specification

77. The '841 patent states that it “relates to diploid, fertile, self-compatible and essentially homozygous potato lines,” “methods for producing such plants” and “hybrid seeds obtained by crossing such homozygous potato lines[.]” (EX1001 ('841 patent), Abstract.) It purports 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.” (*Id.*, 4:31-35.)

78. The '841 patent states that the inventors produced 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.” (*Id.*, 4:47-51.) The patent specification further describes that “at least 200 grams per plant are in general terms also referred to herein as being vigorous.” (*Id.*, 4:51-54.) It also provides that “‘fertile’ and ‘fertility’ broadly refer to the capacity to reproduce, i.e. to conceive and to produce offspring, preferably fertile offspring” (*id.*, 18:45-47), while “self-compatible” refers to “capacity to develop seeds in berries that are the result of self-pollination, self fertilization and producing fertile

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progeny” (*id.*, 19:5-7).

79. The patent further purports to describe a method for making a diploid, fertile, self-compatible, and essentially homozygous potato line. (*Id.*, 5:22-24.) To do so, the inventors of the '841 patent describe selecting first and second potato plants, and cross pollinating the plants; growing the offspring of these plants; and then selfing the hybrid offspring “for between 1 to 8 selfings or backcrosses[.]” (*Id.*, 5:27-49.) In the context of creation of hybrids, the specification also explains that the first and second potato lines can optionally have “agronomically desirable characteristics, have good general combining abilities, and preferably have at least 20% contrasting homozygous loci as determinable by molecular marker analysis.” (*Id.*, 6:5-10.)

80. As part of the invention, the '841 patent inventors relied on the use of the *Sli* gene to develop homozygous potato lines. There was nothing novel or inventive about doing so just as there was nothing novel about the breeding scheme the inventors used. Even the '841 patent inventors recognized that the prior art had “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.” (*Id.*, 4:6-9.) The patent (wrongly) contends, however and as described further below, that “no homozygous lines with good agronomic traits

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such as good tuber yield, have ever been reported from this proposed line of research.” (*Id.*, 4:10-14.)

81. With respect to potato lines with the *Sli* gene, the '841 patent describes three potato lines made by the '841 patent inventors, AGVD1, AGVD2, and AGVD3. (*Id.*, 22:16-57, 29:47-30:21.) The '841 patent inventors made these lines by crossing the parent donor plant D1 with H (IVP07-1001/4, apparently a group of *Sli* donor lines obtained from the Hosaka group) and then selfing to produce (AGVD1); sib-mating (H x D2) x (D1 x H) to produce AGVD2, and backcrossing [H x (D1 x H)] to produce AGVD3. (*Id.*) The '841 patent also describes AGVD17, which it states was made by crossing D2 with IVP07-1001/4, further backcrossing the F₁ offspring IVP07-1001/4, and then two rounds of selfing. (*See id.*, 22:58-23:3.)⁸ The '841 patent estimates the homozygosity of AGVD1, AGVD2, AGVD3, and AGVD17 as about 50, 25, 75, and >80% for loci for which the parents differ, respectively. (*See id.*, 22:30-32, 22:44-45, 22:56-57, 23:1-3.)

82. The '841 patent has several Examples. In Example 2, the '841 patent

⁸ I note that the '841 patent is ambiguous about the breeding history of AGVD17. Figure 2 of the patent, which purportedly shows the breeding history of the deposited lines AGVD1, 2, 3, and 17, does not agree with the statements in the specification. Figure 2 indicates that AGVD17 (which is apparently mislabeled AGVD7) is the result of a cross of “H” with “D1,” resulting in an F₁ generation that was then selfed twice to form an F₃. (*See id.*, Fig. 2.) It is not clear whether the breeding history given in the specification or Figure 2 for AGVD17 is the correct one.

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inventors describe the yield of some potato lines, including two F₂ generation lines made by selfing H x D1 and H x D2 F₁ hybrids. (*See id.*, 31:19-33:26.) The '841 specification does not describe any level of homozygosity for these plants, and only one of the two selfed F₂ families produced an average yield of more than 200 grams of tubers. (*See id.*, Table 2.) Furthermore, tuber yield was based on an unreplicated winter greenhouse trial, which is not standard practice in the field. As well, “[m]ost of the populations showed a weak plant growth[.]” (*Id.*, 32:62-63.) A POSA would thus have understood that the inventors encountered inbreeding depression, just as would be expected from the prior art. Consequently, the statement “unexpectedly, the desired plants could be obtained, starting from material that would otherwise have been neglected by breeders” fails to acknowledge that a POSA would have expected inbreeding depression and would have reduced selection intensity or increased population size to account for it if necessary. (*Id.*, 33:5-7.) I also note, as I mentioned above, that there are inconsistencies in the breeding history of the AGVD lines as explained in the body of the patent versus as explained in Fig. 2. Similarly confusing is that the plants used to obtain the tuber yield data provided in Table 2 are not identified as necessarily corresponding with any of the other plants or lines identified in the patent or in Fig. 2., or with any of the deposited AGVD lines.

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83. The patent specification further states that the inventors obtained lines with “intermediate/high” vigor and tuber yield. The specification, however, never quantifies “[i]ntermediate/high” vigor or tuber yield nor does it provide data to support these statements. (*See id.*, 33:7-9, Table 4; *see also generally id.*)

84. In Example 3, the ’841 patent inventors describe “development of a molecular marker platform” based on single nucleotide polymorphisms (“SNPs”). (*See id.*, 33:28-47:11.)

85. In Example 4, the ’841 patent inventors further describe the attempted development of homozygous diploid potato plants and the generation of heterozygous F₁ hybrid offspring from those plants. To generate plants, the inventors selfed an H x D1 F₁ plant and an H x D2 F₁ plant, and then selfed twice to create six F₃ families, and then used markers to determine the level of homozygosity in the F₃ plants. (*Id.*, 47:12-51:20.) Within the F₃ populations, the patent reports that “[t]he mean heterozygote level ranged from 84 to 95%, while that of individual plants ranged from 71 to 100%[.]” (*Id.*, 47:63-67; *see also id.*, at Table 7.) These numbers are based on a very small set of SNP markers (only 36), which is insufficient to support the claim that “hybrid seeds that are essentially uniform ...have now been produced.” (*Id.*, 50:30-36.) Furthermore, no evidence is provided to support that heterosis was observed in “hybrid plants with at least five

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heterozygous chromosome regions.” (*Id.*, 50:33-34.) Yield data for these F₃ lines in Example 4 are not reported by the patent.

86. In Example 5, the '841 patent inventors then describe an example breeding scheme for a commercial potato variety although no resultant plants from this scheme are described. (*Id.*, 51:22-54:38.) Again, there is nothing novel about this breeding scheme which had already been described sixty years before.

87. I note that despite claiming the production of uniform hybrid seed by crossing inbred lines and claiming obtaining hybrids yielding at least 200 grams (*see id.*, Claim 8), the specification never describes that the inventors actually practiced the steps of Claim 8.

88. I further note that the inventors make several statements in the specification claiming that the work they described was entirely new, novel, and unexpected. For example, the inventors stated:

- “[t]his is an entirely new approach...” (*Id.*, 24:61);
- “unlike the prior art methods the procedures are performed using diploid plant lines, instead of tetraploid plants.” (*Id.*, 24:65-67);
- “this radically new approach...” (*Id.*, 25:1);
- “properties, heretofore never attained together in a single potato line...” (*Id.*, 19:59-60);

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- “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” (*Id.*, 20:51-54);
- “diploid potato plants resulting from inbreeding, and attaining homozygosity of at least 25% or 50% on the alleles are invariably weak growers” (*Id.*, 21:14-16); and
- “it has proven impossible to provide the combination of all these features in a single potato plant (line)” (*Id.*, 24:25-26).

Considering the prior art discussed in this declaration, in my view these statements made by the inventors were not correct.

C. Provisional Application Nos. 61/254,980 (US) and 09013474 (EP)

89. I understand from counsel that the '841 patent claims priority to U.S. Provisional 61/254,980 (EX1040), and EP document 09013474 (EX1010 ('841 patent file history), 0380-415).

90. I have reviewed both of these patent application documents and note several differences between the issued '841 patent and the applications:

- a) *First*, neither application discloses at least 75% homozygosity of any potato line, as claimed by the '841 patent.
- b) *Second*, neither application discloses 200 grams fresh weight of tubers

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per plant.

- c) *Third*, the applications lack certain disclosures of the *Sli* gene: they do not disclose *Sli* self-compatibility gene by name and they do not disclose the H line that the inventors of the '841 patent appear to have used to source *Sli*.
- d) *Fourth*, they do not disclose several lines recited in the '841 patent, for example they lack the donor lines D1, D2, or D3 as well as the AGVD17 line.

D. Overview of the Prosecution History

91. I have reviewed the prosecution history for the '841 patent. Counsel has informed me, and I understand, that Jong was not used by the Examiner in an office action. I find this surprising given Jong discloses and renders obvious diploid, fertile, self-compatible, essentially homozygous potato lines having an average tuber yield of at least 200 grams per plant and methods for making these plants. (*See generally* EX1004 (Jong).) I am also aware that the Opposition Division of the European Patent Office has recently revoked a related European Patent owned by Agventure. (EX1057.) I understand this decision was based in part on the finding that the US-W4 potato was described in the literature, publicly available prior to the '841 patent, and met all the limitations of at least one claim of the patent under

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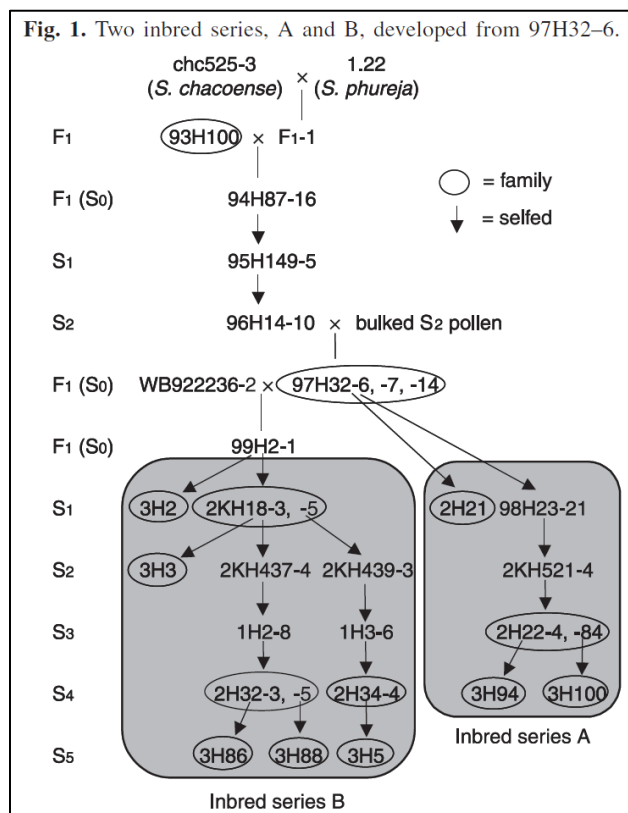
review. (EX1057, 0010-12.) I discuss these arguments more in section VI.G below.

92. As described below, the Examiner also appears to have misunderstood the Phumichai reference. Further, Agventure made statements about Phumichai which are incorrect.

1. Statements about Phureja

93. During prosecution, Agventure argued that the inbreeding technique disclosed in Phumichai is **not** performed with *S. tuberosum*. (EX1010 ('841 patent file history), 1036.) Agventure was incorrect. For the reasons I explained in Section IV.A above and reiterate here, a POSA would have known that Group Phureja plants are *S. tuberosum*. Phumichai discloses the following breeding scheme, beginning with an initial cross of *S. chacoense* and *S. phureja* (i.e., an *S. tuberosum* plant):

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(EX1005 (Phumichai), Fig. 1.)

94. Before 2009, the scientific literature firmly established Phureja as within the species *S. tuberosum*. In 1962, Dodds and Paxman classified Phureja as *S. tuberosum* and did not consider it a separate species. (EX1046 (Dodds), 0012 (Table 14).) Later, but still many years before 2009, Huaman studied the morphology of many potato varieties and confirmed that Phureja was not distinct from *S. tuberosum*. Instead, Huaman recognized “all landrace populations of cultivated potatoes [including Phureja Group] as a single species, *S. tuberosum*[.]” (EX1012 (Huaman), Abstract, 0011-12.)

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95. Studies using genetic tools further confirmed that Group Phureja was not a distinct species. Spooner studied 742 landrace potatoes using molecular markers and concluded that recognition of *S. phureja* as a species was “no longer tenable.” (EX1006 (Spooner), 0012.) Indeed, the ’841 patent demonstrates that Agventure’s characterization of the plants in Phumichai was wrong. For example, the molecular markers used by the ’841 patent to assess homozygosity of its own claimed *S. tuberosum* diploid potatoes were developed from “the first draft sequence of the potato genome” which was based on the sequence of a DM1-3 potato plant. (EX1001 (’841 patent), 33:44-45, 33:57-61.) DM1-3, as the specification highlights, is a Phureja potato, and the specification uses nomenclature referring to it as *Solanum tuberosum* Group Phureja. (*See supra*, §IV.A.) Thus, the ’841 patent as well as the scientific literature before it recognized that Group Phureja is *S. tuberosum* germplasm.

2. The Lindhout Declaration Confirms Inbreeding Schemes for Diploid Potatoes Were Well-Known

96. During prosecution, Agventure submitted a declaration from Willem Hendrik Lindhout, one of the inventors on the ’841 patent. (EX1010 (’841 patent file history), 0535-52 (“Lindhout Decl.”).) The Lindhout Declaration states that it was made “to provide evidence demonstrating that the dihaploid lines designated D1, D2, and D3 are genetically diverse and are representative of the entire range of genomic

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diversity in the *Solanum tuberosum* germplasm that is currently available[.]”
(Lindhout Decl., ¶4.)

97. The Lindhout Declaration also contains many statements confirming that breeding schemes for making potatoes like those disclosed in the ’841 patent were well-known and widely used by 2009 and that a POSA would have been able to use any *S. tuberosum* variant in that breeding. For example, the Declaration explains that “success in practicing the claimed invention is not unpredictable and does not depend on the genotype of the potato lines used.” (*Id.*, ¶5.) It further provides that

[A]ny *S. tuberosum* diploid is equally suitable for use as starting material in a method of the invention, that is, to serve as a recipient of the *Sli*-gene to produce a self-compatible diploid line that can be selfed in order to increase its level of homozygosity.

(*Id.*, ¶15.)

98. The Lindhout Declaration refers to another declaration, again from Dr. Lindhout, submitted in U.S. Patent Application No. 13/504,156 for now issued U.S. Patent No. 10,524,436. (EX1053 (’436 Lindhout Decl.).) I understand from counsel that this patent is in the same patent family as the ’841 patent and thus statements made during the prosecution of that patent are relevant to the prosecution of the ’841 patent. Furthermore, the Lindhout Declaration expressly incorporates statements

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from this other declaration, explaining Dr. Lindhout “reiterate[s] the comments” he made in that declaration, namely:

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 self 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 *Solanum tuberosum* plants, and further supports the effectiveness of the method.

(Lindhout Decl., ¶21.) Thus again, Dr. Lindhout confirmed that the breeding scheme was not novel, and a POSA would have been able to start the breeding program with any *S. tuberosum* diploid donor line to generate lines that practice the Claims of the ’841 patent. The work described in the quoted language above is familiar to me, and as I explain in this declaration, work such as this could have been performed by a POSA using potato germplasm that was available before 2009.

99. Additionally, the Lindhout Declaration makes clear that *Sli* was available to any POSA and already disclosed in the prior art, stating that the *Sli*-gene donor used by the ’841 patent inventors is the “Hosaka” donor. (Lindhout Decl., ¶24.) The ’841 patent discloses that “Hosaka” refers to the donor described in Hosaka 1998a (EX1030) and subsequent publications from the Hosaka group.

100. Accordingly, even the patent inventors recognized that the prior art already disclosed breeding plants with the *Sli* gene and that a POSA could use any *S. tuberosum* plant in that breeding scheme.

3. Agventure Incorrectly Argued That a POSA Would Not Select Plants in a Breeding Scheme Based on Fertility

101. The Lindhout Declaration goes on to suggest that “selection of progeny plants for subsequent crosses based on a plant’s fertility” was not “well-understood and routine[.]” (Lindhout Decl., ¶29.) The Lindhout Declaration further states that “[s]election for fertile offspring or persistent self-compatibility in the selfed progeny of inbred diploid potato has shown to require the generation of large numbers of plants[.]” (*Id.*) In turn, “the plants that held potential of yielding fertile progeny were shown to be seemingly useless plants which often carried only a few berries” and “[t]his meant that the vigorous and abundantly flowering plants were not the plants to be selected as these were the plants that were the least homozygous.” (*Id.*)

102. For several reasons, I disagree with the idea that anything about the selection of progeny based on fertility was unexpected. First, before 2009, potato breeders and other plant breeders who were developing inbred lines focused on selections for fertility, and did not only select for, for example, tuber yield. In fact, the prior art expressly discloses selecting for fertility. (*See, e.g.*, EX1004 (Jong), 0013 (describing selection for self-fertility); EX1005 (Phumichai), 0010 (explaining

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“[i]n this study, we paid little attention to tuber yield because most self-pollinations were made on seedlings”).) Furthermore, inbreeding requires selfing (or sib-mating), and thus it was necessary to the success of the breeding program that the plants be fertile. Thus, contrary to the Lindhout Declaration, methods for selecting for fertility were routine, and indeed it was obvious that only fertile plants could be carried forward in the inbreeding program.

103. Second, due to the routine selection for fertility, the well-known concept of inbreeding depression, and the widely appreciated relationship between homozygosity and inbreeding depression, plant breeders knew that the more homozygous plants might not be the most vigorous (at least initially). (*See supra*, §IV.F.) Thus, breeders would not necessarily have chosen the most vigorous plants at each stage of the selection. In fact, Jong makes this explicit:

In our experiment, however, **special efforts were made to obtain selfed seed from the weaker clones** as well as from the more vigorous ones.

(EX1004 (Jong), 0012.)

104. Third, the Lindhout Declaration appears to simply state the obvious—that the creation of inbreds in breeding programs often requires large populations (in part due to inbreeding depression). A POSA by 2009 would have been well-versed in inbreeding schemes and the fact that inbreeding depression could ultimately be

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overcome by selecting fertile plants within large breeding populations. The Lindhout Declaration thus simply reiterates well-known principles of inbreeding. Nothing the Lindhout Declaration explains is unique to potato inbreeding. Instead, the statements in it reflect common principles of inbreeding programs. (*See supra*, §§IV.F, H.)

VI. APPLICATION OF THE PRIOR ART TO CHALLENGED CLAIMS

105. I have reviewed and analyzed the prior art references and materials listed in Section I.B above and discussed in more detail in Section VI.A below. In my opinion, all claims of the '841 patent are invalid based on the following prior art, organized into five “Grounds” as set forth below.

Ground	Claim(s)	Basis for Challenge
1	1, 4, 7	Anticipated by Jong (EX1004)
2	1-7	Obvious over Jong, Chase, and Bamberg (EXS1004, 1007, 1009)
3	8-10	Obvious over Jong, Chase, Bamberg, and Springer (EXS1004, 1007, 1008, 1009)
4	1-7	Obvious over Phumichai, Jong, Chase, Bamberg, and Spooner (EXS1004-1007, 1009)
5	8-10	Obvious over Phumichai, Jong, Chase, Bamberg, Spooner, and Springer (EXS1004-1009)
6	1, 4	Anticipated by US-W4 Disclosed in Jong
7	5-10	Obvious over US-W4, Chase, Bamberg, and Springer

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Ground	Claim(s)	Basis for Challenge
8	1, 4	Anticipated by RH89-039-16 Disclosed in Voort (EX1070)
9	5-10	Obvious over RH89-039-16, Chase, Bamberg, and Springer

A. Brief Summary of Prior Art

1. Jong [EX1004]

106. The Jong reference is a journal article titled “Inbreeding in cultivated diploid potatoes[,]” published in volume 14 of *Potato Research* in 1971.

107. Jong describes studying “[t]he effects of inbreeding in cultivated diploid potatoes [] by using self-fertile hybrids from crosses between Group Phureja and Group Stenotomum and haploids of Group Tuberosum.” (EX1004 (Jong), 0006 at Summary.) As Jong explains, the study was aimed at researching “the effect of inbreeding on populations derived from diploid-haploid hybrids.” (*Id.*) The authors were motivated to conduct this diploid inbreeding study as it had several advantages over inbreeding tetraploids, including (1) producing plants that were an extremely fertile source of unexplored genetic variability; (2) faster progress to homozygosity upon selfing; (3) the ability to quickly obtain stocks homozygous for marker genes; and (4) easier analysis of segregation ratios from progenies of selfed seeds. (*Id.*, 0006-07.)

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108. Jong further describes inbreeding potato plants in the following hybrid families:

<i>US-W 5309 (Phu PI 195191 × US-W4)</i>
<i>US-W 5314 (Phu PI 225708.1 × US-W4)</i>
<i>US-W 5315 (Phu PI 225675.1 × US-W4)</i>
<i>US-W 5328 (Stn PI 230513.1 × US-W4)</i>

(*Id.*, 0007.) All of these potatoes are *Solanum Tuberosum*. “Phu” and “Stn” denote Group Phureja and Stenotomum while US-W4 is a Group Tuberosum haploid known to confer self-compatibility. Jong then notes that these plants were “self-pollinated and the seed produced by self-fertile plants bulked to produce subsequent generations.” (*Id.*) With subsequent levels of inbreeding, Jong states that “it is possible to obtain homozygous clones for future genetic studies on the diploid level” and “the diploid S₅ generation is about 97% homozygous.” (*Id.*, 0013.)

109. In the Results, Jong discloses the effects of the inbreeding of the 4 families as follows:

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INBREEDING IN CULTIVATED DIPLOID POTATOES															
Table 1. Effect of inbreeding on four diploid potato families.															
Family ¹	Number of clones ²			Plant height ³ (cm)			Vigour index ⁴			Tubers/hill ⁵			Tuber weight g/hill ⁶		
	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂
First clonal generation ⁷															
<i>US-W 5309</i>	12	16	16	43	25	27	3.5	2.3	2.5	21	16	15	563	248	269
<i>US-W 5328</i>	9	12	8	41	27	17	3.6	2.4	1.6	19	15	8	390	425	167
<i>US-W 5314</i>	0	12	11		27	23		2.4	2.2		13	7		287	88
<i>US-W 5315</i>	0	10	9		25	29		2.6	2.7		20	21		297	415
Total	21	50	44												
Weighted average ⁸				42	26	25	3.5	2.4	2.2	20	16	14	499	304	181
% of S ₀ ⁹				100	62	60	100	69	63	100	80	70	100	61	36

(*Id.*, 0009 (Table 1).) As shown in the table, Jong reports on achieved tuber weights of over 200 grams in the S₀, S₁ and S₂ generations. Table 4 further reports on the effects of inbreeding on flowering and fertility:

Table 4. Effect of inbreeding on flowering and fertility.									
Level of inbreeding ¹	Clones planted ²	Per cent stand ³	Per cent flowering ⁴	Fertility in per cent of flowering clones ⁵			Seeds/fruit for fertile plants ⁶		
				Self- ⁷	Pollen- ⁸	Ovule- ⁹	Self- ⁷	Pollen- ⁸	Ovule- ⁹
S ₀	21	95	100	47	85	86	12	54	76
S ₁	50	91	54	16	34	23	9	36	34
S ₂	44	74	54	16	41	47	6	38	30

¹ Inzuchtgrad – Degré de consanguinité

² Anzahl gepflanzter Klone – Clones plantés

³ Prozent Pflanzenentwicklung – Situation en %

⁴ Prozent Blühzustand – % de floraison

⁵ Fertilität in % der blühenden Klone – Fertilité en % des clones fleurissant

⁶ Samen/Frucht für fruchtbare Pflanzen – Semences par fruit chez les plantes fertiles

⁷ Selbst – Auto

⁸ Pollen- – Pollen-

⁹ Eizellen – Ovule

Tabelle 4. Einfluss der Inzucht auf den Blühzustand und die Fruchtbarkeit.									
Tableau 4. Effet de l'autofécondation sur la floraison et la fertilité.									

(*Id.*, 0011 (Table 4).) In addition to this publication, I understand that Professor Jong also produced similar results in a detailed thesis work, also published in 1971. In my opinion, a POSA interested in the work described in Jong would have also

consulted this thesis for additional insight. (See EX1034 (Jong thesis).)

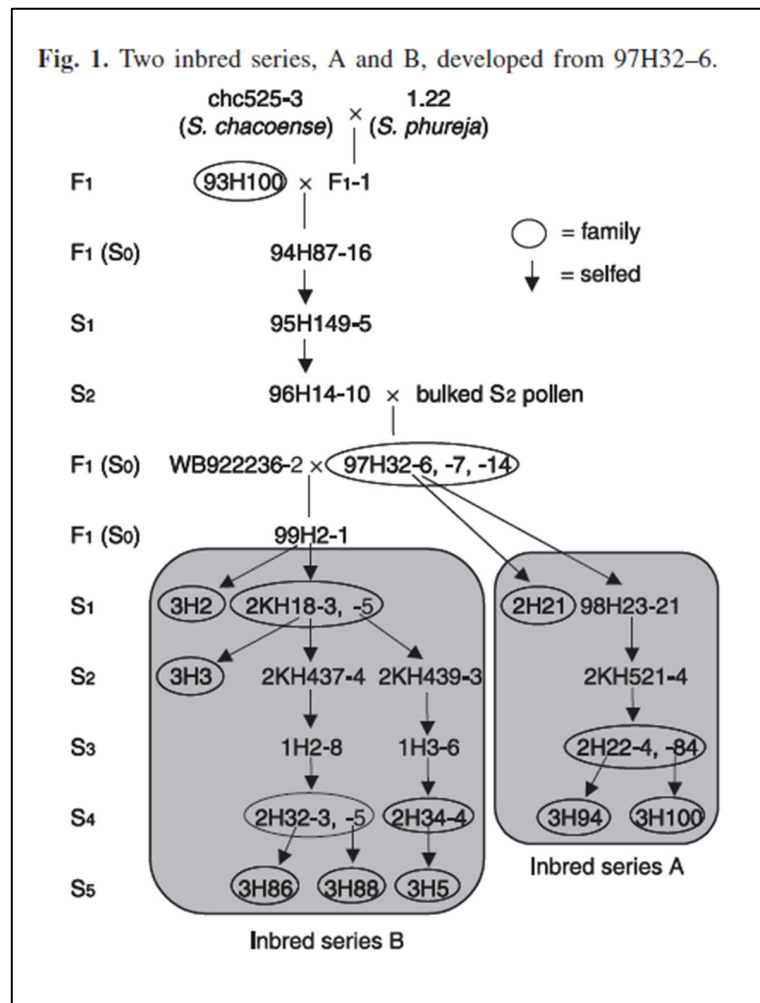
2. Phumichai [EX1005]

110. Phumichai is a journal article titled “Toward the development of highly homozygous diploid potato lines using the self-compatibility controlling *Sli* gene,” published in 2005 on pages 977-984 of volume 48 of *Genome*.

111. Phumichai describes inbreeding of *Solanum tuberosum* having the dominant allele *Sli* (the S locus inhibitor gene). In particular, Phumichai states that one objective of the study was “to discuss the usefulness of *Sli* gene in developing of highly homozygous lines of diploid potato.” (EX1005 (Phumichai), 0006.)

112. As shown in Figure 1, Phumichai crossed the *Solanum tuberosum* cultivar-group, Group Phureja, with *Solanum chacoense* to eventually produce two inbred series:

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(EX1005 (Phumichai), 0007 (Fig. 1).) An F1 hybrid clone generated by crossing chc525-3 with 1.22 was crossed to 93H100 (Group Phureja and Group Stenotomum germplasm, *see* EX1030 (Hosaka 1998a)) followed by self-pollinations, an outcross event, and then additional selfings. There were at least 5 selfing generations in inbred series B and 4 in inbred series A. Phumichai discloses that series A was obtained from a diploid clone 97H32-6 which was “self-compatible due to the function of the *Sli* gene.” (EX1005 (Phumichai), 0006.) It further describes that

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series B was initiated by crossing WB922236–2 and WB922236–3 (Group Phureja, *see* EX1024 (Phumichai 2006), 0003) with *Sli* gene donors. (*Id.*)

113. Phumichai further explains that some S₄ plants in inbred series A “produced considerable tuber yields.” (EX1005 (Phumichai), 0010.) It also explains that inbred series B “maintained relatively constant frequencies of flowering plants and selfers throughout selfing generations.” (*Id.*)

3. Spooner [EX1006]

114. The Spooner reference is a journal article titled “Extensive simple sequence repeat genotyping of potato landraces supports a major reevaluation of their gene pool structure and classification,” published December 4, 2007 in volume 104, 19398-19403 of the Proceedings of the National Academy of Sciences (“PNAS”).

115. Spooner discusses efforts to describe and find support for the taxonomy of cultivated potatoes, based on a large-scale molecular marker study of 742 landraces of all cultivated species (or Cultivar Groups) of potato and eight closely related wild species. (EX1006 (Spooner), 0009; *see also id.*, 0013 at Materials and Methods.) Using simple sequence repeat (“SSR”) and plastid DNA deletion markers, the authors re-classify cultivated potatoes into four species, *S. tuberosum* (including Andigenum Group and Chilotanum Group), *S. ajanhuiri*, *S. juzepczukii*, and *S.*

curtilobum. (*Id.*, 0009, 0012.)

116. Notably, Spooner concludes that “[t]he recognition of *S. phureja* as either a species or Cultivar Group (Phureja Group) . . . is no longer tenable[.]” (*Id.*, 0012.) It further explains that outside the four species classified by Spooner, “consistent and stable identifications are impossible, their classification as Linnean species is artificial, and their maintenance as either species or Cultivar Groups only serves to perpetuate confusion by breeders and gene bank managers, and the instability of names in the literature.” (*Id.*) A POSA by 2009 would thus have understood that *S. phureja* was not a distinct species but instead was classified as *S. tuberosum*.

4. Chase [EX1007]

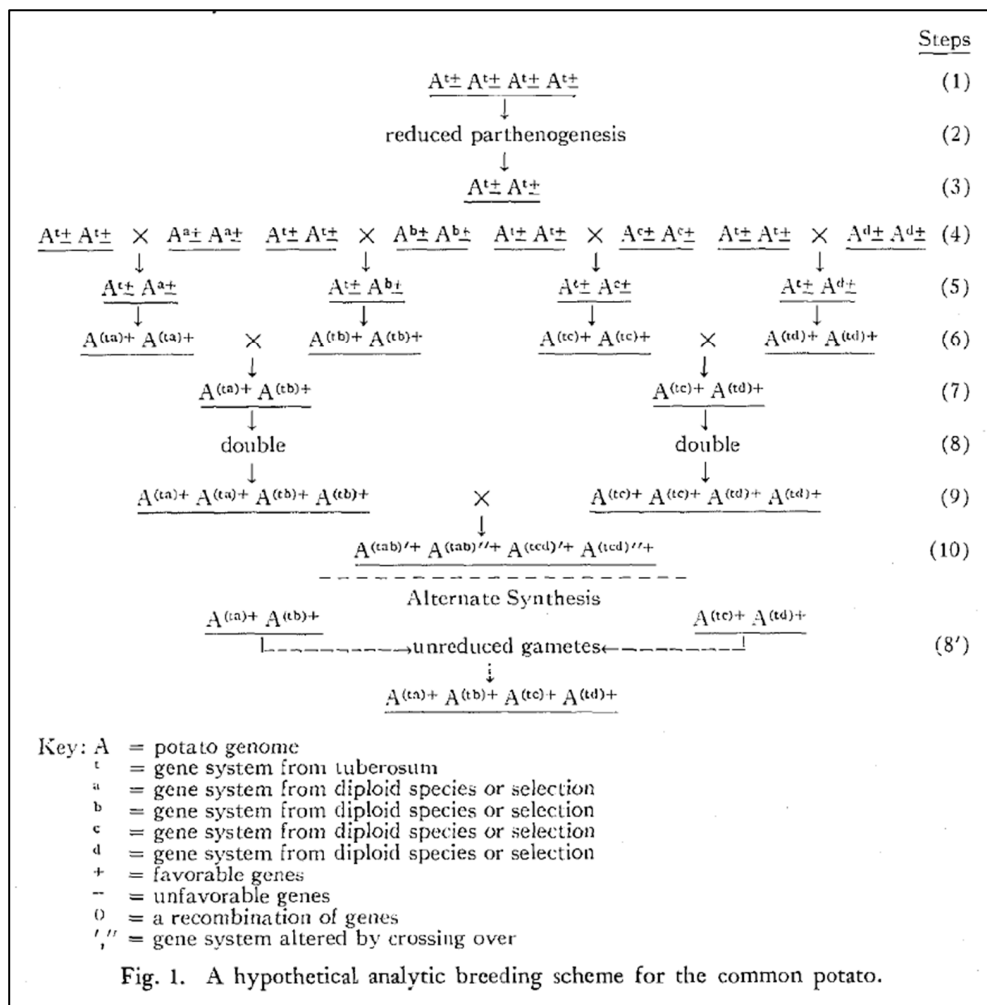
117. Chase is an article by Sherret S. Chase entitled “Analytic Breeding in *Solanum Tuberosum* L. – A Scheme Utilizing Parthenotes and Other Diploid Stocks.” It was published in December 1963 in Volume V No. 4 of the Canadian Journal of Genetics and Cytology.

118. Chase explains that a “potato can, with comparative ease, be a) propagated vegetatively, b) reproduced sexually, c) reduced to the diploid state by parthenogenesis, d) crossed with diploids including native forms at the diploid level, and e) polyploidized” back to the tetraploid level. (EX1007 (Chase), 0004.)

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119. Chase then describes a breeding scheme for the creation of hybrid potato plants. (*Id.*, 0006-07.) It explains that “[a]nalytic breeding [] is a three phase process involving, a) reduction of a polyploid to its diploid components, b) intensive breeding and selection at the diploid level, and c) resynthesis and testing of the polyploid [tetraploid] form.” (*Id.*, 0004.)

120. Chase further details an analytic breeding scheme in ten steps:



(*Id.*, 0005 at Fig. 1; *see also id.*, 0006-07), with the steps delineated in Fig. 1

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discussed extensively in Section IV.H.1 above.

121. Thus, decades before the filing of the '841 patent, inbreeding techniques in potatoes had been described and were well-known.

5. Springer [EX1008]

122. Springer is an article by Nathan M. Springer and Robert M. Stupar titled “Allelic variation and heterosis in maize: How do two halves make more than a whole?” It was published on pages 264-275 of volume 17 of *Genome Research*.

123. Springer reviews research on allelic variation in maize and how this research applies more broadly to heterosis in plants. (*See* EX1008 (Springer), Abstract.) As I explained above, heterosis, also called “hybrid vigor,” is the increased vigor or performance of a hybrid relative to its parents. (*See supra*, §IV.F.) Springer reports on corn plants that, when crossed, provide “an excellent example of heterosis.” (EX1008 (Springer), 0006.) It then discloses that the parents were genetically different from each other for 44% of the DNA sequences evaluated. (*Id.*, 0006-07.) Finally, it provides that “[a]s the genetic distance between the parental inbreds increases, there is generally an increase in heterosis.” (*Id.*, 0012.)

6. Bamberg [EX1009]

124. Bamberg is a publication by NRSP-6, the working potato genebank for the United States, part of the US National Plant Germplasm System (NPGS).

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Bamberg lists scores of accessions of potato germplasm available to the public on request, and it provides data on agronomically desirable traits for the accessions in the collection.

125. The U.S. Potato Genebank is a federal facility that serves potato breeders and other potato scientists by providing wild and cultivated germplasm free of charge. Some genetic stocks are maintained as populations and distributed as true potato seed; other stocks are clones and distributed as tubers or tissue culture plantlets. In addition, the Genebank collects data on traits of agricultural interest in its holdings and makes these data available through printed publications and online. Genebank personnel are well-connected with potato breeders. They regularly give presentations at regional, national, and international meetings attended by potato breeders. In addition, breeders ask for advice from Genebank staff regarding germplasm qualities and methods for using Genebank accessions.

126. I am intimately familiar with the work of the U.S. Potato Genebank, located in Wisconsin, and with its practice of publication and dissemination, both online and in print, of the accessions it keeps and makes available to the public, along with detailed information about the characteristics of the accessions kept in the collection. A POSA desiring information, or samples, of potato varieties in the prior art would have known to consult with the information disseminated by this

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institution in order to learn more about its accessions and/or to obtain plant material for use in breeding. In particular, a POSA would have recognized that the “PI” nomenclature used in Jong (EX1004) would be a reference to the “Plant Introduction” collection maintained by the Agricultural Research Station at Sturgeon Bay, Wisconsin, which houses the Potato Genebank. PI accession numbers are extensively described throughout the Bamberg publication. For example, details concerning agronomically desirable traits and other characteristics valuable to plant breeders are disclosed for large numbers of accessions in the Bamberg publication.

B. GROUND 1: Jong Anticipates Claims 1, 4, and 7

1. Claim 1

(a) Claim 1[a]

1[a]	A plant of a potato line, wherein said potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to <i>Solanum tuberosum</i> ,
------	--

127. Jong anticipates Claim limitation 1[a] of the '841 patent.

128. As I explained above, Jong discloses studying self-fertile hybrids from crosses between either *Solanum tuberosum* Group Phureja or *Solanum tuberosum* Group Stenotomum and a haploid of *Solanum tuberosum* Group Tuberosum (US-W4). For these crosses, Jong discloses “an initial genetic base” of the following hybrid families:

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US-W 5309 (Phu PI 195191	×	US-W4)
US-W 5314 (Phu PI 225708.1	×	US-W4)
US-W 5315 (Phu PI 225675.1	×	US-W4)
US-W 5328 (Stn PI 230513.1	×	US-W4)
<i>S. tuberosum</i> Group Phureja and Stenotomum	X	<i>S. tuberosum</i> Group Tuberosum

(EX1004 (Jong), 0007.) As I have shown in red, *Phu* PI 195191, 225708.1, 225675.1 are Group Phureja parents, *Stn* PI 230513.1 is a Group Stenotomum parent plant, and US-W4 is a Group Tuberosum parent plant.

129. A POSA reading Jong would thus have understood that Jong discloses creating potato plants by crossing *Solanum tuberosum* with other varieties or species crossable to *Solanum tuberosum*. Under the widely accepted taxonomic system for potato which I described in Section IV.A above and the classification of cultivated potatoes into *S. tuberosum*, a POSA would have known that Group Phureja, Group Stenotomum, and Group Tuberosum are all classified as *Solanum tuberosum* species, and any cross between these groups necessarily results in progeny that are also *Solanum tuberosum*. Jong thus discloses “[a] plant of a potato line, wherein said potato line is of the species *Solanum tuberosum*” as required by Claim 1[a].

130. A POSA, however, need not have relied on this taxonomic system alone to know that Jong discloses Claim limitation 1[a]. As noted in paragraph 108, Jong

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describes parent lines that are *S. tuberosum* Group Tuberosum (US-W4). A cross between US-W4 and either Group Phureja or Group Stenotomum, which are also *S. tuberosum*, would thus create a potato line of *S. tuberosum* with introgressed segments of other *Solanum tuberosum*, as recited in the claim as an optional limitation.

131. Even if Agventure’s argument that Phureja is a different species from *S. tuberosum* were correct (which it is not), a POSA would nevertheless have understood that crossing Group Phureja or Group Stenotomum with Group Tuberosum would have resulted in introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*.⁹ Jong successfully produced progeny from the crosses and described the characteristics of plants from those crosses. (*See, e.g.*, EX1004 (Jong), 0009, 0011 (Tables 1, 4); *see also id.*, 0012 (“several fairly vigorous S₅ lines have now been obtained”).)

(b) Claim 1[b]

1[b]	wherein said potato line is diploid, fertile, self-compatible
------	---

132. Jong discloses diploid, fertile, self-compatible potato lines.

⁹ I note that the ’841 patent appears to contemplate introgression as the recombination and subsequent transfer of genetic material upon a cross. (*See* EX1001 (’841 patent), 12:29-50.)

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133. **Diploid:** Jong is titled “Inbreeding in cultivated **diploid** potatoes.” (EX1004 (Jong), 0006 at Title.) It states that “[t]he effects on inbreeding in cultivated **diploid** potatoes were studied by using self-fertile hybrids from crosses between Group Phureja and Group Stenotomum and haploids of Group Tuberosum.” (*Id.*, 0006.) Jong further states that “it is possible to obtain homozygous clones for future genetic studies on the diploid level” and that “the diploid S₅ generation [described in Jong] probably represents the greatest degree of inbreeding ever imposed upon potatoes.” (*Id.*, 0013.) A POSA would have understood from these disclosures that Jong studied cultivated diploid potatoes and that it produced diploid potato progeny at several generations.

134. **Fertile and Self-Compatible:** I understand that the ’841 patent describes “fertile” as

broadly refer[ring] 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.

(EX1001 (’841 patent), 18:45-51.)

135. The ’841 patent describes “self-compatible” as referring to the

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“capacity to develop seeds in berries that are the result of self-pollination, self-fertilization and producing fertile progeny.” (*Id.*, 19:5-7.) Jong describes fertile and self-compatible potato lines. For example, in Table 4, Jong describes the effects on inbreeding on flowering and fertility in several generations of plants created from crosses disclosed in the reference:

Table 4. Effect of inbreeding on flowering and fertility.									
Level of inbreeding ¹	Clones planted ²	Per cent stand ³	Per cent flowering ⁴	Fertility in per cent of flowering clones ⁵			Seeds/fruit for fertile plants ⁶		
				Self- ⁷	Pollen- ⁸	Ovule- ⁹	Self- ⁷	Pollen- ⁸	Ovule- ⁹
S ₀	21	95	100	47	85	86	12	54	76
S ₁	50	91	54	16	34	23	9	36	34
S ₂	44	74	54	16	41	47	6	38	30

¹ Inzuchtgrad – Degré de consanguinité
² Anzahl gepflanzter Klone – Clones plantés
³ Prozent Pflanzenentwicklung – Situation en %
⁴ Prozent Blühzustand – % de floraison
⁵ Fertilität in % der blühenden Klone – Fertilité en % des clones fleurissant
⁶ Samen/Frucht für fruchtbare Pflanzen – Semences par fruit chez les plantes fertiles
⁷ Selbst – Auto
⁸ Pollen- – Pollen-
⁹ Eizellen – Ovule

Tabelle 4. Einfluss der Inzucht auf den Blühzustand und die Fruchtbarkeit.
Tableau 4. Effet de l'autofécondation sur la floraison et la fertilité.

(EX1004 (Jong), 0011 (Table 4).) Under the heading “Fertility in per cent of flowering clones,” Jong describes values for “self-” fertility and provides non-zero values, under self-fertility, indicating the plants could produce offspring from selfing. (*Id.*) A POSA would have understood that “self” fertility and the non-zero values of 16% and 16% at the S₁ and S₂ generations, which indicate fertility after selfing, mean that some of the resultant plants were self-compatible and fertile.

136. As shown in Table 4, Jong further describes “pollen-” and “ovule-” fertility and provides non-zero values for the S₁ and S₂ generations. (*Id.*) Pollen and

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ovule fertility reference the cross-fertility of the plants. Again, based on the non-zero values, a POSA would have understood that Jong disclosed plants that could produce offspring and thus were fertile plants.

(c) Claim 1[c]

1[c]	produces at least 200 grams fresh weight of tubers per plant, and
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137. In Table 1, Jong describes families US-W5309 and US-W5315 with average yields in the S₂ generation of greater than 200 grams of fresh weight of tubers per hill:

Table 1. Effect of inbreeding on four diploid potato families.															
Family ¹	Number of clones ²			Plant height ³ (cm)			Vigour index ⁴			Tubers/hill ⁵			Tuber weight g/hill ⁶		
	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂
First clonal generation ⁷															
US-W 5309	12	16	16	43	25	27	3.5	2.3	2.5	21	16	15	563	248	269
US-W 5328	9	12	8	41	27	17	3.6	2.4	1.6	19	15	8	390	425	167
US-W 5314	0	12	11		27	23		2.4	2.2		13	7		287	88
US-W 5315	0	10	9		25	29		2.6	2.7		20	21		297	415
Total	21	50	44												
Weighted average ⁸				42	26	25	3.5	2.4	2.2	20	16	14	499	304	181
% of S ₀ ⁹				100	62	60	100	69	63	100	80	70	100	61	36

(EX1004 (Jong), 0009 (Table 1).) For breeding program evaluations, tubers are collected from each plant and planted in the field in plots containing one to several hills (plants). (See EX1011 (Jansky), 0025; *see also supra*, ¶46.) A POSA would have understood that hill is synonymous with a single plant and thus Jong's reference

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to “/hill” means “/plant.” (*See supra*, ¶46.) Accordingly, Jong teaches 269 grams and 415 grams of tuber/plant for S₂ US-W5309 and US-W5315 families, respectively, in the first clonal generation, which is greater than 200 grams of fresh weight of tubers per plant. In addition, since Table 1 reports family mean values, it is expected that some individuals within each family yielded even higher values than reported in the table.

138. Additionally, Jong teaches that “several fairly vigorous S₅ lines have now been obtained” (EX1004 (Jong), 0012), indicating these plants retained vigor across five generations of selfing. The Jong thesis further teaches that Jong’s highest-yielding varieties (US-W5309 and US-W5315) were inbred further, with US-5315 taken to the S₅ generation. (*See* EX1034 (Jong thesis), 0010.) I note that the ’841 patent expressly ties “vigor” to tuber yields of 200 grams or more. (EX1001 (’841 patent), 16:53-59.)

139. Jong thus discloses Claim limitation 1[c].

(d) Claim 1[d]

1[d]	and at least 75% of the genomic loci in said potato line are homozygous
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140. Jong discloses Claim limitation 1[d].

141. First, Jong teaches that, theoretically “the diploid S₅ generation is about 97% homozygous.” (EX1004 (Jong), 0013.) Based on this disclosure, a POSA

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would have expected that the genomic loci of the plants produced in Jong were at least 75% homozygous.

142. Moreover, Jong discloses that “[t]he number of generations needed to **reduce heterozygosity by 50 per cent by inbreeding is 1 in diploids** and 3.8 in autotetraploids.” (EX1004 (Jong), 0007 (citing Bartlett and Haldane, 1934).) Based on this disclosure and the fact that Jong discloses inbreeding in diploids (*see supra*, ¶¶107, 132), a POSA would have understood that, even in the highly unlikely situation where the S₀ plant is 0% homozygous (i.e., 100% heterozygous at each locus), by S₂, the homozygosity would be at least 75% and subsequent generations would have even higher percentage of homozygosity:

	% homozygosity	% heterozygosity	% reduction in homozygosity
S₀ generation	0 %	100 %	N/A
S₁ generation	50 %	50 %	50 % from S ₀
S₂ generation	75%	25 %	50 % from S ₁
S₃ generation	87.5%	12.5%	50% from S ₂

143. As shown in Tables 1-4 of Jong, Jong discloses plants through at least the S₂ and S₃ generations, and thus, a POSA would have understood that Jong discloses potato lines where at least 75% of the genomic loci are homozygous. Further, as confirmed by his companion thesis dissertation, Jong took the US-W5309

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and US-W5315 lines to the S₄ and S₅ level, respectively. (EX1034 (Jong Thesis), 0075-85 (Table 21).) Jong also found that the US-W5309 S₄ population did not segregate for any of the five genetic markers he tested, supporting Jong's statement that these inbreds were likely to be highly homozygous. (*Id.*)

(e) Claim 1[e]

1[e]	wherein said self-compatibility in said potato line is conferred by the S-locus inhibitor (<i>Sli</i>) gene, and wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively.
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144. Jong discloses Claim limitation 1[e].

145. Jong teaches crosses using US-W4. (*See* EX1004 (Jong), 0007.) Further, according to Jong, US-W4 provides self-compatibility to the inbred lines disclosed. (*Id.*, 0006 (explaining “crosses involving haploids from an inbred Minnesota seedling, *Minn. 20-20-34*, (primarily *US-W4*) were found to be self-fertile.”).)

146. As Clot describes, US-W4 has the S-locus gene inhibitor (*Sli*) and *Sli* imparts self-compatibility to US-W4. (*See* EX1036 (Clot), Abstract (reporting the well-known US-W4 clone is positive for *Sli*); *id.*, 0007-08, fig. 4a (similar); *id.*, 0012 (reporting a homozygous clone that had one *Sli* allele from US-W4); *see also id.*,

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0002 (referencing Jong (EX1004)).) While Clot is dated after the patent, I understand that a POSA need not have recognized that the *Sli* gene was present in US-W4 as of the priority date, and art dated after the priority date may be used to show that the prior art inherently disclosed a limitation.

147. Clot shows that the same US-W4 line used in Jong necessarily has a copy of the *Sli* gene that is present in the *Sli*-containing lines described by the inventors. (See EX1036 (Clot), 0002 (citing Jong for US-W4), *id.*, 0014 (citing Jong).) Clot describes that the *Sli* gene was “originally identified in chc 525-3, a clone of the typically self-incompatible species *S. chacoense*.” (EX1036 (Clot), 0002 (citing Hosaka 1998a (EX1030)).) This is the same source of *Sli* used by the inventors of the ’841 patent. (See EX1001 (’841 patent), 5:50-56 (describing the potato plant has the *Sli* gene “as described in Hosaka and Hanneman 1998 Euphytica, 99: 191-197”); Cols. 46-47 (Table 6) (“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.”).) These three references from the Hosaka group are Exhibits EX1005 (Phumichai), EX1037 (Phumichai and Hosaka), and EX1024 (Phumichai 2006) in these proceedings, respectively.

148. Clot further makes clear that US-W4 contained this same *Sli* gene. (See

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EX1036 (Clot), Abstract (explaining that US-W4 was positive for DNA markers specific to a self-compatibility region on chromosome 12 and “[h]ence, the *S. tuberosum* source of SC [“self-compatibility”] seems identical to *Sli*”); *id.*, 0002 (explaining “in three independent mapping studies, the distal end of chromosome 12 was associated with self-compatibility, or self-fertility,” including mapping studies on the *Sli* gene of chc 525-3); *id.*, 0007 (“We observed that the SC clones RH89-039-16, M6 and US-W4, display high shared *k*-mer densities. This observation supports identity-by-state (IBS) of the *Sli* locus of M6 with the SC haplotype of RH89-039-16 and US-W4.”); *id.*, 0012 (describing the SC chromosomal region as “indistinguishable” between *S. tuberosum* and *S. chacoense* clones.)

149. This same *Sli* gene also would have been present in the offspring of US-W4 crossed with other plants as Jong describes that those offspring were selfed and self-fertile. (EX1004 (Jong), 0007.) Accordingly, given that Jong discloses plants with a copy of the same *Sli* gene, it necessarily discloses “wherein a copy of said gene is present in” potato lines that have the same characteristics (e.g., diploid, fertile, self-compatible, highly homozygous, producing 200 grams of tubers) as AGVD1, AGVD2, AGVD3, and AGVD17 and thus Jong discloses Claim 1[e].

2. Claim 4

4	A seed or tuber that produces the plant of claim 1.
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150. Jong teaches seeds and tubers that produce the plant of Claim 1 of the '841 patent. Jong expressly describes

In each generation, plants were self-pollinated and the **seed** produced by self-fertile plants bulked to produce subsequent generations. Observations were made on populations **grown from true seed** and from **tubers**.

(EX1004 (Jong), 0007; *see also id.* (“All plants producing tubers were saved for evaluation[.]”).) Table 1 of Jong then discloses S₀, S₁, and S₂ generations and reports on the number of clones, plant height, vigour index, tubers/hill, and tuber weight in g/hill for each of those generations of plants. (*See* EX1004 (Jong), 0009 (Table 1).) Table 2 reports on characteristics of plants grown from true seed, including S₀, S₁, S₂, and S₃ generations of seedling populations. (*Id.*, 0010 (Table 2).) In plant breeding, “S” refers to a “selfed generation” where “S₁” refers to “first selfed generation,” and “S₂” refers to “second selfed generation.” A POSA would thus recognize that the S₁, S₂, and S₃ generations were produced by selfing the plant, growing those seeds and selfing the resulting plant to produce a subsequent generation. These rounds of selfing and seed collecting necessarily require seeds.

151. Table 1 of Jong further describes first clonal generations of potato plants:

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Table 1. Effect of inbreeding on four diploid potato families.															
Family ¹	Number of clones ²			Plant height ³ (cm)			Vigour index ⁴			Tubers/hill ⁵			Tuber weight g/hill ⁶		
	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂	S ₀	S ₁	S ₂
First clonal generation ⁷															
US-W 5309	12	16	16	43	25	27	3.5	2.3	2.5	21	16	15	563	248	269
US-W 5328	9	12	8	41	27	17	3.6	2.4	1.6	19	15	8	390	425	167
US-W 5314	0	12	11		27	23		2.4	2.2		13	7		287	88
US-W 5315	0	10	9		25	29		2.6	2.7		20	21		297	415
Total	21	50	44												
Weighted average ⁸				42	26	25	3.5	2.4	2.2	20	16	14	499	304	181
% of S ₀ ⁹				100	62	60	100	69	63	100	80	70	100	61	36

(EX1004 (Jong), 0009 (Table 1).) A POSA would have known that the term “clone” as used in Jong refers to a potato plant asexually reproduced from a tuber. Similarly, a POSA would have known that “clonal generations” refer to plants asexually reproduced from tubers.

152. Thus, Jong discloses Claim 4.

3. Claim 7

7	A potato plant produced by the method of claim 5, wherein said potato plant is diploid, fertile, self-compatible, produces at least 200 grams fresh weight of tubers per plant, wherein at least 75% of the genomic loci in said potato plant are homozygous, and wherein said self-compatibility in said potato plant is conferred by the <i>Sli</i> gene.
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153. Jong teaches Claim 7 of the '841 patent.

154. I understand that Claim 7 is a product-by-process claim. As I noted in Section III.D above, a product-by-process claim is invalid if the product was described in the prior art – even if made by a process different than that recited in the claim. Thus, although I address the breeding methods recited in Claim 5 below

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(*see supra*, §VI.C.5), here I address only the product recited in Claim 7, which was anticipated by the prior art.

155. As I further explained for Claim 1 above, Jong already disclosed potato plants that are diploid, fertile, self-compatible with self-compatibility produced by the *Sli* gene, produce at least 200 grams fresh weight of tubers per plant, and that are homozygous for at least 75% of their genomic loci. (*See supra*, §VI.B.) Thus, Jong discloses and thus anticipates the product of Claim 7.

C. GROUND 2: Claims 1-7 Are Obvious Over Jong, Chase, and Bamberg

1. Claim 1

1[a]	A plant of a potato line, wherein said potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to <i>Solanum tuberosum</i> ,
1[b]	wherein said potato line is diploid, fertile, self-compatible,
1[c]	produces at least 200 grams fresh weight of tubers per plant,
1[d]	and at least 75% of the genomic loci in said potato line are homozygous,
1[e]	wherein said self-compatibility in said potato line is conferred by the S-locus inhibitor (<i>Sli</i>) gene, and wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively.

156. For the reasons I stated in Ground 1, Jong also renders obvious all of the limitations of Claim 1 of the '841 patent. (*See supra*, §VI.B.)

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157. Jong discloses the “at least 75% of the genomic loci in said potato line are homozygous” limitation of Claim 1[d]. (*See* EX1004 (Jong), 0007, 0013.) Moreover, as one advantage of studying inbreeding using diploid potatoes, Jong describes that “the rate of progress towards homozygosity following selfing is much faster with diploids.” (EX1004 (Jong), 0007.) Given this goal and as I explained in the background sections on hybrid breeding and heterosis (*see supra*, §§IV.F, H), a POSA would have been motivated to continue to self plants in order to obtain homozygosity.

158. Jong further discloses that the number of generations needed to reduce heterozygosity by 50 per cent in diploids is 1. (EX1004 (Jong), 0007.) As I described in Section VI.B.1[d] above, a POSA would have quickly arrived at a potato plant like that disclosed in Jong where at least 75% of genomic loci are homozygous. In fact, Jong estimates that “the diploid S₅ generation is about 97% homozygous” (*id.*, 0013), which far exceeds the 75% homozygosity of Claim limitation 1[d].

2. Claim 2

2	The potato plant of claim 1, wherein said plant comprises at least one agronomically desirable trait selected from the group consisting of: insect tolerance, nematode tolerance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, flooding tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.
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159. Jong renders Claim 2 obvious.

160. Jong does not make explicit that the potato plants disclosed have one or more of the traits recited in Claim 2. A POSA, however, would have understood that parental lines used in Jong possess at least one of the claimed traits and based on simple principles of breeding would reasonably expect those same traits to be present in at least some of the plants derived from the parental plants like those used in Jong.

161. As I explained for Ground 1 Claim 1 above, Jong discloses plants created by crossing several different parental lines:

US-W 5309 (*Phu PI 195191* × *US-W4*)
US-W 5314 (*Phu PI 225708.1* × *US-W4*)
US-W 5315 (*Phu PI 225675.1* × *US-W4*)
US-W 5328 (*Stn PI 230513.1* × *US-W4*)

S. tuberosum Group Phureja
and *Stenotomum*

X *S. tuberosum* Group
Tuberosum

(EX1004 (Jong), 0007.)

162. By 2009, the accessions (“PIs”) that served as parents of US-W5309 and US-W5315 were known to have resistance to diseases, nematodes, and insects. EX1009 discloses that the parental accession *Phu PI 195191* (parent of US-W 5309) exhibits disease resistance (ring rot and blackleg), nematode resistance (golden potato

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cyst, horserettle cyst, northern rootknot, and Osborne's cyst nematodes), and insect tolerance (tarnish plant bug). (*See* EX1009 (Bamberg), 0024, 0027, 0029, 0032, 0033, 0045.) A POSA would have understood that *Phu PI 195191* thus has several agronomically desirable traits as recited in Claim 2. Similarly, *Phu PI 225675* (the parent of US-W5315) exhibits disease resistance (potato virus X, late blight, and blackleg) and insect tolerance (flea beetle and tarnish plant bug. (*See id.*, 0013, 0018, 0024, 0038, 0045.)

163. Upon crossing the parental lines, a POSA would have selected a plant that maintained at least one of these traits as they would have been motivated to maintain these desirable traits in subsequent generations. Resistance to diseases or pests confers an agricultural benefit as the plants are less likely to experience crop damage or death. Accordingly, at least some progeny of US-W5309 would have been expected to have disease, nematode, and/or insect resistance while at least some US-W5315 progeny would have been expected to have disease and/or insect resistance – and it would have been obvious to select for these characteristics.

3. Claim 3

3	The potato plant of claim 1, wherein said potato plant has a fresh weight of the foliage and shoots of at least 500 grams per plant at maturity.
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164. Jong and Bamberg render obvious Claim 3 of the '841 patent.

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165. The '841 patent provides definitional language stating that plants which have at least 500g of foliage are considered “vigorous.” (EX1001 ('841 patent), 5:2-4.) While Jong does not directly describe the fresh weight of foliage and shoots for the plants it describes, it teaches that “several fairly vigorous S₅ lines have now been obtained.” (EX1004 (Jong), 0012.) Thus, a POSA employing the definition for vigor used by the patent would have interpreted Jong as teaching plants expected to have at least 500 grams of above-ground foliage and shoots.

166. A POSA could have also easily estimated the expected foliage weights from Jong's reporting of tuber weight information and the well-known harvest index for *Solanum tuberosum*, including Phureja varieties. The harvest index (“HI”) of a plant is the proportion of the harvested part of a crop relative to the total weight of the crop. In potato, HI is calculated based on tuber weight (“wt.”) and foliage weight as follows:

$$\text{Harvest Index (\%)} = \left(\frac{\text{tuber wt.}}{\text{tuber wt.} + \text{foliage wt.}} \right) * 100$$

(See, e.g., EX1038 (Hay), 0003-05; see also EX1039 (Knowles), 0003.)

167. Thus, in the context of potatoes, HI reflects relative contribution of tuber weight to the total plant weight. Based on this equation, the smaller the HI, the less the tuber weight contributes to the overall weight of the plant as a whole. A POSA would have known this equation, which is a standard way to understand the

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effectiveness with which a plant directs its resources toward a product of commercial value. Using the equation, one can calculate foliage weight from known tuber weight. As one example, the foliage weight of a potato plant with a tuber weight of 200 grams and an HI of 28.57% would be approximately 500 grams.

168. A POSA would have known that the HI values for *Solanum tuberosum* varieties at maturity were reported to range between 47% to 62%. (EX 1038 (Hay), 0004 (Table 1); *see also* EX1039 (Knowles), 0001.) For the first clonal generation of US-W5315 S₂, Jong reports an average tuber yield of 415 g/hill. (EX1004 (Jong), 0009 (Table 1).) Using an HI of 47%, this corresponds to a fresh foliage weight of 468 grams, which is approximately the same as recited by Claim 3 of the '841 patent. Further, the 415 gram tuber value reported by Jong is an average value, meaning that some of Jong's plants likely had tuber yields higher than 415 grams and accordingly foliage weights above 500 grams. Still further, data from another reference measuring foliage and tuber weights of *Tuberosum* haploid x Phureja hybrids grown in the field at Sturgeon Bay, Wisconsin (where Jong carried out his field trials), revealed a harvest index at maturity of approximately 28%. (*See* EX1049 (Landeo), 0059 (Table 1).)¹⁰ Applying a harvest index of 28% to Jong's inbred lines would lead

¹⁰ Table 1 discloses a tuber and vine yields of 1.44 and 3.69 pounds, respectively, resulting in a harvest index of 28%. TH = *Tuberosum* haploids, PHU = Phureja clones. (EX1049 (Landeo), 0059 (Table 1).)

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to an expected foliage yield of up to 1,067 grams per plant in the S₂ generation. Thus, based on well-known principles and Jong's disclosure of tuber weights, a POSA would have understood that at least some of Jong's plants would have been expected to have a fresh weight of the foliage and shoots of at least 500 grams per plant at maturity. I note in this respect that, if a plant as recited in the challenged claims gave a tuber yield and foliage yield per plant of 200 grams and 500 grams, respectively, this would also correspond to a harvest index of 28%.

169. Indeed, a POSA would have had an even greater expectation of success given that at least one of the parental accessions of US-W5315 in Jong was scored as an outstanding accession for vine and flowering vigor. (*See* EX1009 (Bamberg), 0004, 0055, 0058.) A POSA would have been motivated to apply Jong's methods to obtain inbred lines maintaining some level of vigor, and thus to select for plants with over 500 grams foliage. A POSA would have expected success based on Jong's reports, known harvest indices, and the known vine-vigor properties of Jong's parental lines.

4. Claim 4

4	A seed or tuber that produces the plant of claim 1.
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170. For the reasons I stated in Ground 1, Jong also renders obvious Claim 4 of the '841 patent. (*See supra*, §VI.B.2.)

5. Claim 5

171. Jong in combination with Chase renders Claim 5 obvious. As I explained in Ground 1 above, Jong discloses potato plants that are diploid, fertile, self-compatible, produce at least 200 grams fresh weight of tubers per plant, and where at least 75% of genomic loci are homozygous. Claim 5 simply recites a method of making plants like those disclosed in Jong. A POSA could create these plants using well-known breeding methods, like those disclosed in Jong in combination with the long known analytical breeding method like that described in Chase. More fundamentally, the claimed breeding scheme described is a common scheme used across breeding programs that simply reflects the breeders' goal of introgressing new traits into potato lines through cross-fertilization and fixing of the traits through inbreeding.

(a) Claim 5[pre]

5[pre]	A method of producing a plant of a potato line, wherein said potato line is diploid, fertile, self-compatible, produces at least 200 grams fresh weight of tubers per plant, and at least 75% of the genomic loci in said plant line are homozygous, comprising the steps of:
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172. For the reasons disclosed in Ground 1 Claim 1 above (*see supra*, §VI.B.1), Jong discloses this limitation. As I noted above, Jong discloses several novel diploid, fertile, self-compatible potato plants displaying at least 200 grams of fresh weight of tubers per plant, and possessing at least 75% homozygous genomic

loci.

173. As described further below, Jong in combination with Chase also discloses the claimed method for producing these plants which is recited in the remaining limitations of Claim 5. Claim 5 recites nothing more than a breeding scheme for making the potatoes in Claim 1. There is nothing novel about this breeding scheme. Instead, as I already explained above, such a breeding scheme reflects the fundamental breeding strategy to cross potato plants and introgress new traits through inbreeding, as evidenced by Chase. (EX1007 (Chase).) Any potato breeder looking to introgress and fix a new trait, such as the desirable traits disclosed in Jong (fertility, self-compatibility, disease and pest resistance, etc.), would thus have implemented this breeding strategy.

(b) Claim 5[a]

5[a]	(a) providing a first potato plant, wherein said first potato plant is the plant according to claim 1;
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174. As I described for Claim 1, Jong discloses a plant according to Claim 1. (*See supra*, §VI.B.1.) For example, Jong discloses US-W5309 and US-W5315. (*Id.*; *see also* EX1004 (Jong), 0009 (Table 1).) In a breeding scheme, a POSA could have similarly produced US-W5309 and US-W5315 plants like those disclosed in Jong and further created progeny of those lines as also disclosed in Jong.

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(c) Claim 5[b]

5[b]	(b) providing a second potato plant, wherein said second potato plant is a diploid plant, and wherein said potato plant comprises any level of homozygosity;
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175. Jong further discloses a second potato plant that is diploid and has homozygosity of any level. For example, Jong discloses US-W5309 or US-W5315, and plants of this type could be used for a cross. Alternatively, a POSA could select any other diploid plant since the claim does not limit the plant to any particular level of homozygosity. It merely says it must be diploid.

(d) Claim 5[c]

5[c]	(c) cross-pollinating said first potato plant and said second potato plant to produce seeds and collecting said seeds to thereby provide hybrid offspring seeds;
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176. Jong further discloses step (c), and in combination with Chase, renders step (c) obvious.

177. Jong describes a breeding scheme that starts with a cross between two diploid parental lines:

US-W 5309 (<i>Phu PI 195191</i>)	×	US-W4)
US-W 5314 (<i>Phu PI 225708.1</i>)	×	US-W4)
US-W 5315 (<i>Phu PI 225675.1</i>)	×	US-W4)
US-W 5328 (<i>Stn PI 230513.1</i>)	×	US-W4)

Diploid Potato Parent 1 X Diploid Potato Parent 2

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(EX1004 (Jong), 0007.)

178. After crossing the diploid parental lines, a POSA would have replicated the hybrid initial cross with different individual plants, including a cross between any of the plants and generations of potato plants disclosed in Jong. For example, a POSA would have found it obvious to cross progeny from plants like US-W5309 or US-W5315, such as plants like the two S₂ or later lines. In fact, Jong discloses that it was “possible to obtain homozygous clones for future genetic studies on the diploid level,” which a POSA would have understood as suggesting conducting crosses between the plants like those of Jong for genetic studies. (EX1004 (Jong), 0013.) I further note, especially given the tuber yield data for US-W4 discussed below, Claim step 5[c] is analogous to Jong’s crossing of Phureja and Stenotomum plants with US-W4.

179. This is also an entirely routine part of any breeding program. For example, it is akin to Chase’s Step 4, in which “the selected parthenote or parthenotes are crossed to a series of diploid species, varieties or selections.” (EX1007 (Chase), 0006.)

180. Jong also describes collecting seeds from the hybrid crosses of the parental lines. Table 4, for example, describes seeds/fruit for fertile plants, which a POSA would have understood shows the counts of seeds harvested from the hybrid

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crosses.

Table 4. Effect of inbreeding on flowering and fertility.									
Level of inbreeding ¹	Clones planted ²	Per cent stand ³	Per cent flowering ⁴	Fertility in per cent of flowering clones ⁵			Seeds/fruit for fertile plants ⁶		
				Self- ⁷	Pollen- ⁸	Ovule- ⁹	Self- ⁷	Pollen- ⁸	Ovule- ⁹
S ₀	21	95	100	47	85	86	12	54	76
S ₁	50	91	54	16	34	23	9	36	34
S ₂	44	74	54	16	41	47	6	38	30

¹ Inzuchtgrad – Degré de consanguinité
² Anzahl gepflanzter Klone – Clones plantés
³ Prozent Pflanzenentwicklung – Situation en %
⁴ Prozent Blühzustand – % de floraison
⁵ Fertilität in % der blühenden Klone – Fertilité en % des clones fleurissant
⁶ Samen/Frucht für fruchtbare Pflanzen – Semences par fruit chez les plantes fertiles
⁷ Selbst – Auto
⁸ Pollen- – Pollen-
⁹ Eizellen – Ovule

Tabelle 4. Einfluss der Inzucht auf den Blühzustand und die Fruchtbarkeit.
Tableau 4. Effet de l'autofécondation sur la floraison et la fertilité.

(EX1004 (Jong), 0011 (Table 4).)

181. By 2009, furthermore, a POSA would have found trivial using cross-pollination to produce seeds. Chase, for example, described a ten-step breeding method for the creation of hybrid potato plants. (*See supra*, §IV.H.1.) A POSA would have used the method disclosed in Chase to breed lines like those in Jong because Chase describes the routine method for hybrid breeding in plants.

(e) Claim 5[d]

5[d]	(d) growing said hybrid offspring seeds to provide a population of hybrid offspring potato plants and selecting from said population a self-compatible potato plant;
------	--

182. Jong further discloses step (d). Jong describes “[i]n each generation, plants were self-pollinated and the seed produced by self-fertile plants bulked to

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produce subsequent generations.” (EX1004 (Jong), 0007; *see also id.*, 0012.) Jong further describes several generations of self-fertile plants from S_0 to S_5 . (*See id.*, 0012.) The production of seeds following self-pollination requires both self-compatibility (the absence of genetic mechanisms which would otherwise block self-fertilization) and fertility (functional pollen and ovules). Self-fertile plants thus must necessarily be both self-compatible and fertile or no subsequent selfing generations would result. A POSA would thus have understood that Jong discloses crossing hybrid lines, growing the offspring, and selecting for self-fertility across multiple generations.

183. Jong also details monitoring the self-fertility rates of the plants across several generations. (*See id.*, 0011 (Table 4); *see also id.*, 0012 (explaining “only a portion of [the plants] were self-fertile in the advanced generations of inbreeding (Table 4)”)). A POSA would similarly be motivated to track self-fertility in a cross between a first potato plant and second potato plant for the obvious reason that selection for lines exhibiting self-fertility would be necessary to a breeder seeking to increase homozygosity by selfing over successive generations.

184. Chase further discloses step (d). It explains:

Next, step #3, comes the selection and clonal propagation from among the array of parthenotes of one or, preferably, several plants that combine self and cross fertility with vegetative vigor and agronomic worth. This is followed

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by step #4 wherein the selected parthenote or parthenotes are crossed to a series of diploid species, varieties or selections.

...

Inbreeding of the diploid F₁ crosses, step #5, with selection under appropriate stress, is required at this stage to fix desirable genetic material.

(EX1007 (Chase), 0006.)

(f) Claim 5[e]

5[e]	(e) inbreeding said self-compatible potato plant by selfing said self-compatible potato plant for between 1 to 8 selfings to thereby increase the degree of homozygosity in each successive generation; and
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185. Jong discloses inbreeding self-compatible potato plants for between 1 to 5 selfings, within the scope of this claim limitation's recited 1 to 8 selfings. Jong explains that "[t]he effects of inbreeding in cultivated diploid potatoes were studied." (EX1004 (Jong), 0006.) Jong further discloses that "plants were self-pollinated." (*Id.*, 0007.) The reference then details the characteristics of plants across at least three generations (S₀ to S₃; *see id.*, 0009-11 (Tables 1-4).) and provides that "several fairly vigorous S₅ lines have now been obtained." (*Id.*, 0012.) Jong thus teaches several rounds of selfing to create an inbred line, which would motivate a POSA to similarly perform one or more rounds of selfing to create an inbred line.

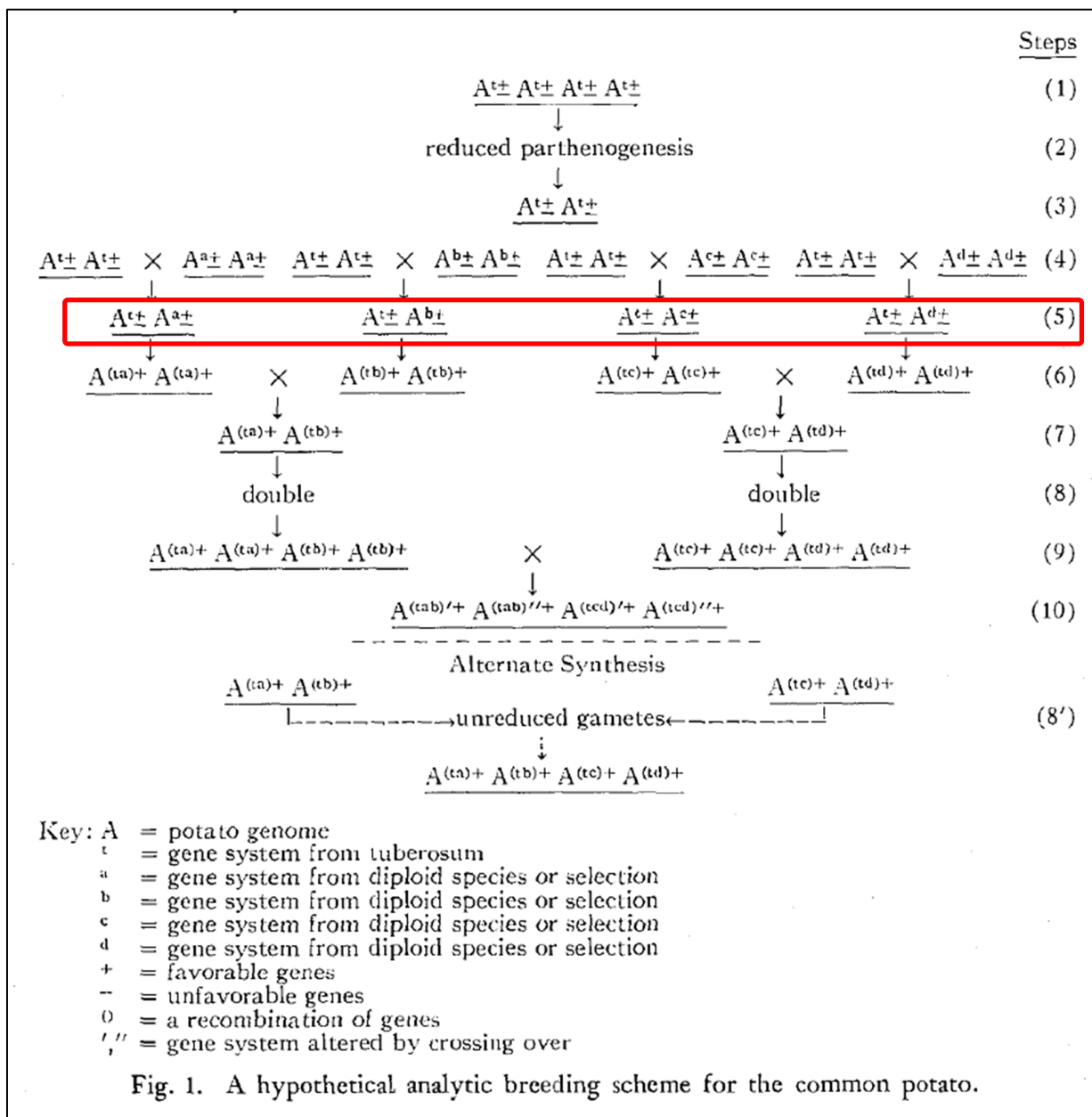
186. As I explained in Ground 1 Claim 1 above, Jong further discloses that selfings increase the degree of homozygosity. (*See supra*, §VI.B.1(d); *see also*

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EX1004 (Jong), 0013 (explaining “[a]ssuming no selection for heterozygosity, the diploid S₅ generation is about 97% homozygous”).) As discussed above, based on well-known principles of genetics, a POSA would have known that selfing increases homozygosity and can be used to fix desirable traits. (*See supra*, §IV.H.1.)

187. Chase further suggests step (e) and together with Jong renders step (e) obvious. In step #5 of the breeding scheme, Chase discloses “[i]nbreeding of the diploid F₁ crosses, step #5, with selection under appropriate stress, is required at this stage to fix desirable genetic material.” (EX1007 (Chase), 0006.) An allele is “fixed” in a population when all individuals in the population are homozygous for that allele. A POSA thus would have understood that “fixing” genetic material means tending toward homozygosity. Chase further demonstrates this inbreeding scheme and selection for desirable traits in Figure 1:

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(EX1007 (Chase), 0005 at Fig. 1.) Chase also provides expectation of success in describing this step as “present[ing] the plant breeder no problems of an unusual nature.” (*Id.*, 0006.) Thus, Jong’s teachings of selfing and increased homozygosity in combination with Chase’s well-known methods for inbreeding render step (e)

obvious.

(g) Claim 5[f]

5[f]	(f) selecting within each generation of inbreeding for a fertile offspring plant, and providing a diploid, fertile, self-compatible potato plant, wherein at least 75% of the genomic loci in said plant are homozygous.
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188. Jong teaches selecting for a fertile offspring plant within each generation of inbreeding. As I described in Section VI.B, Jong discloses selfing plants across multiple generations and selecting for self-compatible, fertile potato plants. (*See also* EX1004 (Jong), 0007 (“[i]n each generation, plants were self-pollinated”); 0011 (Table 4).) Moreover, the lines are created by breeding progeny from parents that are diploids, meaning the resulting progeny will also be diploid.

189. As I further described in Section VI.B, Jong also teaches inbreeding plants across multiple generations so that at least 75% of the genomic loci are homozygous. 75% homozygosity is not particularly high, especially given Jong teaches that 1 generation is needed to reduce heterozygosity by 50 percent. (*See supra*, §VI.B.1(d).) Additionally, Chase further suggests this breeding scheme. (*See* EX1007 (Chase), 0006-07.)

(h) Motivation to Combine Jong, Chase, and Bamberg with Reasonable Expectation of Success

190. Jong describes the successful production of inbred lines from US-

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W5309 and US-W5315 and further encourages a POSA to produce additional inbred lines, explaining:

Considering the success with hybrid vigour in other crops, this area certainly warrants further investigation in potatoes, especially on the diploid level where advanced inbred lines can be obtained in a relatively short time. A broader genetic base will probably be necessary to develop more diverse inbred lines that can be used as parents to produce maximum hybrid vigour.

(EX1004 (Jong), 0013.) Based on this express suggestion to create additional lines and the demonstration from Jong that similar lines can be created, a POSA would have been motivated to produce additional diploid, fertile, and self-compatible inbred lines. Moreover, a POSA would have known that a successful hybrid breeding program in potato requires a pool of fertile and diploid inbred lines (*see* EX1007 (Chase), 0006), and thus would have additionally been motivated to create lines for a hybrid breeding program, which would lead a POSA to plants similar to those described by Jong. A POSA would have looked to the Bamberg publication for additional information about the parental accessions used in Jong's crosses, and understood from that reference what beneficial traits (including vine and flowering vigor) were exhibited by lines used by Jong.

191. A POSA additionally would have had a reasonable expectation of success in creating diploid, fertile, self-compatible lines for the hybrid breeding

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program as Jong already proved this was possible. The inbreds derived from US-W5309 and US-W5315 lines are diploid, fertile, self-compatible and produce high yields, and Jong expressly directs that “it is possible to obtain homozygous clones for future genetic studies on the diploid level” and that “on the diploid level [] inbred lines can be obtained in a relatively short time.” (EX1004 (Jong), 0013.) Chase further provides that inbreeding of diploid crosses “present[] the plant breeder no problems of an unusual nature” (EX1007 (Chase), 0006), and that all of the steps in the analytical breeding process “have in one or another line of research already been accomplished” and “[t]hus, it is not unreasonable to expect that these operations can be carried out in stepwise fashion.” (*Id.*, 0007.) Thus, both Jong and Chase teach that the plants can be produced with reasonable expectation of success.

192. As I explained above, during prosecution, Agventure argued that development of the inbred plants via the method of Claim 5 was not obvious because breeders would not persist in a large-scale breeding program with selections based on fertility as opposed to tuber yield. (*See supra*, §V.D.3.) For the reasons I stated above, Agventure’s comments were incorrect. (*See id.*)

6. Claim 6

6	The method of claim 5, wherein said second potato plant is a donor for an agronomically desirable trait selected from the group consisting of: insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, flooding tolerance, tolerance to dry and
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	wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.
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193. As I explained for Claim 2 above, Jong renders obvious a plant with one or more of the agronomically desirable traits recited in Claim 6. (*See supra*, §VI.C.2.) Claim 6 simply recites these same traits for a plant produced by the method of Claim 5 and thus Jong, in combination with Chase and Bamberg, similarly renders Claim 6 obvious.

194. Jong discloses US-W5309 and US-W5315. (EX1004 (Jong), 0007; *see also supra*, §§VI.C.5(a), (b).) Inbred lines derived from either US-W5309 or US-W5315 like those disclosed in Jong could be the first and/or second potato plant of Claim 5.

195. As I explained for Claim 2 above, the female parents of US-W5309 and US-W5315 each have several agronomically desirable traits. Further, some of the resistance traits exhibited by these accessions are shared, such as resistance to tarnish plant bug. A POSA would have reasonably expected at least some progeny of a cross between any of the parental plants like those described in Jong would also exhibit at least one of these resistance traits. Under basic principles of genetics and statistics, the probability that all of the traits are eliminated across the progeny population is low, and the prior art teaches a POSA the importance of transferring useful agronomic traits to offspring. (EX1007 (Chase), 0006; EX1022 (DeMaine),

0006.) Further, the traits would have been easy for a POSA to identify.

196. A POSA would have been motivated to maintain these traits in the progeny since they are agronomically desirable and thus would have selected offspring like those in the US-W5309 and US-W5315 lines that have at least one of the resistance traits of the parents. Accordingly, the “second potato plant” would have had one of the traits listed in Claim 6, rendering this claim obvious.

7. Claim 7

7	A potato plant produced by the method of claim 5, wherein said potato plant is diploid, fertile, self-compatible, produces at least 200 grams fresh weight of tubers per plant, wherein at least 75% of the genomic loci in said potato plant are homozygous, and wherein said self-compatibility in said potato plant is conferred by the <i>Sli</i> gene.
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197. As explained in Ground 1 (§VI.B.3), Jong anticipates Claim 7 of the '841 patent. For the same reason, Jong also renders Claim 7 obvious.

198. Indeed, Claim 7 simply describes a plant produced by practicing the method of Claim 5. As I further explained in Section VI.C.5 above, Jong, in combination with Chase and Bamberg, renders Claim 5 obvious, and a POSA practicing the prior art would find plants produced by those methods equally obvious.

D. GROUND 3: Claims 8-10 Are Obvious over Jong, Chase, Bamberg, and Springer

1. Claim 8

199. Jong in combination with Chase, Bamberg, and Springer renders Claim 8 obvious.

(a) Claim 8[pre]

8[pre]	A method of producing a uniform diploid hybrid <i>Solanum tuberosum</i> potato seed, which seed, when sown produces a diploid, fertile, and self-compatible potato plant having a tuber yield expressed in grams of fresh weight of at least 200 grams and wherein said self-compatibility trait is due to the presence of the <i>Sli</i> gene, said method comprising:
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200. Claim 8 is focused on a method for producing uniform TPS that, when sown, produces a plant with the same performance characteristics described in Claims 1 and 5. As discussed throughout my treatment of Claim 8, the arrangement of steps in this claim was obvious. And as described in Section VI.B.1 for Claim 1, Jong discloses a diploid, fertile, and self-compatible potato plant with a tuber yield of at least 200 grams and compatibility due to the *Sli* gene. Jong further describes a seed of this plant. (*See supra*, §VI.B.2.) Finally, as described for Claim 5, Jong in combination with Chase discloses a method for making inbred plants that would be used as the parental lines for generating the hybrid cross of Claim 8. (*See supra*, §VI.C.5.) When homozygous inbred lines are crossed, it is expected that the resulting hybrid F₁ population will be uniform, as recited in this claim. (*See supra*,

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¶¶60, 63.) Given the known fertility of these lines, a POSA would have reasonably expected that any method for making the plants would also result in potato seed.

201. A POSA would have reasonably expected that a cross between the plants like those disclosed in Jong (e.g., inbreds derived from families like US-W5309 and US-W5315) would have produced a sufficiently large population of offspring where the seeds and a proportion of plants grown from the seed would exhibit the traits of being diploid, fertile, self-compatible due to the *Sli* gene, and having a tuber yield of at least 200 grams. A POSA could easily select for these traits.

(b) Claim 8[a]

8[a]	(a) providing a first potato plant, wherein said first potato plant is a plant of a first potato line, wherein said first potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to <i>Solanum tuberosum</i> , wherein said first potato line is diploid, fertile, self-compatible and wherein at least 75% of the genomic loci in said first potato line are homozygous, and wherein said self-compatibility in said first potato line is conferred by the <i>Sli</i> gene, wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively, and wherein said first potato plant has a tuber yield expressed in grams of fresh weight of at least 200 grams;
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202. Jong discloses step (a). As I explained in Sections VI.A.1, B.1, Jong

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discloses potato plants derived by selfing US-W5309 and US-W5315. These plants are of the *Solanum tuberosum* species, diploid, fertile, self-compatible, and are homozygous for at least 75% of their genomic loci. (*See supra*, §§VI.B.1(d), C.5(e), (f) (on Claims 1, 5).) Jong further discloses a potato plant where self-compatibility is conferred by the *Sli* gene as recited in the claim and that has a tuber yield of at least 200 grams. (*See supra*, §VI.B.1(c), (e) (regarding Claim 1[c],[e]).) A POSA would have used plants like these described in Jong in a breeding scheme, and thus Jong discloses this limitation.

(c) Claim 8[b]

8[b]	(b) providing a second potato plant, wherein said second potato plant is a plant of a second potato line, wherein said second potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to, wherein said second potato line is diploid fertile, self-compatible and wherein at least 75% of the genomic loci in said second potato line are homozygous, wherein said self-compatibility in said second potato line is conferred by <i>Sli</i> gene, wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively, wherein said second potato plant has a tuber yield expressed in grams of fresh weight of at least 200 grams, and wherein said second potato plant contains at least 20% contrasting homozygous loci as determined by molecular marker analysis when compared to said first potato plant;
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203. Jong discloses a potato plant of the species *Solanum tuberosum* that is

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diploid, fertile, homozygous for at least 75% of its genomic loci, self-compatible due to the *Sli* gene, and has a tuber yield of at least 200 grams. (*See supra*, §§VI.B.1, VI.C.5 (regarding Claims 1 and 5).) Apart from the limitation on 20% contrasting homozygous loci (which Jong also discloses as discussed below), the properties of the “second plant” of Claim 8 are essentially the same as the “first plant” of Claim 8. Accordingly, as discussed above, Jong discloses claim limitation 8[b].

204. Jong further renders obvious the second potato plant containing “at least 20% contrasting homozygous loci as determined by molecular marker analysis” when compared to the first potato plant. As discussed further in the section on motivations to combine below, in terms of general motivation, Jong advises that “hybrid vigour may be obtained when two inbred clones with a high combining ability are crossed” and “[c]onsidering the success with hybrid vigour in other crops, this area certainly warrants further investigation in potatoes, especially on the diploid level where advanced inbred lines can be obtained in a relatively short time.” (EX1004 (Jong), 0013.) Based on this and a POSA’s general motivation in agricultural plant breeding to maximize hybrid vigor, a POSA would have been motivated to elicit heterosis and, to do so, would have chosen parental lines with at least 20% contrasting loci.

205. As I explained above, by 2009, potato breeders aimed to maximize

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heterosis in potato. A POSA would have known that breeders could best achieve heterosis by crossing inbred plants that have a high degree of homozygosity within each of the parental plants but are genetically distant from each other. (*See supra*, §IV.H; *see also* EX1011 (Jansky 2009), 0026 (explaining that a breeding strategy that maximizes heterosis is one that first develops highly inbred clones at the diploid level and then combines genetically diverse diploids).)

206. Further, by 2009, it was known that a goal of at least 20% contrasting loci was a reasonable minimum for genetic distance to obtain some degree of heterosis. For example, using molecular marker analysis, several studies had already reported on achieving a high degree of heterosis when a higher percentage of contrasting loci existed between the parents. In maize, for example, Springer reported on two well-characterized, inbred lines, B73 and Mo17, which when crossed “provides an excellent example of heterosis.” (EX1008 (Springer), 0006.) From amplicon analysis, Springer further reported that “44% of the sequences contained at least one polymorphism in B73 relative to Mo17,” and that “it is estimated that there is one polymorphism every 100 bp in any two randomly chosen maize inbred lines” (*id.*, 0007), which a POSA would have understood means the two lines have more than 20% contrasting loci based on molecular marker analysis. Springer further concluded that “heterosis is the result of variation at multiple

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genomic locations,” and “[a]s the genetic distance between the parental inbreds increases, there is generally an increase in heterosis.” (*Id.*, 0012.) Springer’s results are in accord with those reported by Lu, which completed SNP analysis on 770 maize inbred lines and reported that “[l]ong-term selection for hybrid performance has contributed to significant allele differentiation between heterotic groups at 20% of the SNP loci.” (EX1044 (Lu), 0001.)

207. Neither Springer’s conclusions nor molecular marker analysis are unique to maize. Instead, maize serves as a paradigmatic example of breeding in a diploid that potato breeders looked to for information about how to breed diploid potatoes. Indeed, Jong discloses that “[t]he success of hybridization between inbred lines in maize has led to many similar investigations with other crops” (EX1004 (Jong), 0006) and goes on to direct a POSA to cross inbred diploid potato clones, looking to maize as an example:

The rapid decline of vigour upon inbreeding suggests that hybrid vigour may be obtained when two inbred clones with a high combining ability are crossed. Considering the success with hybrid vigour in other crops, this area certainly warrants further investigation in potatoes, especially on the diploid level where advanced inbred lines can be obtained in a relatively short time.

(*Id.*, 0013.) A POSA would thus have been motivated to apply the teachings of Springer to diploid potato and would have had reasonable success in doing so given

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that potatoes, like maize, are diploid cross-pollinated crops. Further, in my experience, potato breeding with respect to heterosis is not unique and the principles of contrasting loci in maize are readily applied to potato. Based on the desire to achieve heterosis and known principles of heterosis, a POSA thus would have crossed two inbred lines with at least 20% contrasting homozygous loci and would have determined the contrasting homozygosity using the well-known technique of molecular marker analysis.

208. I note that while the claims supply a threshold of “at least 20% contrasting homozygous loci,” nothing in the specification demonstrates that this threshold is essential to achieving heterosis (or nonobvious). The patent does not describe any reason for the 20% threshold as opposed to any other specific numerical threshold nor does it provide any experiments or data showing that this threshold is critical. In fact, the specification never describes whether the patent inventors measured vigor in a hybrid cross as recited in Claim 8. Based on the teachings of the prior art as discussed above, a POSA would have understood that some degree of genetic distance was essential to obtaining heterosis. For example, a 0% level of contrasting homozygous loci would mean that the first and second plants being crossed were identical to each other, which would be equivalent to another round of selfing, and thus not be expected to lead to any heterosis at all. On the other hand,

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100% contrasting loci (even if possible) might represent a genetic distance too great and present problems in obtaining fertile offspring. As shown by the levels of genetic distance that have been empirically determined to give good heterosis in maize, discussed above, a POSA would have found the 20% threshold of the claims obvious.

(d) Claim 8[c]

8[c]	(c) cross-pollinating said first and said second potato plant and allowing said potato plant to produce berries with seeds; and
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209. Jong discloses step (c). As I described in Sections VI.A.1, C.5(d) above, Jong teaches cross-pollinating diploid potato plants including the selfed progeny of US-W5309 and US-W5315, such that those plants produce berries containing seeds.

(e) Claim 8[d]

8[d]	(d) collecting said seeds from said berries to provide hybrid potato seeds.
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210. Jong teaches collecting seeds to provide hybrid potato seeds.

211. Jong teaches “it is possible to obtain homozygous clones for future genetic studies on the diploid level” and further teaches “hybrid vigour may be obtained when two inbred clones with a high combining ability are crossed.” (EX1004 (Jong), 0013.) A POSA would have understood Jong’s call to cross plants

as requiring the need to collect seeds, because collecting seeds is the end result of a hybrid cross.

(f) Motivation to Combine Jong, Chase, and Springer with Reasonable Expectation of Success

212. For the reasons I provided in Section VI.C.5 above for Ground 2 Claim 5, a POSA would be motivated to combine Jong, Chase and Bamberg. (*See supra*, §VI.C.5.)

213. Additionally, a POSA would be motivated to combine these references with Springer in the context of making hybrid crosses. Jong advises that “hybrid vigour may be obtained when two inbred clones with a high combining ability are crossed” and “[c]onsidering the success with hybrid vigour in other crops, this area certainly warrants further investigation in potatoes, especially on the diploid level where advanced inbred lines can be obtained in a relatively short time.” (EX1004 (Jong), 0013.) Based on this and a POSA’s general motivation in agricultural plant breeding to maximize hybrid vigor (*see supra*, §IV.F), a POSA would have been motivated to develop parents that, when crossed, would maximize heterosis.

214. A POSA further would have had an expectation of success in creating uniform hybrids based on the teachings in Jong which describe inbred lines that are highly homozygous and uniform. (*See* EX1004 (Jong), 0012-13 (describing “fairly vigorous” S₅ lines that had a “high degree of uniformity” and were estimated to be

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“about 97% homozygous”).) Given these teachings, a POSA further would have expected uniform seeds.

215. A POSA seeking to apply the teachings in Jong, including its teaching that there has been success with hybrid vigor in other crops, would rely on Chase and Springer. Springer teaches that plants that are genetically more diverse are more likely to demonstrate heterosis and thus, using more genetically divergent plants leads to better performing hybrids. (*See* EX1008 (Springer), 0007, 0012; *see also* EX1044 (Lu), 0001-02.) Chase teaches breeding methods which a POSA would have applied to obtain hybrid crosses. (EX1007 (Chase), 0006-07.) A POSA breeding plants for heterosis would have been well-aware of this prior art and would have applied it to potato plants in the same way that the prior art, as discussed above, readily pointed to the maize example when discussing hybrid breeding in potatoes at the diploid level.

2. Claim 9

9	The method according to claim 8, wherein at least one of said first and said second potato plant 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, flooding tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.
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216. Jong, Chase, Bamberg, and Springer render Claim 9 obvious. As I explained in Sections VI.C.2, 6 for Claims 2 and 6, a POSA would have reasonably

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expected US-W5309 and US-W5315 to have at least one of the claimed traits. The female parents are accessions reported to have resistance to disease, nematodes, and/or insects. Based on breeding, US-W5309 and US-W5315 would similarly be expected to possess at least one of these traits – and it would have been obvious to select for such plants in progeny populations.

217. While Claim 8 recites a hybrid breeding method as opposed to the inbreeding method of Claim 5, this hybrid method would not change the desirability of traits of the parental lines or subsequent generations. Thus, like Claims 2 and 6, Claim 9 is obvious.

3. Claim 10

10	A uniform hybrid F1 potato seed produced according to the method of claim 8.
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218. Jong, Chase, and Springer render obvious Claim 10.

219. Claim 10 recites nothing more than the F₁ potato seed produced according to Claim 8. As I described in Section VI.D.1, Jong describes the breeding method of Claim 8. Jong further discloses that “several fairly vigorous S₅ lines have now been obtained,” and “[m]any of these lines exhibit a high degree of uniformity in leaf type, tuber shape and patterns of pigmentation.” (EX1004 (Jong), 0012.) Based on this disclosure, a POSA would have understood that uniformity

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was expected for inbred lines like those described in Jong as “uniformity in leaf type, tuber shape and patterns of pigmentation,” indicates uniformity at the level of the seed that produced these plants. Further, as a general matter and as explained above for Claim 8, the expected result of crossing inbred lines as discussed above is to obtain a population of hybrid F₁ seed that is highly uniform.

**E. GROUND 4: Phumichai, Jong, Chase, Bamberg, and Spooner
Render Claims 1-7 Obvious**

1. Claim 1

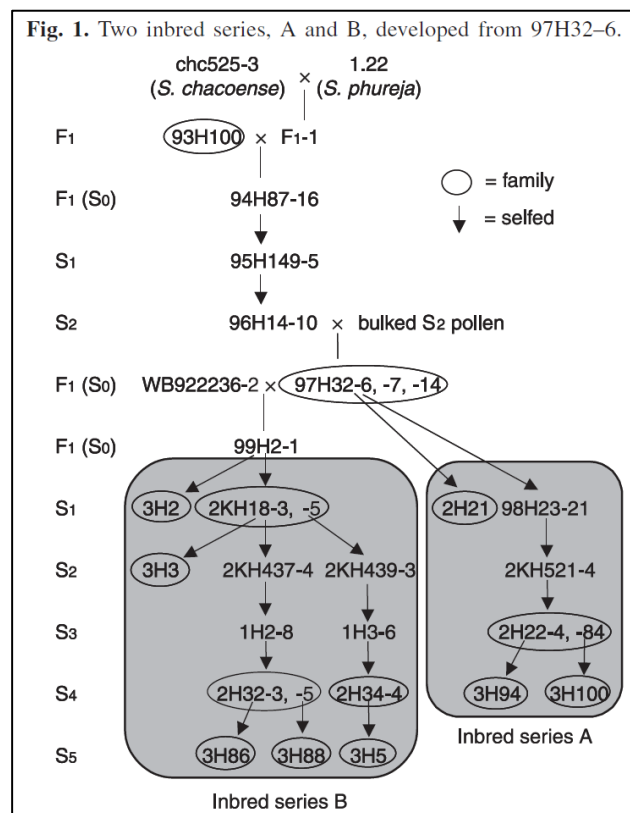
- (a) **“A plant of a potato line, wherein said potato line is of the species *Solanum tuberosum* optionally comprising introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*,” (Claim 1[a])**

220. Both Jong and Phumichai teach Claim 1[a].

221. As I described in paragraphs 108 and 128-131 above, Jong discloses a potato line of the species *Solanum tuberosum*.

222. Like Jong, Phumichai also teaches Claim 1[a]. As shown in the figure below, Phumichai discloses studies on a first series of inbred lines (inbred series A) obtained from diploid clone 97H32–6 (derived from Phureja, *S. chacoense*, and 93H100, which is comprised of Phureja Group and Stenotomum Group germplasm) and on a second series of inbred lines (inbred series B) derived from 97H32-6 and the diploid clone, WB922236–2, which contains Phureja in its background:

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(EX1005 (Phumichai), 0007 (Fig. 1); *see also id.*, 0006.) For the same reasons, I explained in Section VI.B.1(a) for Ground 1, a POSA would have known from the Spooner reference (and others) that 1.22 (referred to as *S. phureja*) is of the species *Solanum tuberosum*, that both Phureja Group and Stenotomum Group are *S. tuberosum*, and that based on both accepted taxonomy and parental lineage, the potato plants of Phumichai are at least essentially *Solanum tuberosum*. (*See supra*, §IV.A; EX1006 (Spooner).) As Spooner stated, “recognition of *S. phureja* as either a species or Cultivar Group (Phureja Group), [] is no longer tenable[.]” (*Id.*, 0012.)

223. Moreover, Phumichai discloses a breeding scheme where a potato line

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of the species *Solanum tuberosum* has introgression segments of other tuber bearing *Solanum* species crossable to *Solanum tuberosum*. In Phumichai, 1.22 is crossed with chc525-3 (*S. chacoense*), which is another species of *Solanum*. As further explained below, *S. chacoense* provided the *Sli* gene to subsequent progeny. (See EX1005 (Phumichai), 0006 (explaining 97H32–6 “was self-compatible due to the function of the *Sli* gene originally derived from a self-compatible variant of *S. chacoense*”).) The progeny of the cross (including 97H32–6) thus are *S. tuberosum* with the introgressed *Sli* gene from another *Solanum* species. Accordingly, Phumichai discloses Claim 1[a] in this way as well.

(b) “wherein said potato line is diploid, fertile, self-compatible,” (Claim 1[b])

224. Both Jong and Phumichai teach Claim 1[b].

225. As I described in Section VI.B.1(b) above, Jong discloses a potato line that is diploid, fertile, and self-compatible.

226. Similarly, Phumichai teaches Claim 1[b]. Phumichai discloses a cross between chc525-3 (*S. chacoense*) and 1.22 (*S. phureja*), which a POSA would have known are both diploid. (EX1005 (Phumichai), 0007 (Fig. 1); *see also id.*, 0006 (“[W]e found a dominant allele (the *S* locus inhibitor gene *Sli*) from a self-compatible variant in a wild diploid species, *S. chacoense*[.]”).) Phumichai further discloses that the progeny of this cross remained diploid. (See *id.*, 0006 (explaining

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“[t]he first series of inbred lines (inbred series A) was obtained from a **diploid** clone 97H32–6”); *id.*, 0010 (reporting production of “self-fertile S₅ **diploid** inbreds”).)

227. Phumichai further teaches fertile, self-compatible potato lines. The reference discloses that “self-fertile S₅ diploid inbreds with more than 90% homozygosity were produced.” (*Id.*) A POSA would have known that “self-fertile” means the potatoes were both self-compatible and fertile. (*See supra*, ¶182.) Moreover, given that 5 generations were produced, the plants were fertile, as they were obviously able to undergo several rounds of sexual reproduction. That the potatoes in Phumichai were fertile and self-compatible is reinforced by the breeding scheme in Figure 1 of Phumichai, which shows selfing across several generations (both in the creation of the inbred series and to create the parents for the inbred series). (*See* EX1005 (Phumichai), Fig. 1.)

(c) “**produces at least 200 grams fresh weight of tubers per plant,**” (Claim 1[c])

228. Jong teaches a potato plant that produces at least 200 grams fresh weight of tubers per plant. (*See supra*, §VI.B.1(c).)

229. Phumichai also teaches Claim 1[c]. It discloses “some S₄ plants in inbred series A produced considerable tuber yields.” (EX1005 (Phumichai), 0010.) It further explains that due to this considerable tuber yield, the “advanced inbreds may be valuable genetic stocks for studying the mechanism of heterosis and for

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producing hybrid variety at the diploid level.” (*Id.*)

230. A POSA would have interpreted “considerable tuber yield” from Phumichai to mean at least 200 grams per plant, at least when such plants are grown under conditions appropriate for tuber production. Indeed, the expected yield for potatoes of *S. tuberosum* Phureja varieties is well above 200 grams. DeMaine, for example, describes the yield of several Phureja varieties as well above 200 grams, ranging from 581 grams to 774 grams tuber yield. (See EX1022 (DeMaine), 0003 (Table 1).) Thus, to be a suitable candidate for “producing hybrid variety at the diploid level[,]” as suggested by Phumichai, a POSA would have looked for and expected yields at least in line with these standard yields. Accordingly, a POSA would have expected that the plants in Phumichai were capable of yielding at least 200 grams fresh weight of tubers per plant and Phumichai, in addition to Jong, renders Claim 1[c] obvious.

(d) “and at least 75% of the genomic loci in said potato line are homozygous,” (Claim 1[d])

231. For the reasons I stated above in Section VI.B.1(d), Jong discloses this limitation.

232. Phumichai also discloses it. Phumichai teaches that, based on molecular marker analysis, “[t]he average heterozygosity levels of the originally

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heterozygous loci decreased from 100% in S₀ to 10.7% in S₄¹¹ and 8.6% in S₅ (inbred series A and B, respectively)[,]” and further discloses that “self-fertile S₅ diploid inbreds with more than 90% homozygosity were produced.” (EX1005 (Phumichai), Abstract, 0010; *see also id.*, 0009 (Table 2).) A POSA would have understood that a plant reported to have 10.7% and 8.6% heterozygous loci has 89.3% and 91.4% homozygosity, respectively (100% - 10.7% = 89.3% and 100% - 8.6% = 91.4%). Further, Phumichai discloses that “further continuous selfings, if possible, would bring about near pure lines: 99% homozygosity at S₁₀, based on a theoretical calculation from the observed 38.4%-38.5% reduction rate in heterozygosity.” (*Id.*, 0010.) Thus, Phumichai discloses a potato line where at least 75% of the genomic loci are homozygous.

- (e) “wherein said self-compatibility in said potato line is conferred by the S-locus inhibitor (*Slh*) gene, and wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively.” (Claim 1[e])

233. In addition to Jong (*see supra*, §VI.B.1(e)), Phumichai describes self-

¹¹ These same series A plants that were 89.3% homozygous also had “considerable tuber yields.” (EX1005 (Phumichai), 0010.)

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compatibility as conferred by the *Sli* gene.

234. Phumichai discloses the F₁-1 line created by a cross between chc525-3 (*S. chacoense*) and 1.22 (*S. phureja*). The chc525-3 variant has the *Sli* gene and thus the F₁-1 lines have the *Sli* gene as well as the inbred series derived from F₁-1. (EX1005 (Phumichai), 0006 (“The first series of inbred lines (inbred series A) was obtained from a diploid clone 97H32–6 (composed of 75% cultivated and 25% wild germplasm with 100% cultivated cytoplasm), which was self-compatible due to the function of the *Sli* gene originally derived from a self-compatible variant of *S. chacoense* (Hosaka and Hanneman 1998*a* [EX1030]).”); *id.* (describing the “*Sli* gene donors F₁-1, 97H32–6, 97H32–7, or 97H32–14”).)

235. As a result of the breeding scheme beginning with parents that have the *Sli* gene, the offspring described in Phumichai’s breeding scheme are self-compatible due to the *Sli* gene. Phumichai provides:

Previously, a diploid clone 97H32–6 was selfed up to S₃ using the *Sli* gene. To explore the usefulness of the *Sli* gene for the production of highly homozygous diploid potatoes, 2 S₄ families from the above 97H32-6 derived S₃ lines (inbred series A) and 3 S₅ families by continuous selfings from a different F₁ (= S₀) plant (inbred series B) were developed. . . Thus, **highly homozygous and seed-propagated diploid potatoes could be obtained by repeated selfing using the *Sli* gene.**

(EX1005 (Phumichai), Abstract.)

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236. In fact, as further evidence that Phumichai discloses that the *Sli* gene confers self-compatibility, the '841 patent describes Phumichai as the source of *Sli* for their plants. (EX1001 ('841 patent), 29:47-51.)

**(f) Motivation to Combine Phumichai, Jong, and Spooner
with Reasonable Expectation of Success**

237. A POSA would have combined Phumichai and Jong with reasonable expectation of success. Jong discloses US-W4 which is self-compatible due to the *Sli* gene and Phumichai describes the *Sli* gene as conferring self-compatibility and that *Sli*-based breeding could be used for multiple selfings to create highly homozygous and vigorous plants. Further, both references are analogous, because they are from the same field of endeavor and both focused on the same subject matter of the '841 patent (diploid inbreeding in potatoes). And as discussed above, a POSA would have known from Spooner that the Phureja potato plants disclosed in Phumichai were *S. tuberosum*. (See *supra*, §§IV.A, VI.A.3.)

2. Claim 2

2	The potato plant of claim 1, wherein said plant comprises at least one agronomically desirable trait selected from the group consisting of: insect tolerance, nematode tolerance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, flooding tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.
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238. Phumichai in combination with Jong and Chase renders Claim 2

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obvious.

239. Based on the disclosures in Phumichai and Jong, a POSA would have been motivated to create potato plants with introgressed genes that confer agronomically desirable traits. Jong discloses that, as evidenced by the results in the reference, “it is possible to obtain homozygous clones for future genetic studies on the diploid level.” (EX1004 (Jong), 0013.) It further provides that in potatoes “advanced inbred lines can be obtained in a relatively short time” and “[a] broader genetic base will probably be necessary to develop more diverse inbred lines[.]” (*Id.*) Based on this disclosure, a POSA would have been motivated to advance the studies in Jong to potatoes with additional traits to obtain such a broader genetic base.

240. Similarly, Phumichai describes that its advanced inbred lines “may be valuable genetic stocks for studying the mechanism of heterosis and for producing hybrid variety at the diploid level.” (EX1005 (Phumichai), 0010.) Again, like Jong, a POSA would have been motivated by Phumichai’s teachings to develop potatoes with additional traits.

241. Given the potato’s vital role in agriculture, a POSA would have applied the teachings in Phumichai and Jong to develop potatoes with agronomically desirable traits, including disease and pest resistance and high yield. As described

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above, Jong discloses plants derived from parents with known resistance traits, and both Jong and Phumichai describe high-performing highly inbred lines. A POSA thus would have been motivated to develop lines following the teachings of both studies, and cross them. Moreover, a POSA would have had reasonable expectation of success in doing so since both Jong and Phumichai disclose successful breeding schemes, which Phumichai describes as a “simple procedure[.]” (EX1005 (Phumichai), 0010.) Chase additionally teaches successfully crossing plants in an inbreeding scheme to introduce beneficial traits (EX1007 (Chase), 0006), and that “all of the operations outlined . . . [have] already been accomplished” and “[t]hus, it is not unreasonable to expect that these operations can be carried out in stepwise fashion[.]” (*Id.*, 0007.)

3. Claim 3

3	The potato plant of claim 1, wherein said potato plant has a fresh weight of the foliage and shoots of at least 500 grams per plant at maturity.
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242. Claim 3 is disclosed by Jong for the reasons I already described in Ground 2 above. (*See supra*, §VI.C.3.)

4. Claim 4

4	A seed or tuber that produces the plant of claim 1.
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243. Both Jong and Phumichai render Claim 4 obvious.

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244. For the reasons stated above in Grounds 1, Jong discloses a seed or tuber that produces the plant of Claim 1. (*See supra*, §VI.B.2.)

245. Phumichai further discloses a seed or tuber that produces the plant of Claim 1. Phumichai describes plants that meet the characteristics recited for Claim 1. (*See supra*, §VI.E.1.) Phumichai produced these plants through sexual reproduction, growing them from true potato seed (*see* EX1005 (Phumichai), 0007 (Figure 1)), which a POSA would have understood means there are necessarily seeds that produce the plants of Claim 1. Phumichai also discloses that the S₄ generation of inbred series A “produced seeds.” (*Id.*, 0007; *see also id.*, 0008 (Table 1) (reporting on inbred series A and B plants that successfully produced seeds by self-pollination).) As explained for Claim 1 above, inbred series A is a line that renders obvious all of the limitations of Claim 1. (*See supra*, §VI.E.1.) Thus, the seeds from this same series A disclose Claim 4.

246. As I described for Ground 4 Claim 1, Phumichai also teaches tubers that produce the plant of Claim 1. (*See id.*)

5. Claim 5

(a) Claim 5[pre]

5[pre]	A method of producing a plant of a potato line, wherein said potato line is diploid, fertile, self-compatible, produces at least 200 grams fresh weight of tubers per plant, and at least 75% of the genomic loci in said plant line are homozygous, comprising the steps of:
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247. Phumichai, in addition to Jong, discloses this limitation.

248. As noted above in connection with claim 1, Phumichai and Jong teach plants that are diploid, fertile, self-compatible due to the *Sli* gene, produce at least 200 grams fresh weight of tubers per plant, and that are homozygous for at least 75% of their genomic loci. (*See supra*, §§VI.E.1(a)-(d).) Phumichai further describes a breeding scheme for making plants like those disclosed in Phumichai as further described below.

(b) Claim 5[a]

5[a]	(a) providing a first potato plant, wherein said first potato plant is the plant according to claim 1;
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249. Phumichai describes inbred series A, which as I explained for Ground 4 Claim 1 above, is a potato plant according to Claim 1. (*See supra*, §VI.E.1.) Thus, Phumichai discloses step (a). Additionally, Jong discloses step (a) for the reasons I explained in Ground 2 above. (*See supra*, §VI.C.5.)

(c) Claim 5[b]

5[b]	(b) providing a second potato plant, wherein said second potato plant is a diploid plant, and wherein said potato plant comprises any level of homozygosity;
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250. Phumichai discloses step (b). Similar to my discussion of this claim step in light of Jong (*see supra*, ¶175), this step merely requires providing any

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diploid potato, of any level of homozygosity, as the second plant for a cross. A potato breeder would have been motivated to introduce such a cross as part of the overall breeding scheme, including for example to introduce desirable genetics into the breeding program. For example, crosses of this type within a breeding program are described by Chase's Step 4 as discussed above in Part IV.H.1 (*see supra*, ¶¶68-70). Indeed, as I discuss with respect to claim element 5[c] below, Phumichai performed just such a cross as part of the overall inbreeding program described in that reference.

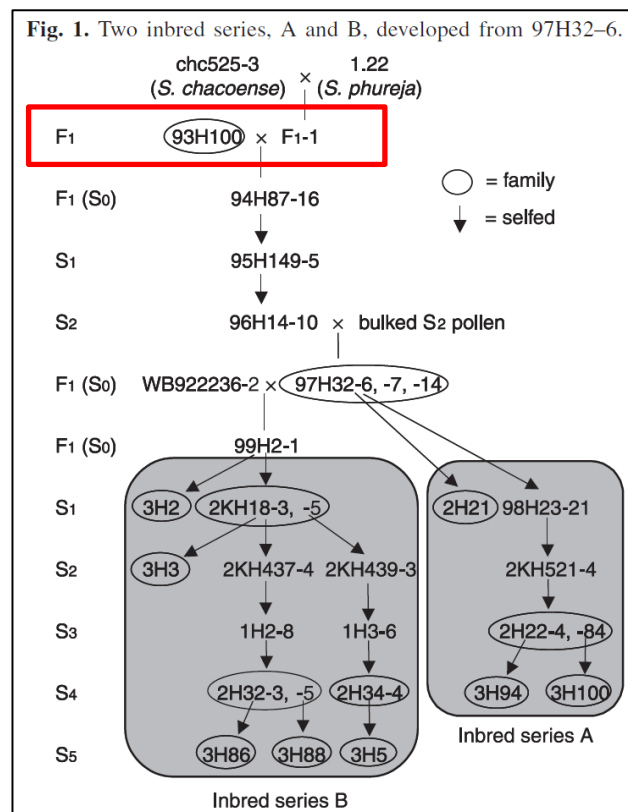
251. Still further, Phumichai describes inbred series A and series B, which are diploid potato plants with high levels of homozygosity. (*See* EX1005 (Phumichai), 0007 (Fig. 1); *see also id.*, Abstract (describing that series A and B are “highly homozygous and seed propagated diploid potatoes”); *id.*, 0010 (“[T]his is the first report that self-fertile S₅ diploid inbreds with more than 90% homozygosity were produced.”). A POSA could thus have used potato plants like those described in Phumichai as the second potato plant. For example, Phumichai discloses S₄ plants of inbred series A that “produced considerable tuber yields.” (*Id.*, 0010; *see also supra*, §§VI.D.1, VI.C.5.)

(d) Claim 5[c]

5[c]	(c) cross-pollinating said first potato plant and said second potato plant to produce seeds and collecting said seeds to thereby provide hybrid offspring seeds;
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252. For the reasons I explained in Section VI.C.5, Jong discloses this claim limitation.

253. Phumichai also teaches step (c). As shown in Figure 1 (reproduced below), Phumichai provides a breeding scheme for the production of inbred series A and B plants:



(EX1005 (Phumichai), 0007 (Fig. 1).) The breeding scheme, as shown in the red

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box, begins with a cross between a diploid F₁-1 (produced via a cross between chc525-3 and 1.22) and 93H100, which a POSA would have known are both diploid. (See also *id.*, 0006 (explaining 97H32-6 (which was derived from the 93H100 F₁-1 cross) is a diploid clone that has self-compatibility due to the *Sli* gene).)

254. Phumichai describes the disclosed breeding scheme as a “simple procedure (crossing with a *Sli* gene donor, then continued selfings)” (EX1005 (Phumichai), 0010.) and accordingly, a POSA would have found it obvious to replicate the procedure with other plants. For example, a POSA would have found it obvious to replicate the creation of plants such as those disclosed in inbred series A or B in Phumichai, and/or US-W4-derived plants as described in Jong, and further to perform crosses with such plants, using them as plant 1 or 2 as recited in Claim 5. Given that the plants in both Phumichai and Jong are diploid potatoes, a POSA would have found it trivial to make this cross and thus would have had a reasonable expectation of success in obtaining progeny from the cross.

255. There is nothing special or novel about collecting seeds from a cross as such a collection was regularly performed by breeders well before 2009 as a simple task of plant breeding. Further, Phumichai discloses collecting seeds from crosses as shown in Table 1, reproduced here:

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Table 1. Total number and percentage of plants that were self-pollinated and those that successfully produced seeds by self-pollination (= selfers). See text for details.

Generation	No. of plants grown	Self-pollinating plants	Flowers	Selfers
Inbred series A				
F ₁ (S ₀)	1	1 (100%)	10	1 (100%)
S ₁	91	57 (62.6%)	401	47 (82.5%)
S ₂	11	3 (27.3%)	15	2 (66.7%)
S ₃	81	37 (45.7%)	307	20 (54.1%)
S ₄	424	30 (7.1%)	132	8 (26.7%)
Inbred series B				
F ₁ (S ₀)	209	90 (43.1%)	578	60 (66.7%)
S ₁	831	186 (22.4%)	712	67 (36.0%)
S ₂	315	58 (18.4%)	231	16 (27.6%)
S ₃	118	38 (32.2%)	282	15 (39.5%)
S ₄	106	55 (51.9%)	727	28 (50.9%)
S ₅	427	115 (26.9%)	536	43 (37.4%)

(EX1005 (Phumichai), 0008 (Table 1); *see also id.*, 0006 (explaining “seedlings except for the initial population of inbred series B, were used” and “[s]elf-pollinations were made on as many flowers as possible until the plants set berries during the season”).) Based on the breeding scheme in Phumichai, a POSA would have understood that the authors of Phumichai collected seeds from the crosses, grew plants from those seeds, and continued collecting seeds from several generations of selfings. A POSA would have found it simple to replicate this collection of seeds with potato plants 1 and 2 (again, by following the teachings of Phumichai and Jong to obtain the necessary inbred lines). Further, the idea to perform a cross as outlined in this claim step is obvious in view of Chase, for the reasons I discussed above in Section VI.C.5.

(e) Claim 5[d]

5[d]	(d) growing said hybrid offspring seeds to provide a population of hybrid offspring potato plants and selecting from said population a self-compatible potato plant;
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256. As I explained in Section VI.C.5, Jong teaches this limitation. Phumichai also teaches claim limitation 5[d].

257. In Figure 1, Phumichai discloses a breeding scheme where diploid potatoes with the *Sli* gene are crossed and then selected during several rounds of selfing to create inbred series A and B. Phumichai further explains that

To advance selfed generations quickly, only **seedlings**, except for the initial population of inbred series B, were used without harvesting tubers. **Self-pollinations were made on as many flowers as possible** until the plants set berries during the season.

(EX1005 (Phumichai), 0006.) As shown in Figure 1, the scheme resulted in several generations of selfings for inbred series A and B. A POSA would have understood that this scheme of breeding across several generations and Phumichai's reference to seedlings required growing the offspring seeds and selecting the resulting plants. Given the multiple rounds of selfing, a POSA further would have understood that the plants were self-compatible. Accordingly, Phumichai teaches step (d).

258. Moreover, Phumichai describes

[I]nbred series B **maintained relatively constant frequencies of flowering plants and selfers throughout selfing generations**, which might be explained partly by a **strong selection pressure for fertility** in the initial stage (4.1% were selected before selfings started).

(*Id.*, 0010.) A POSA would have thus understood that Phumichai discloses tracking self-fertility across several generations, which evinces growing plants and selecting for self-fertility. (*See also id.*, 0008 (Table 1) (showing number and percentage of plants that were self-pollinated and produced seeds by self-pollination).) Based on these teachings, a POSA crossing plants like those described in Phumichai with each other, or plants like those described in Phumichai with plants like those described in Jong would be encouraged to similarly collect seeds and grow offspring and further select for self-compatibility. Growing offspring from seeds and selecting for a desirable trait, like self-compatibility, was commonplace in breeding potatoes before 2009 and is still commonplace today.

(f) Claim 5[e]

5[e]	(e) inbreeding said self-compatible potato plant by selfing said self-compatible potato plant for between 1 to 8 selfings to thereby increase the degree of homozygosity in each successive generation; and
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259. Jong and Chase teach this Claim limitation. (*See supra*, §VI.C.5.)

Phumichai further teaches step (e). As I described above, Phumichai discloses that inbred series A and B were created through at least four or five rounds of selfing.

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(See *supra*, ¶¶112, 227, 255; see also EX1005 (Phumichai), 0006, 0007 (Fig. 1), 8 (Table 1).)

260. Phumichai additionally teaches that this selfing increases homozygosity in successive generations. For example, it provides that “this is the first report that self-fertile S₅ diploid inbreds with more than 90% homozygosity were produced.” (EX1005 (Phumichai), 0010.) Additionally, as shown in Table 2, Phumichai used molecular markers to examine heterozygosity across several generations in inbred series A and B, and found that heterozygosity decreased across these generations (i.e., homozygosity increased).

Table 2. Locus-based observed percentage of heterozygosity (LOPH) or chromosome section-based observed percentage of heterozygosity (SOHP) estimated using RFLP and AFLP markers. For parental clones, LOPH and SOPH were estimated by the proportion of segregating loci in their progeny, while those for the progeny were represented by the mean with the range in parentheses.

Parent						Progeny					
Generation	Clone	Expected	LOPH (RFLP)	SOPH (RFLP)	LOPH (AFLP)	Generation	Family	No.	Expected	LOPH (RFLP)	SOPH (RFLP)
Inbred series A											
S ₀	97H32-6	100	100	100	100	S ₁	2H21	15	50	49.6 (32.3-62.9)	57.4 (41.2-70.6)
S ₂	2KH521-4	25	50.0	52.9	62.2	S ₃	2H22	15	12.5	26.1 (19.4-41.9)	30.8 (20.6-44.1)
S ₃	2H22-4	12.5	17.7	20.6	45.1	S ₄	3H94	15	6.25	9.6 (3.2-14.5)	12.0 (2.9-17.6)
S ₅	2H22-84	12.5	14.5	17.7	42.4	S ₄	3H100	15	6.25	8.2 (0-14.5)	9.4 (0-17.6)
Inbred series B											
S ₀	99H2-1	100	100	100	100	S ₁	3H2	12	50	56.0 (39.0-76.3)	62.4 (48.3-75.9)
S ₁	2KH18-3	50	59.3	65.5	79.1	S ₂	3H3	14	25	29.1 (15.5-39.0)	37.9 (20.7-44.8)
S ₃	1H2-8	12.5	20.3	20.7	19.9	S ₄	2H32	7	6.25	7.5 (1.7-13.6)	9.9 (3.4-13.8)
S ₄	1H3-6	12.5	11.9	20.7	38.3	S ₄	2H34	16	6.25	5.6 (0-10.3)	10.4 (0-17.9)
S ₄	2H32-3	6.25	20.3	20.7	19.3	S ₅	3H86	15	3.125	10.7 (1.7-18.6)	12.2 (3.4-17.2)
S ₄	2H32-5	6.25	13.6	13.8	19.0	S ₅	3H88	15	3.125	6.1 (0-11.9)	7.6 (0-10.3)
S ₄	2H34-4	6.25	5.1	10.3	21.2	S ₅	3H5	12	3.125	3.0 (0-5.1)	6.0 (0-10.3)

(EX1005 (Phumichai), 0009 (Table 2); see also generally *id.*, 0007-09.)

261. Based on Phumichai’s teachings that selfing the plants increases homozygosity, a POSA would have been motivated to similarly self the offspring of any cross between plants like those described in Phumichai or plants like those disclosed in Phumichai and Jong, and would have found it trivial to do so. Also as

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noted above, Chase discloses the common concept of repeated rounds of selfing as a method of inbreeding. (*See supra*, §VI.C.5.)

(g) Claim 5[f]

5[f]	(f) selecting within each generation of inbreeding for a fertile offspring plant, and providing a diploid, fertile, self-compatible potato plant, wherein at least 75% of the genomic loci in said plant are homozygous.
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262. Jong discloses this claim limitation for the reasons I described in Section VI.C.5. As I explain here, Phumichai also disclosed this limitation. Above, I explained that Phumichai teaches multiple rounds of selfings in inbred series A and B. (*See supra*, ¶¶112, 227, 255, 259; *see also* EX1005 (Phumichai), 0006 (Fig. 1).) As Phumichai teaches, this breeding scheme produces progeny which are diploid, fertile, and self-compatible.

263. Further, Phumichai provides that offspring of the selfings are more than 75% homozygous at genomic loci, explaining that “this is the first report that self-fertile S₅ diploid inbreds with more than 90% homozygosity were produced.” (EX1005 (Phumichai), 0010.) As one can observe from Table 2 in Phumichai, furthermore, several of the plants were less than 25% heterozygous, meaning at least 75% of the genomic loci were homozygous (homozygous % = 100 – heterozygous %). (*See id.*, 0009 (Table 2).) Thus, Phumichai teaches step (f).

264. As I explained above, during prosecution, Agventure appeared to argue

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that a breeder would not conduct a large-scale diploid inbreeding program and select for fertility in that breeding program. (*See supra*, §§V.D.2 and 3.) For the reasons I stated above, however, Agventure is wrong.

265. Additionally, Phumichai demonstrates that the prior art was not focused on yield at the expense of fertility. It discloses a successful breeding program resulting in diploid, fertile, self-compatible, highly homozygous potatoes while at the same time noting “we paid little attention to tuber yield because most self-pollinations were made on seedlings,” which a POSA would have understood means the authors did not select based on yield. (EX1005 (Phumichai), 0010.)

(h) Motivation to Combine Phumichai, Jong, Chase, Bamberg, and Spooner with Reasonable Expectation of Success

266. In Section VI.C.5(h) for Ground 2 above, I explained why a POSA would be motivated to combine Jong, Chase, and Bamberg, and would do so with reasonable expectation of success. A POSA would additionally be motivated to combine these references with Phumichai and Spooner.

267. Both Phumichai and Jong are in the same field and concern studies of diploid breeding in fertile, self-compatible potato. (*See generally*, EX1004 (Jong); EX1005 (Phumichai).) Further, both references motivate studying inbreds and heterosis in potato for the creation of better performing hybrids, and thus a POSA

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would easily combine the teachings of both. As confirmed by Spooner (EX1006), both references disclose inbreeding at the diploid level in *S. tuberosum* potatoes. Phumichai teaches that “highly homozygous and seed-propagated diploid potatoes could be obtained using the *Sli* gene” and that “[b]ecause of the simple procedure (crossing with a *Sli* gene donor, then continued selfings), the *Sli* gene method may be a better alternative in obtaining such inbreds.” (EX1005 (Phumichai), 0010.) Phumichai further teaches that “advanced inbreds may be valuable genetic stocks for studying the mechanism of heterosis and for producing hybrid variety at the diploid level.” (*Id.*) Similarly, Jong teaches that “it is possible to obtain homozygous clones for future genetic studies on the diploid level” and “[c]onsidering the success with hybrid vigour in other crops, this area certainly warrants further investigation in potatoes, especially on the diploid level where advanced inbred lines can be obtained in a relatively short time.” (EX1004 (Jong), 0013.) Thus, for example, a POSA would also have been motivated to cross a line like that disclosed in Phumichai with a second diploid potato plant (like those described in Phumichai or Jong).

268. Moreover, a POSA would have been motivated to obtain diploid, fertile, self-compatible potato lines with high homozygosity (e.g., at least 75%) and tuber yield (e.g., 200 g per plant) as these plants would be valuable for both research

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and cultivar development. A POSA motivated to create these plants would have found both Jong and Phumichai, which teach that the potatoes like those described in the references can be successfully created, as well as Chase which discloses a successful breeding scheme in potatoes, all to be relevant to this endeavor because these references each directly discuss inbreeding programs at the diploid level in potatoes.

269. As I noted above in connection with Ground 2, a POSA additionally would have had a reasonable expectation of success in creating diploid, fertile, self-compatible lines for the hybrid breeding program as Jong already proved this was possible. (*See supra*, §VI.C.5(h).) The inbred lines derived from US-W5309 and US-W5315 are diploid, fertile, self-compatible and produce high yields, and Jong expressly directs that “it is possible to obtain homozygous clones for future genetic studies on the diploid level.” (EX1004 (Jong), 0013.) Chase further provides that inbreeding of diploid crosses “present[] the plant breeder no problems of an unusual nature” (EX1007 (Chase), 0006), and that all of the steps in the analytical breeding process “have in one or another line of research already been accomplished” and “[t]hus, it is not unreasonable to expect that these operations can be carried out in stepwise fashion.” (*Id.*, 0007.) Thus, both Jong and Chase teach that the plants can be produced with reasonable expectation of success.

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270. Phumichai's disclosures add further reason for a POSA to have a reasonable expectation of success by providing yet another example, in addition to Jong, of a successful long-term inbreeding program at the diploid level, in which the challenges of self-compatibility, fertility, and vigor were sufficiently overcome to carry the program forward and obtain lines with desirable qualities for the breeder – exactly like those later outlined in the '841 patent claims.

6. Claim 6

6	The method of claim 5, wherein said second potato plant is a donor for an agronomically desirable trait selected from the group consisting of: insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, flooding tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.
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271. Phumichai in combination with Jong renders Claim 6 obvious.

272. As I explained for Ground 2 above, Jong in combination with Bamberg discloses parental lines with several desirable traits, and a POSA would have reasonably expected that the crosses disclosed in Jong would have at least one of these traits – and would have selected for such plants from the progeny population. (*See supra*, §VI.C.6.) For the same reasons I described for Ground 2, a POSA would have been motivated to use a plant with agronomically desirable traits for the second plant so as to introgress desirable traits into the gene pool of the population being

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inbred.

7. Claim 7

7	A potato plant produced by the method of claim 5, wherein said potato plant is diploid, fertile, self-compatible, produces at least 200 grams fresh weight of tubers per plant, wherein at least 75% of the genomic loci in said potato plant are homozygous, and wherein said self-compatibility in said potato plant is conferred by the <i>Sli</i> gene.
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273. Phumichai and Jong render Claim 7 obvious.

274. As I explained above for Claims 1 and 5, a POSA would have understood that Phumichai and Jong disclose breeding methods for creating potato plants that are diploid, fertile, self-compatible due to the *Sli* gene, produce at least 200 grams of fresh weight of tubers, and are homozygous for at least 75% of their genomic loci. (*See supra*, §§VI.E.1 and 5.) Both Phumichai and Jong successfully produced these plants, and accordingly, they disclose plants by the method of Claim 5.

275. Further, I understand from counsel that Claim 7 is a product-by-process claim, and that the process recited in Claim 7 only merits weight if it imparts some novel property to the resulting potato plant. There is nothing unique about the potato plant in Claim 7—as I have already described, Jong and Phumichai already described potato plants with the recited features.

F. GROUND 5: Phumichai, Jong, Chase, Bamberg, Spooner, and Springer Render Claims 8-10 Obvious

1. Claim 8

276. Phumichai in combination with Jong, Chase, Bamberg, Spooner, and Springer render Claim 8 obvious. As I explained above, Phumichai and Jong both disclose diploid, fertile, self-compatible plants and seeds of *Solanum tuberosum* that have a tuber yield of at least 200 grams and that are self-compatible due to the *Sli* gene. (*See supra*, §§VI.A.1, 2; VI.E.1, 3, 4.)

(a) Claim 8[pre]

8[pre]	A method of producing a uniform diploid hybrid <i>Solanum tuberosum</i> potato seed, which seed, when sown produces a diploid, fertile, and self-compatible potato plant having a tuber yield expressed in grams of fresh weight of at least 200 grams and wherein said self-compatibility trait is due to the presence of the <i>Sli</i> gene, said method comprising:
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277. Both Phumichai and Jong teach this claim limitation.

278. As Phumichai and Jong demonstrate, the benefits of hybrid breeding were well-known in the prior art before 2009. Phumichai discloses that “[s]ince 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.” (EX1005 (Phumichai), 0005.) It further provides that “[h]ighly homozygous inbreds, once amply produced, would be highly useful for the development of [true potato seed] varieties with genetic uniformity as well as for the

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investigation of heterosis.” (*Id.*) Similarly, Jong motivates hybrid breeding, disclosing “[t]he success of hybridization between inbred lines in maize has led to many similar investigations with other crops[,]” including in potato. (EX1004 (Jong), 0006.) A POSA would have been well aware of these benefits and would have been motivated to develop a method for hybrid breeding based on inbred potato lines.

279. Phumichai and Jong disclose such a method for development of inbred lines and further suggest their use for hybrid crossing. Phumichai provides a scheme for developing inbred series A and B potato lines that are self-compatible due to the *Sli gene*. (See EX1005 (Phumichai), 0006, 0007 (Fig. 1).) This breeding scheme was successful resulting in diploid, fertile, self-compatible plants and seeds. (See *id.*, 0007, 0008 (Table 1), 0010 (“[T]his is the first report that self-fertile S₅ diploid inbreds with more than 90% homozygosity were produced.”).) Jong similarly provides a breeding scheme between US-W4 and different Phureja selections that similarly produced hybrids from which several generations of inbred diploid, fertile, self-compatible seeds and plants were produced. (EX1004 (Jong), 0007-11.)

280. A POSA reading Phumichai and Jong would be motivated to cross plants like those disclosed in these references, as both references describe similar crosses whereby cultivated potato plants are crossed with self-compatible potatoes

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that have the *Sli* gene. Thus, as explained further below, a POSA could cross plants created by following the teachings of Phumichai's inbred series A with inbreds such as plants like those disclosed in the US-W5309 or US-W5315 families. From these crosses, and as already discussed in connection with Ground 3 above, a POSA would have had a reasonable expectation of success in obtaining diploid seeds that carry *Sli* and produce fertile plants capable of high tuber yield, since similar crosses in Phumichai and Jong were successful and produced similar plants.

(b) Claim 8[a]

8[a]	(a) providing a first potato plant, wherein said first potato plant is a plant of a first potato line, wherein said first potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to <i>Solanum tuberosum</i> , wherein said first potato line is diploid, fertile, self-compatible and wherein at least 75% of the genomic loci in said first potato line are homozygous, and wherein said self-compatibility in said first potato line is conferred by the <i>Sli</i> gene, wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively, and wherein said first potato plant has a tuber yield expressed in grams of fresh weight of at least 200 grams;
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281. As I described in Ground 3 above, Jong discloses the plant of step (a), for example in inbreds derived from US-W5315 (and US-W5309). (*See supra*, §VI.D.1(b).) Phumichai likewise discloses a plant meeting all the characteristics of

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this limitation, as explained above in Ground 4. (*See supra*, §VI.E.1.) A POSA could thus make plants like those disclosed in Jong and Phumichai relying on their teachings.

(c) Claim 8[b]

8[b]	(b) providing a second potato plant, wherein said second potato plant is a plant of a second potato line, wherein said second potato line is of the species <i>Solanum tuberosum</i> optionally comprising introgression segments of other tuber bearing <i>Solanum</i> species crossable to, wherein said second potato line is diploid fertile, self-compatible and wherein at least 75% of the genomic loci in said second potato line are homozygous, wherein said self-compatibility in said second potato line is conferred by <i>Sli</i> gene, wherein a copy of said gene is present in potato lines AGVD1, AGVD2, AGVD3, and AGVD17, representative seeds of said lines having been deposited with the NCIMB under NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765, respectively, wherein said second potato plant has a tuber yield expressed in grams of fresh weight of at least 200 grams, and wherein said second potato plant contains at least 20% contrasting homozygous loci as determined by molecular marker analysis when compared to said first potato plant;
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282. As I explained above, Jong discloses the plant of step (b).

283. Phumichai also discloses the plant of step (b). It describes a series A inbred which is diploid, fertile, self-compatible due to the *Sli* gene and that is homozygous for at least 75% of genomic loci and produces a fresh tuber weight of at least 200 grams per plant. (*See supra*, §§VI.E.1(a)-(d).) Phumichai thus discloses a “second potato plant” as required by step (b), such that a POSA following these

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teachings could obtain such a plant and use it in a breeding program.

284. Further, as explained for Ground 3 Claim 8, a POSA would have been well aware of and motivated by principles of hybrid vigor, and thus would have used a second potato plant with at least 20% contrasting loci. (*See supra*, §VI.D.1(c).) Springer describes the benefits of using more genetically distinct plants to maximize hybrid vigor, and, for the same reasons I described above, a POSA would easily apply the teachings of Springer to crosses between potato plants like those described in Phumichai or crosses between the potato plants like those described in Phumichai and Jong. (*See supra*, §§VI.D.1(c), (f).) A POSA furthermore could have easily determined the percent of contrasting loci using molecular marker analyses (*see supra*, §§IV.G, VI.D.1) and would have expected that plants like either of the Phumichai or Jong plants, as a second potato plant, would have at least 20% contrasting loci from the first plant given their different lineages. Accordingly, a POSA would have used a second potato plant as disclosed by Phumichai with at least 20% contrasting loci from the first potato plant.

(d) Claim 8[c]

8[c]	(c) cross-pollinating said first and said second potato plant and allowing said potato plant to produce berries with seeds; and
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285. Jong and Chase disclose step (c) for the same reasons I described above.

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Phumichai further discloses step (c). Phumichai explains that the “advanced inbreds” described in Phumichai “may be valuable genetic stocks for studying the mechanism of heterosis and for producing hybrid variety at the diploid level.” (EX1005 (Phumichai), 0010.) A POSA would have understood that Phumichai’s teachings about producing a hybrid variety requires cross-pollinating inbred potatoes and allowing them to produce berries containing hybrid seeds. Thus, a POSA would have cross-pollinated plants like those described in Phumichai and/or Phumichai and Jong.

(e) Claim 8[d]

8[d]	(d) collecting said seeds from said berries to provide hybrid potato seeds.
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286. Jong discloses step (d). (*See supra*, §VI.D.1.)

287. Similarly, Phumichai discloses collecting seeds in the context of the plants in inbred series A, which was produced through a cross. (*See, e.g.*, EX1005 (Phumichai), 0007 (Fig. 1), 0008 (Table 2).) Further, Phumichai explains that “highly homozygous and seed-propagated diploid potatoes could be obtained using the *Sli* gene” and that “these advanced inbreds may be valuable genetic stocks for studying the mechanism of heterosis and for producing hybrid variety at the diploid level.” (*Id.*, 0010.) As with Jong, a POSA would have understood that Phumichai’s teaching that “seed propagated diploid potatoes could be obtained” and producing

hybrid varieties requires the collection of seed. A POSA thus would have collected seeds from berries produced by cross-pollinating plants like those described in Phumichai and/or Jong.

(f) Motivation to Combine References with Reasonable Expectation of Success

288. In Ground 3 for Claim 8 above, I explained why a POSA would be motivated to combine Jong, Chase, Bamberg, and Springer, and would do so with reasonable expectation of success. (*See supra*, §VI.D.1.) I further explained in Ground 4 for Claims 1-7, that a POSA would be motivated to combine Phumichai, Jong, Chase, Bamberg and Spooner. (*See supra*, §VI.E.) Those same reasons apply here. Because Claim 8 merely recites the obvious method of hybrid breeding using inbred diploid potatoes, the obvious rationales discussed in connection with Ground 3 apply equally here, where the only difference is that the Phumichai and Spooner references have been added to the obviousness combination.

2. Claim 9

9	The method according to claim 8, wherein at least one of said first and said second potato plant 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, flooding tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color, and cold-sweetening resistance.
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289. Phumichai and Jong in combination with Bamberg render Claim 9

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obvious. As I explained in Sections VI.C.2, 6., a POSA would reasonably expect US-W5309 and US-W5315 to have at least one of the claimed traits. The parental lines of these plants have resistance to disease, nematodes, and/or insects, and based on breeding, US-W5309 and US-W5315 (and plants created using a similar breeding scheme) would similarly be expected to possess at least one of these traits.

3. Claim 10

10	A uniform hybrid F1 potato seed produced according to the method of claim 8.
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290. Claim 10 is obvious for the same reasons set forth for Ground 3 above. (*See supra*, §VI.D.3.) The only difference in Ground 5 is that the Phumichai and Spooner references have been added to the obviousness combination, which only provide still further motivation and expectation of success. As explained in Ground 3 above, the expected result of crossing inbred lines as discussed above is to obtain a population of hybrid F₁ seed that is highly uniform.

G. GROUND 6: Anticipation by US-W4 Disclosed in Jong

1. Claim 1

291. As I explain below, it is also my opinion that Claim 1 is anticipated by disclosures of the US-W4 potato. As discussed above and further in this section, US-W4 was also disclosed in several prior art references such as Jong (EX1004).

292. US-W4 was available well before the priority date of the '841 patent.

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For example, US-W4 has been available to the public from the U.S. Potato Genebank since at least 1993, and indeed probably since at least 1967. (EX1058 (U.S. Potato Genebank Record for US-W4 (Accession ID GS 02), 0013; *see also* EX1067.) Prior art references discussed in this declaration such as Jong (EX1004) and Peloquin and Hougas (EX1047) describe the use of US-W4 potato plants in breeding programs, further showing that it was available to a POSA before 2009. Indeed, the breeding history of the deposited lines of the challenged patent were themselves made with plant material that was derived from crosses using US-W4, further illustrating that the US-W4 disclosed in the prior art was available.

293. US-W4 is *Solanum tuberosum*. References such as Jong (EX1004) and Bamberg & Martin 1993 (EX1058) clearly describe US-W4 as *Solanum tuberosum*. (*See also* EX1067.)

294. US-W4 is diploid. US-W4 is a well-known haploid derived from a tetraploid ancestor, and hence is diploid as I discussed in ¶52 above. I also note that the Clot paper, which includes two named inventors from the '841 patent among its authors, refers to US-W4 as “diploid.” (EX1036 (Clot), 0003.) I understand from counsel that evidence from after the priority date of the invention can be relevant as proof of inherency, and that a POSA need not have recognized the inherent disclosure as of the time of the invention. (*See supra*, ¶60.)

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295. US-W4 is fertile. This is shown for example at least by Jong's work, in which US-W4 was successfully used in several crosses. (EX1004 (Jong), 0007.) I am also personally familiar with working with US-W4 as breeding material and have observed that it has the characteristics of not only female fertility but also male fertility. As further support, the pedigree for the potato RH89-039-16 discussed in Ground 8 below lists the use of US-W4 as the male parent in several instances. (EX1076.)

296. US-W4 is self-compatible. I note that the Clot paper, which includes two named inventors from the '841 patent among its authors, refers to US-W4 as "SC," meaning self-compatible. (EX1036 (Clot), 0002, 0003.) The disclosures of Jong further demonstrate that US-W4 is self-compatible. Jong states: "Crosses between cultivated diploid species and male-fertile Tuberosum haploids produce vigorous, highly fertile progeny. Most of these 24-chromosome hybrids are self-incompatible, but crosses involving haploids from an inbred Minnesota seedling, *Minn. 20-20-34*, (primarily [the haploid clone] US-W4) were found to be self-fertile (Smiley, 1963; Cipar, 1964)." (EX1004 (Jong), 0006.) Self-compatibility is a dominant trait, and therefore it necessarily follows from this discussion that US-W4 is self-compatible; otherwise the hybrids resulting from crosses with various cultivated diploid species would not be self-compatible. I have also personally selfed

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US-W4 successfully on many occasions. For example, reproduced below is a photograph of tubers of an S₃ clone produced from an S₂ selfing of US-W4. This photograph is the result of experiments done during the winter of 2013-2014 where I self-pollinated several US-W4 plants in a greenhouse on the University of Wisconsin campus. To the best of my recollection, the plants were grown using supplemental high intensity grow lights and a photoperiod of 18 hours. Day/night temperatures were likely 24/18 °C. Plants were grown in 15-cm-diameter pots in soil-less potting mix. Although US-W4 is male fertile, it does not generally produce abundant pollen. Consequently, flowers with dehiscent anthers were collected, stored at room temperature overnight, and then pollen was collected into a gelatin capsule using the vibrating head of a toothbrush. That pollen was then applied to the stigmas of the US-W4 plants in the greenhouse to achieve self-pollination. This resulted in the production of over 1000 seeds. In the spring of 2014, I sowed the selfed seeds and generated approximately 50 S₁ seedlings. The S₁ plants were self-pollinated in August 2014, as described above, and selfed seeds were obtained on three S₁ clones. During the winter of 2014-2015, 50 S₂ seedlings from each of the three S₁ clones were grown in a greenhouse, as described above, and selfed to produce S₃ seeds from 8 of the S₂ plants. During the summer of 2015, 125 S₃ seedlings were grown and selfed, as described above, and 12 produced S₄ seeds.

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297. US-W4 produces at least 200 grams fresh weight of tubers per plant. Experiments described in this declaration showing the tuber yield of US-W4 were carried out under my supervision and performed according to the protocols described herein. As these data show, plants of the line US-W4 provide fresh tuber yields of up to 735 grams per plant, much higher than the 200 gram threshold of the claims. The detailed experimental protocols and resulting data for these experiments are attached to this declaration as **Exhibit B**. These data were generated by plants grown on Plainfield loamy sand soil, at the University of Wisconsin Hancock Agricultural Experiment Station in summer. I note that the patent references tuber yield in terms of plants “grown from seed in clay soil under normal North Western European summer conditions[.]” (EX1001, 16:59-61.) The climatic conditions of central Wisconsin are agriculturally comparable to those of northwestern Europe, such that yields obtained for a line grown in central Wisconsin would be comparable to those

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obtainable with the same line in northwestern Europe. For example, the average yearly commercial potato yield in the Netherlands in the period 2008-2012 was 409 cwt/ac per year, while commercial yield in Wisconsin for that period averaged 429 cwt/ac per year.¹² Consequently, there is less than a 5% difference between commercial potato yields in the Netherlands and Wisconsin. The data shown in **Exhibit B** were collected from clonally propagated lines in 2014 and in 2017.

298. US-W4 is homozygous for at least 75% of its genomic loci. I have reviewed the declaration of David Douches, Ph.D. submitted as EX1003 in this proceeding. Professor Douches is a highly regarded potato breeder and geneticist; I have reviewed his work and the methods he used for assessing homozygosity, and I agree with his conclusion that his analysis shows that US-W4 is homozygous for at least 75% of its genomic loci. I rely on Professor Douches' declaration and the data presented therein, in combination with my findings and opinions as set forth in this section, in reaching my conclusion that Claim 1 is anticipated by disclosures referencing US-W4.

299. US-W4's self-compatibility is conferred by the same *Sli* gene present

¹² Netherlands commercial yield data is from EX1059 (Silva), 0007 (Table 2)): 51.3 t/ha = 409 cwt/ac. Wisconsin commercial yield data is from USDA-NASS annual potato crop reports from 2008-2012 (EX1018, EX1061-EX1064): 2008=415 cwt/ac, 2009=460 cwt/ac, 2010=395 cwt/ac, 2011=415 cwt/ac, 2012=460 cwt/ac; mean=429 cwt/ac.

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in the AGVD lines recited in the claims. I explained above in ¶¶146-149 that self-compatibility in US-W4 is conferred by the *Sli* gene, and that this same *Sli* gene is also present in the Agventure deposited lines. I incorporate those opinions and references here.

300. Clonally-propagated material such as the US-W4 material available from the potato genebank is highly stable. (*See, e.g.*, EX1014 (Stern), 0047.) In fact, all potato production studies are based on the assumption that all seed tubers of a variety are genetically identical. Thus, there is no reason to think that the yield generated from plants of US-W4 in 2014 and 2017 (as in **Exhibit B**) under equivalent conditions would differ from the yield provided by US-W4 plants as of 2009 or earlier. Instead, variation in yield data for a clonally propagated line such as US-W4 is dependent on environmental factors rather than on genetic variability. Based on data from the USDA-NASS potato crop annual reports, average potato yields in Wisconsin in 2009, 2014, and 2017 were 460, 410, and 425 cwt/ac, respectively. (EX1061, EX1065, EX1066.) The growing season in 2009 was actually more favorable for potato production than those in 2014 and 2017, thus yields based on trials carried out in 2014 and 2017 likely actually underestimated yield potential in the field in 2009. In light of all these factors, it is scientifically reasonable and appropriate to conduct experiments with US-W4 in the present day to determine the

inherent characteristics of this plant material, and to say based on those experiments with a high degree of scientific certainty that these same characteristics were necessarily present in US-W4 before 2009.

2. Claim 4

301. Claim 4 is anticipated because the prior art as well as the gene bank discussed above disclosed US-W4 as a tuber. Moreover, a POSA would have known that disclosed US-W4 plants were provided and used in tuber form, since that would ensure clonal propagation, and hence stability, of the line.

H. GROUND 7: Claims 5-10 Are Obvious over US-W4, Chase, Bamberg, and Springer.

302. As discussed above in connection with Ground 2, the methods for inbreeding recited in Claims 5-7 were obvious when plants like those disclosed in Jong are combined with the teachings of Chase and Bamberg. (*See supra*, §VI.C.) And in Ground 3, I opined that the hybrid breeding methods of Claims 8-10 were obvious in view of the further combination with Springer. (*See supra*, §VI.D.) These arguments apply in the same fashion, and with the same obviousness rationale, in the context of the disclosure of the US-W4 plant. As I opined in Ground 6 above, US-W4 meets all the limitations of Claims 1 and 4. A POSA would have been motivated to employ US-W4 in the methods recited in Claims 5-10 for the same reasons that POSA would have been motivated to do so with lines like those disclosed in Jong,

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for the reasons I explained above in connection with Ground 2 and 3. I incorporate that reasoning by reference here.

I. GROUND 8: Anticipation by RH89-039-16 Disclosed in Voort

1. Claim 1

303. As I explain below, it is also my opinion that Claim 1 is anticipated by disclosures of the RH89-039-16 potato. RH89-039-16 was disclosed in several prior art references such as Voort. (EX1070 (Voort), 0002; *see also* EX1071, 1076.)

304. RH89-039-16 was disclosed and available well before the priority date of the '841 patent. For example, the USDA GRIN database shows that it was received by NPGS in 2004. (EX1068.) Indeed, the '841 patent itself admits that RH89-039-16 was “available” several times. (EX1001, 16:30-33, 16:46-48, Col. 46 (Table 6, entry 8).)

305. RH89-039-16 is *Solanum tuberosum*. (*See, e.g.*, EX1068.)

306. RH89-039-16 is diploid. (EX1070 (Voort), 0002.) The '841 patent also consistently characterizes RH89-039-16 as diploid. (EX1001, 16:27, 16:40-41.)

307. RH89-039-16 is fertile. The prior art discloses that RH89-039-16 has successfully been used in crosses, demonstrating its fertility. (EX1070 (Voort), 0002.)

308. RH89-039-16 is self-compatible. I note that the Clot paper, which

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includes two named inventors from the '841 patent among its authors, expressly refers to RH89-039-16 as "SC," meaning self-compatible. (EX1036 (Clot), 0002, 0003.) Other researchers have also published findings confirming that RH89-039-16 is self-compatible. (EX1072, 0001-02.)

309. RH89-039-16 produces at least 200 grams fresh weight of tubers per plant. The patent states that RH89-039-16 has 68% (range 44-86%) of the tuber yield of tetraploid potato varieties. (EX1001, 16:26-29.) As explained above (§54), it was well known before 2009 that tetraploid varieties yielded well in excess of 200 grams per plant. As further example, average yearly commercial potato yield in the Netherlands from 2008-2012 was ~1280 grams per plant. (EX1059 (Silva), 00007 (Table 2).) Similarly, tetraploid varieties in the U.S. in the 2008 growing season yielded about 1111 grams per plant. (EX1018; *see also supra*, §54.) The 68% figure reported by the patent for RH89-039-16 would be far in excess of the claimed 200 grams yield threshold. As further evidence, RH89-039-16 grown in Michigan was reported to yield 300 grams per plant and 200 grams per plant in the 2012 and 2013 growing seasons, respectively. (EX1069, 0006 (Table 1).) The growing conditions in Michigan are comparable to the northwestern Europe region referenced in the '841 patent; based on agronomic data if anything yields in Michigan would be somewhat lower. For example, the average yearly commercial potato yield in the Netherlands

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in the period 2008-2012 was 409 cwt/ac per year, while commercial yield in Michigan for that period averaged 353 cwt/ac per year. (*See* EX1059, 0007 (Table 2) (Netherlands data); EX1018, EX1061-EX1064 (Michigan data 2008-2012).)

310. RH89-039-16 is homozygous for at least 75% of its genomic loci. I have reviewed the declaration of David Douches, Ph.D. submitted as EX1003 in this proceeding. Professor Douches is a highly regarded potato breeder and geneticist; I have reviewed his work and the methods he used for assessing homozygosity, and I agree with his conclusion that his analysis shows that RH89-039-16 is homozygous for at least 75% of its genomic loci. I rely on Professor Douches' declaration and the data presented therein, in combination with my findings and opinions as set forth in this section, in reaching my conclusion that Claim 1 is anticipated by disclosures referencing RH89-039-16. I note that the '841 patent refers to RH89-039-16 as "essentially heterozygous." (EX1001, 16:40-41.) However, as shown above, RH89-039-16 is in fact at least 78% homozygous, so the patent is not correct to characterize this line as "essentially heterozygous." In my opinion the characterization in the patent is also misleading, because the patent admits that its low-density SNP analysis used only 100 markers that were selected "with a preference" for markers found to be heterozygous in RH89-039-16. (EX1001, 34:37-46.) Ultimately, Claim 1 of the '841 patent recites a specific requirement for level of homozygosity, and Prof.

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Douches' SNP data proves that RH89-039-16 meets this requirement, so it does not matter whether the patent, or any piece of prior art, describes RH89-039-16 as "heterozygous."

311. RH89-039-16's self-compatibility is conferred by the *Sli* gene just as it is in the AGVD lines recited in the claims. As I noted above, the Clot paper, which includes two named inventors from the '841 patent among its authors, expressly refers to RH89-039-16 as "SC," meaning self-compatible; this same paper also showed that RH89-039-16 has the *Sli* gene. (EX1036, 0001; *see also* EX1072, 0002.) This is perhaps not surprising given that Wageningen's pedigree map for RH89-039-16 shows that US-W4 occurs at least six times in the parental lineage. (EX1076.)

2. Claim 4

312. Claim 4 is anticipated because the prior art as well as the gene bank discussed above disclosed RH89-039-16 as a tuber. Moreover, a POSA would have known that disclosed RH89-039-16 plants were provided and used in tuber form, since that would ensure clonal propagation, and hence stability, of the line

J. GROUND 9: Claims 5-10 Are Obvious over RH89-039-16, Chase, Bamberg, and Springer

313. As discussed above in connection with Ground 2, the methods for inbreeding recited in Claims 5-7 were obvious when plants like those disclosed in Jong are combined with the teachings of Chase and Bamberg. (*See supra*, §VI.C.)

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And in Ground 3, I opined that the hybrid breeding methods of Claims 8-10 were obvious in view of the further combination with Springer. (*See supra*, §VI.D.) These arguments apply in the same fashion, and with the same obviousness rationale, in the context of the disclosure of the RH89-039-16 plant. As I opined in Ground 8 above, RH89-039-16 meets all the limitations of Claims 1 and 4. A POSA would have been motivated to employ RH89-039-16 in the methods recited in Claims 5-10 for the same reasons that POSA would have been motivated to do so with lines like those disclosed in Jong, for the reasons I explained above in connection with Ground 2 and 3. I incorporate that reasoning by reference here.

VII. NO SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

314. As explained in Section III.C., I understand that “secondary considerations” may be used as indicia of non-obviousness, provided that any such consideration has a nexus to the invention as claimed. I also understand that any secondary considerations evidence that is not both claimed and novel cannot have a nexus to the claimed invention.

315. For the reasons set forth below, it is my opinion that there is no evidence for secondary considerations of non-obviousness that would weigh against the strong case of obviousness set forth in Grounds 1-5 above:

316. *No industry praise:* Any industry praise for the potatoes in the ’841

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patent would necessarily point to the *Sli* gene since this is the gene that confers self-compatibility in the potatoes and allows them to be selfed to further homozygosity. As I explained above, the *Sli* gene was already known in the prior art, and breeders knew for decades that selfing (or backcrossing) increases homozygosity. (See EX1004 (Jong), EX1005 (Phumichai), EX1030 (Hosaka 1998a), EX1031 (Hosaka 1998b), EX1032 (Birhman).) Thus, to the extent there was industry praise of the '841 patent invention, it was due to elements already known in the prior art.

317. *No unexpected results:* The '841 patent contends that “production of true breeding lines of potato is considered impossible.” (EX1001 ('841 patent), 4:21-22.) Similarly, the patent contends that “it has proven impossible to provide the combination of all these features in a single potato plant (line).” (*Id.*, 24:25-26.) On the contrary, however, as I have explained extensively for the Grounds above, the prior art, including Phumichai and Jong, had already described true breeding lines of potato, and there is thus nothing unexpected about the '841 patent invention.

318. Furthermore, the '841 patent explains that “[o]nly 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.” (*Id.*, 4:44-47.) To the extent Agventure thus argues that its breeding scheme produced unexpected results, the results are based on the *Sli* gene, which again was already

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well-known in the art as conferring self-compatibility, and which had already been used as the basis of a successful inbreeding program as shown by Phumichai. The '841 patent describes nothing more than using the *Sli* gene to produce inbred potatoes, again which was already described in the prior art, including in Phumichai and Jong.

319. Additionally, to the extent Agventure argues that it would have been unexpected to select for fertility and conduct a large-scale breeding program, Agventure is incorrect for the reasons I have already stated, including that POSAs developing inbred lines were required to select for fertility and that breeders knew that large scale breeding programs were required for the production of inbred lines where the issue of inbreeding depression was well-known. (*See supra*, §V.D.3.)

320. I note that the inventors relied on a news article in which I am quoted during prosecution of the '841 patent. (*See* EX1010 ('841 patent file history), 1047-1050.) In that article, I am quoted as saying “I was trained to believe that potatoes can’t be inbred.” (*Id.*, 1049.) To the extent Agventure argues based on this statement that the results in the '841 patent are unexpected, or that I was skeptical the results obtained by the inventors could have been achieved as of 2009, that interpretation would be incorrect. I was referring to my graduate training in the early 1980’s, focusing on the challenges associated with inbreeding at the tetraploid level, and with the preference among breeders for developing commercial cultivars at the tetraploid

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level. Indeed, as the sentences immediately following that quote make clear, by 1998, the genetic basis of self-compatibility was discovered. (*Id.*) When the Hosaka lab demonstrated that a single dominant gene confers self-compatibility, it provided breeders with a powerful tool to systematically self-pollinate diploid potatoes. Certainly by 2009, the production of inbreds in diverse diploid germplasm was not considered an impossible task. This shift was due to the important work of the Hosaka laboratory such as is disclosed in Phumichai. These authors—not the inventors of the '841 patent—showed that extensive inbreeding in *S. tuberosum* potatoes was achievable, and it was those authors who had already expressly suggested to the field the utility of diploid inbreeding in potatoes for the purpose of making hybrid crosses and achieving uniform hybrid TPS.

321. *No long-felt, unmet need:* For the same reasons that there are no unexpected results of the '841 patent, there is also no long-felt, unmet need. The prior art I discuss throughout this declaration had already described methods for creating diploid, fertile, self-compatible, highly homozygous, high yielding potatoes and the production of uniform hybrid potato seed from these plants. Thus, to the extent there was a need for these types of plants, the prior art had already solved it.

322. I reserve the right to rebut any evidence of secondary considerations that Agventure may assert in this proceeding.

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VIII. CONCLUSION

323. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in this proceeding. If required, I will appear for cross-examination at the appropriate time.

324. I hereby declare that all statements made herein of my own knowledge are true and that all statements are made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001.

Dated: November 04, 2024

Respectfully submitted,



Shelley Jansky, Ph.D.

EXHIBIT A

Shelley Hermundstad Jansky

Formal Education

- Ph.D. University of Wisconsin - Madison
Major: Plant Breeding and Plant Genetics
Advisor: Dr. S.J. Peloquin
1984-1986
Thesis title: *Haploid Tuberosum-wild species hybrids in potato breeding, genetics and germplasm enhancement.*
- M.S. University of Wisconsin-Madison
Major: Plant Breeding and Plant Genetics
Advisor: Dr. S.J. Peloquin
1982-1984
Thesis title: *Production and evaluation of haploid Tuberosum-wild species hybrids.*
- B.S. University of Wisconsin-Stevens Point
Major: Biology Minor: Chemistry
1978-1982

Positions Held

- Research Geneticist United States Department of Agriculture
Agricultural Research Service
Vegetable Crops Research Unit
GS-12 2004-2007
GS-13 2007-2012
GS-14 2012-2016
GS-15 2016-2020
- Professor Emeritus Department of Horticulture
University of Wisconsin-Madison
2020-present
- Professor 2017-2020
- Associate Professor 2009-2017, tenured 2009
- Assistant Professor 2004-2009
- Professor Department of Biology
University of Wisconsin-Stevens Point
1998-2004
- Department Chair 1995-1998

Associate Professor 1992-1998, tenured 1995
Assistant Professor 1990-1992

Department of Horticulture
North Dakota State University
Assistant Professor 1986-1990

Selected Accomplishments

Textbook Author

Bidlack, J. and S. Jansky. Stern's Introductory Plant Biology. McGraw-Hill Higher Education. Dubuque. 12th-15th editions.
Stern, K., J. Bidlack and S. Jansky. 2008. Introductory Plant Biology. McGraw-Hill Higher Education. Dubuque. 9th-11th editions.

Honors and Awards

Honorary Life Member, Potato Association of America, awarded 2020
Researcher of the Year, Wisconsin Potato and Vegetable Growers Association, 2018
Co-author of research article selected as one of the outstanding papers published in Crop Science in 2009. (Tests of taxonomic and biogeographic predictivity: Resistance to multiple disease and insect pests in wild relatives of cultivated potato).

Invitations and Assignments

Invited speaker, "My mother is also my father: Tales of inbreeding and redemption through the eyes of a potato." Annual Meeting of the National Association of Plant Breeders, Pine Mountain, GA. Aug 26-28, 2019.
Invited speaker, "Increasing genetic gain by reducing ploidy in potato." National Association of Plant Breeders Annual Meeting. August 8, 2017. Davis, CA.
Invited speaker/participant, "The development of diploid inbred lines in potato – progress and challenges." International Potato Center Workshop: Heterosis and hybrid breeding in potato and sweet potato. May 29-30, 2017. Lima, Peru.
Invited speaker, Plant Breeding Symposium, Iowa State University. "Reinventing potato at the diploid level." April 11, 2017. Ames, Iowa.
Invited speaker, Potato Expo – S. Jansky, D. Douches, and A. Charkowski. "Following in the footsteps of corn breeders – Potato as an inbred line-based crop." San Francisco. Jan. 5, 2017.
Invited to Inner Mongolia University to teach a workshop on diploid inbred line development in potato. HuHot, China. 2016.
Invited keynote speaker to present "*Progress Toward the Development of Recombinant Inbred Lines*" at the Joint Meeting of the European Association for Potato Research and Eucarpia. Vico Equense, Italy. 2015.
Invited speaker to present "*Reinventing Potato at the Diploid Level*" at the Plant and Animal Genome Meeting, San Diego, California. 2015.
Invited speaker to present "*Extreme Makeover: Potato Edition*" at the National Association of Plant Breeders Annual Meeting. Pullman, Washington. 2015.
Invited by the Simplot Food Science and Plant Science research groups to present "*New*

Directions in Potato Breeding” Boise, Idaho. 2014.

Potato Association of America, President 2018-2019, President-Elect 2016-2017, Vice President 2015-2016

Advisory and Consultant Activities

Organized and led a Research Planning Meeting in Estes Park, Colorado entitled “Developing hybrid potato varieties.” The goal of the meeting was to plan a Coordinated Agriculture Proposal to convert potato into a diploid inbred-hybrid crop. There were 35 participants from industry and academia across the United States and Canada. October 26, 2018. This meeting led to the development of the grant listed below entitled “Creating a new paradigm for potato breeding based on true seed.”

Organized and co-hosted a meeting in Madison, Wisconsin entitled “Reinventing potato at the diploid level.” There were 48 participants from across the US and Canada, including most of the public potato breeders and R&D scientists from PepsiCo and Simplot. June 25, 2015.

Solanaceae workshop organizer, Plant and Animal Genome Meeting, 2016-2019.

National Science Foundation Panel Member, Plant Genome Program. Washington, DC. 2013.

Editorial Assignments

Invited Reviews Editor for the American Journal of Potato Research (journal of the Potato Association of America), 2013-2019.

Processing Editor for Potato Research (journal of the European Association for Potato Research), 2008-2015.

Grants Funded

Jansky, S. H., D. Douches, and J. Endelman. 2014-2018. 2xcelerate: A diploid inbred line strategy to accelerate genetic gain in potato. USDA-Agriculture and Food Research Initiative. \$500,000. (92 proposals were submitted; this was one of seven funded).

Endelman, J. 2019-2023. Creating a new paradigm for potato breeding based on true seed. USDA-National Institute for Food and Agriculture. \$6,017,246. (I led the effort to develop and submit this grant proposal, but in anticipation of my retirement, Endelman assumed directorship of the project.).

Publications Relevant to Diploid Potato Breeding

1. **Hermundstad, S. A.** and S. J. Peloquin. 1985. Germplasm enhancement with potato haploids. *Journal of Heredity* 76:463-467.
2. **Hermundstad, S. A.** and S. J. Peloquin. 1986. Tuber yield and tuber traits of haploid-wild species F₁ hybrids. *Potato Research* 29:289-297.
3. **Jansky, S. H.**, G. L. Yerk, and S. J. Peloquin. 1990. The use of potato haploids to put 2x wild species into a usable form. *Plant Breeding* 104:290-294.
4. **Jansky, S. H.**, G. L. Davis, and S. J. Peloquin. 2004. A genetic model for tuberization in potato haploid-wild species hybrids grown under long day conditions. *American Journal of Potato Research* 81:335-339.
5. **Jansky, S. H.** 2006. Overcoming hybridization barriers in potato. *Plant Breeding* 125:1-12.
6. Ortiz, R., P. Simon, **S. Jansky**, and D. Stelly. 2009. Ploidy manipulation of the gametophyte, endosperm, and sporophyte in nature and for crop improvement – A tribute to Prof. Stanley J. Peloquin (1921-2008). *Annals of Botany* 104:795-807.

7. Spooner, D. M., T. Gavrilenko, **S. H. Jansky**, A. Ovchinnikova, E. Krylova, S. Knapp, and R. Simon. 2010. Ecogeography of ploidy variation in cultivated potato (*Solanum* sect. *Petota*). *American Journal of Botany* 97:2049–2060.
8. **Jansky, S. H.** 2011. Parental effects on the performance of cultivated x wild species hybrids in potato. *Euphytica* 178:273-281.
9. Kittipadukul, P., P.C. Bethke, and **S.H. Jansky**. 2012. The effect of photoperiod on tuberisation in cultivated x wild potato species hybrids. *Potato Research* 55:27-40.
10. **Jansky, S.**, A. Hamernik, and X. Cai. 2012. Rapid cycling with true potato seed. *Seed Science and Technology*. 40:43-50.
11. Hirsch, C.N., C.D. Hirsch, K. Felcher, J. Coombs, D. Zarka, A. van Deynze, W. de Jong, R. Veilleux, **S. Jansky**, P. Bethke, D.S. Douches, and C.R. Buell. 2013. Retrospective view of North American potato (*Solanum tuberosum* L.) breeding in the 20th and 21st centuries. *G3: Genes, Genomes, Genetics*. 3:1003-1013.
12. **Jansky, S. H.**, Y.S. Chung, and P. Kittipadukul. 2014. M6: A diploid inbred line for use in breeding and genetics research. *Journal of Plant Registrations*. 8:195-199.
13. Spooner, D. M., M. Ghislain, R. Simon, **S. H. Jansky**, and T. Gavrilenko. 2014. Systematics, diversity, genetics, and evolution of wild and cultivated potatoes. *Botanical Review*. 80:283-383.
14. Endelman, J. B. and **S.H. Jansky**. 2016. Genetic mapping with an inbred line-derived F2 population in potato. *Theoretical and Applied Genetics*. 129:935-943.
15. **Jansky, S.**, A. Charkowski, D. Douches, G. Gusmini, C. Richael, P. Bethke, D. Spooner, R. Novy, H. De Jong, W. De Jong, J. Bamberg, S. Thompson, B. Bizimungu, D. Holm, C. Brown, K. Haynes, V. Sathuvalli, R. Veilleux, C. Miller, J. Bradeen, and J. Jiang. 2016. Reinventing potato as a diploid inbred line-based crop. *Crop Science*. 56:1-11.
16. **Jansky, S.H.** and D.M. Spooner. 2017. Evolution of potato breeding. *Plant Breeding Reviews*. 41:160-214.
17. Bethke, P.C., D. Halterman, and **S.H. Jansky**. 2017. Are we getting better at using wild potato species in light of new tools? *Crop Science* 57:1241-1258.
18. Leisner, C., J. Hamilton, E. Crisovan, N. Manrique-Carpintero, A. Marand, L. Newton, G. Pham, J. Jiang, D. Douches, **S. Jansky**, and R. Buell. 2018. Genome sequence of M6, a diploid inbred clone of the high glycoalkaloid-producing potato species *Solanum chacoense* reveals residual heterozygosity. *The Plant Journal*. 94:562-570.
19. Alpers, R. and **S. Jansky**. 2019. Diploid true potato seed: Relationships among seed weight, germination, and seedling vigor. *American Journal of Potato Research*. 96:217-224.
20. Marand, A., **S. Jansky**, J. Gage, A. Hamernik, N. de Leon, and J. Jiang. 2019. Residual heterozygosity and epistatic interactions underlie the complex genetic architecture of yield in diploid potato. *Genetics* 212:317-332.
21. Bethke, P.C., D.A. Halterman, and **S.H. Jansky**. 2019. Potato germplasm enhancement enters the genomics era. *Agronomy* 9:575.
22. Nashiki, A, **S.H. Jansky**, and P.C. Bethke. 2021. The effect of mother plant fertilization and stratification on the germination of true potato seed. *American Journal of Potato Research*. 98:194-201.

Book Chapters

23. **Hermundstad, S. A.** and S. J. Peloquin. 1987. Breeding at the 2x level and sexual polyploidization. In: *The Production of New Potato Varieties: Technological Advances*, eds. D. E. Richardson and G. J. Jellis. New York: Cambridge University Press. pp. 197-210.
24. **Jansky, S. H.** 2009. Breeding, genetics, and cultivar development. In: J. Singh and L. Kaur eds. *Advances in Potato Chemistry and Technology*. San Diego, CA: Elsevier. pp. 27-61.
25. Bamberg, J., A. del Rio, **S. Jansky**, and D. Ellis. 2018. Ensuring the genetic diversity of potatoes. In: G. Wand-Pruski (Ed.) *Achieving sustainable cultivation of potatoes*. Vol. 1. *Breeding Improved Varieties*. Burleigh Dodds Science Publishing. Cambridge, UK.
26. **Jansky, S.H.**, K.G. Haynes, W.S. De Jong, D.S. Douches, and D. G. Holm. Cultivar improvement with exotic potato germplasm. 2019. In: D. Carputo (ed.) *Compendium of Plant Genome Sequences*. Springer-Verlag.