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

Docket No.: 091876-0014

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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

: Customer Number: 23630

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Application No.: 13/504,156

: Confirmation No.: 6337

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Filed: July 10, 2012

: Art Unit: 1663

:

For: Hybrid Seed Potato Breeding

: Examiner: Russell T. Boggs

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

AMENDMENT SUBMITTED WITH REQUEST FOR CONTINUED EXAMINATION

Sir:

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

Amendments to the Claims begin on Page 2.

Remarks/Arguments begin on Page 10.

AMENDMENTS TO THE CLAIMS

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

wherein said self-compatibility originating from *Solanum chacoense* and is referred to as S-locus inhibitor (*Sli*) gene, a copy of said gene is present in a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said lines having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively; and

wherein at least 25% of the plants of said line produce seed-carrying berries, each carrying at least 5 seeds, and

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

2. (Cancelled)

3. (Previously Presented) The potato line of claim 1, wherein said plant of said line, in addition to said tuber yield, comprises at least one agronomically desirable trait selected from the group consisting of insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color and cold-sweetening resistance.

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

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

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

7. (Cancelled)

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

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

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, said potato line which may have any level of homozygosity, said line of said second potato plant comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant;

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

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

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

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

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

10. (Cancelled)

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

12. (Currently Amended) The method of claim 8, wherein said second potato plant is the plant of a second diploid, fertile, self-compatible and essentially homozygous potato line according to claim 1.

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

14-15. (Cancelled)

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

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

(b) providing a second potato plant, wherein said second potato plant is a plant of a second diploid or tetraploid, fertile, self-compatible and essentially homozygous *Solanum*

tuberosum potato line according to claim 1, wherein said first and second plant contain at least 20 % contrasting homozygous loci as determined by molecular marker analysis, and

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

17. (Cancelled)

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

19. (Previously Presented) The method of claim 16, wherein said first potato plant is a plant of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said lines having been deposited with the NCIMB, Aberdeen, Scotland.

20. (Previously Presented) The method of claim 16, wherein said second potato plant is a plant of a second diploid or tetraploid, self-compatible and essentially homozygous *Solanum tuberosum* potato line, said second potato line comprising an additional agronomically desirable trait; and wherein said trait is insect tolerance, nematode resistance, disease resistance, herbicide tolerance, cold tolerance, drought tolerance, wet tolerance, tolerance to dry and wet rot, salinity tolerance, yellow flesh color or cold-sweetening resistance.

21. (Previously Presented) A seed of potato lines NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said line having been deposited with the NCIMB, Aberdeen, Scotland.

22. (Previously Presented) A seed produced by the method of claim 16.

23. (Previously Presented) A hybrid potato plant, or part thereof, produced by growing the seed of claim 22.

24. (Previously Presented) Pollen or an ovule of the plant of claim 23.

25. (Previously Presented) A tuber from the plant of claim 23.

26-28. (Cancelled)

29. (Currently Amended) A method for producing a hybrid potato seed wherein the method comprises crossing a first potato plant with a second potato plant and harvesting a hybrid potato seed resulting from said crossing, wherein said first or second parent potato plant is the potato plant of claim 5 ~~or claim 38~~, wherein said first and second parent potato have at least 20 % contrasting homozygous loci as determined by molecular genetic marker analysis.

30. (Previously Presented) A method of producing a hybrid potato plant, said method comprising producing a seed according to a method of claim 16 and growing said seed into a potato plant.

31. (Cancelled)

32. (Previously Presented) A set of 2 homozygous diploid, fertile, self-compatible and essentially homozygous potato lines according to claim 1, wherein each of said lines differ from another line in said set by having at least 20% contrasting homozygous loci as determined by molecular genetic marker analysis; and wherein at least 50% of loci in said plants are homozygous.

33-34. (Cancelled)

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

(a) providing a first potato plant, which first potato plant is a plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, or NCIMB accession number 41765, representative seeds of said line having been deposited with the NCIMB, Aberdeen, Scotland under breeders reference AGVD1, AGVD2, AGVD3, and AGVD17 respectively;

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid or tetraploid *Solanum tuberosum* potato line, said potato line of said second potato plant having any level of homozygosity, said line of said second potato plant comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant;

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

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

(e) selfing said hybrid offspring potato plant or backcrossing said hybrid offspring potato plant to [[a]] at least one potato plant of potato line NCIMB accession number 41663, NCIMB accession number 41664, NCIMB accession number 41665, and NCIMB accession number 41765 ~~said line of said first potato plant~~, for between 1 to 8 selfings or backcrosses, to thereby provide a diploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato breeding line, said potato ~~breeding~~ breeding line comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant;

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

36. (Cancelled)

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

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

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

40-41. (Cancelled)

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

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

(b) providing a second potato plant, wherein said second potato plant is a plant of a second diploid or tetraploid, fertile, self-compatible and essentially homozygous *Solanum tuberosum* potato line according to claim 1, wherein said first and second plant contain at least 20% contrasting homozygous loci as determined by molecular marker analysis, and

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

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

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

(b) providing a second potato plant, wherein said second potato plant is a plant of a diploid *Solanum tuberosum* potato line, said potato line which may have any level of homozygosity, said line of said second potato plant comprising plants having an average tuber yield expressed in grams of fresh weight of at least 200 grams per plant;

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

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

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

REMARKS/ARGUMENTS

Status of Claims

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

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

No new matter is believed to be added herein.

Claim Objections

Claim 35 is objected to as “breeding” was misspelt in the third to last line.

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

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

A. Claims 1, 3-6, 8-9, 12-13, 16, 18, 20, 22-25, 27-32, 37-39 and 40-41 are rejected under 35 U.S.C. § 112(a) or 35 U.S.C. § 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement.

According to the Examiner, the claims are broadly drawn to *S. tuberosum* lines, provided they have a yield of 200 g per plant and have the *Sli* gene. According to the Examiner, the Applicant claims a large genus, whereas the instant application describes only the four deposited potato lines to use in the claimed methods.

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

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

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

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

Reconsideration and withdrawal of rejection are respectfully requested.

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

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

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

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

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

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

Reconsideration and withdrawal of rejection are respectfully requested.

Rejections under 35 U.S.C. § 103

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

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

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

Combined disclosures of the prior art may suggest that *Sli* genes were well known. The state of art of *Sli* gene is such that can be crossed into cultivated diploid potatoes, which expressed self-compatibility and were selfed up to S₂ generation. Subsequent continuous selfings successfully produced S₂ progeny (see Phumichai 2006, Introduction).

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

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

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

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

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

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

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

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

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

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

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

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

Reconsideration and withdrawal of rejection are respectfully requested.

Allowable Subject Matter

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

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

CONCLUSION

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

The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-1133, under Order No. 091876-0014 from which the undersigned is authorized to draw.

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

Respectfully submitted,

McDERMOTT WILL & EMERY LLP



Kristin A. Connarn
Registration No. 57,025

28 State Street
Boston, MA 02109-1775
Phone: 617-535-4453
Facsimile: 617-535-3800

Date: August 29, 2018

**Please recognize our Customer No. 23630 as our
correspondence address**