UNITED STATES PATENT AND TRADEMARK OFFICE

_____

BEFORE THE PATENT TRIAL AND APPEAL BOARD

_____

INARI AGRICULTURE, INC.,
Petitioner,

v.

PIONEER HI-BRED INTERNATIONAL, INC.,
Patent Owner.

_____

Case No. PGR2024-00023
Patent No. 11,696,545

_____

DECLARATION OF RAYMOND D. RILEY, PH.D.

Inari Exhibit 1003
Inari v. Pioneer

TABLE OF CONTENTS

I. INTRODUCTION 1

II. BACKGROUND AND QUALIFICATIONS 2

A. Academic Training 2

B. Selected Professional Experience 3

C. Patents 6

III. LEVEL OF ORDINARY SKILL IN THE ART 7

IV. MATERIALS CONSIDERED AND RELIED UPON 10

V. LEGAL STANDARDS 10

A. Obviousness 10

B. Claim Construction 16

C. Utility 16

D. Written Description 18

E. Enablement 19

VI. DESCRIPTION OF THE RELEVANT FIELD AND TIMEFRAME 22

VII. OVERVIEW OF THE '545 PATENT 22

A. Subject Matter of the '545 Patent 22

VIII. TECHNICAL BACKGROUND AND STATE OF THE ART 26

IX. GROUNDS 1-3: CLAIMS 1-20 ARE UNPATENTABLE AS OBVIOUS OVER THE PRIOR ART 29

A. Graham Factor Analysis Relevant to Grounds 1-3 30

1. Scope and Content of the Prior Art 30

2. Differences Between the Prior Art and the Claimed Invention 45

3. Level of Ordinary Skill in the Art 76

4. Secondary Considerations 84

B. Ground 1: Claims 1-20 Are Unpatentable as Obvious Over Smalley (EX1005) and the Corresponding PVPA Certificate (EX1008) 85

1. Claim 1: Variety PH4CYJ 87

2. Claims 2-20: Variations and Hybrids Related to PH4CYJ 92

a. Claim 2: Ovule or Pollen From the Inbred Line of Claim 1 95
b. Claims 3-8: Hybrids and Related Uses Derived From 1PFHC43 95
c. Claim 9: Nucleic Acids Isolated From PH4CYJ 99
d. Claims 10-17: Converted Seeds of PH4CYJ 100
e. Claims 18-20: F1 Hybrid Derived From Variety PH4CYJ with a Transgene 103
C. Ground 2: Claims 1-20 Are Unpatentable as Obvious Over Benson (EX1006) 104
1. Claim 1 106
2. Claims 2-20 108
D. Ground 3: Claims 1-20 Are Unpatentable As Obvious Over Longenberger (EX1007) 114
1. Claim 1 116
2. Claims 2-20 119
X. GROUND 4: CLAIMS 1-20 LACK SPECIFIC UTILITY 123
A. Analysis of Patents at Issue in *J.E.M. Ag Supply* 128
XI. GROUNDS 5-6: THE '545 PATENT FAILS TO STAISFY SECTION 112 151
A. The Minimal Differences Between the '545 Patent's Specification and the Prior Art Are At Best Consistent with the Disclosures Required for PVP Certificates 151
B. The Minimal Differences Between the '545 Patent's Specification and the Prior Art Do Not Adequately Describe or Enable Claims 1-20 154
1. Lack of Written Description 158
2. Lack of Enablement 158
C. The Minimal Differences Between the '545 Patent's Specification and the Prior Art Stand in Contrast to PO's Earlier Plant Utility Patents the Supreme Court Considered in *J.E.M.* 159
1. Unlike the '545 Patent, PO's Earlier Patents Had Highly Customized Specifications Highlighting Distinctive Properties of the Claimed Inbred Lines 159

2. Unlike the ’545 Patent, PO’s Earlier Patents Had Narrower Claims Specifically Linked to PO’s Deposits and/or “All” Disclosed Characteristics of the New Varieties 161

XII. CONCLUSION 163

I, Raymond D. Riley, Ph.D., hereby declare under penalty of perjury:

I. INTRODUCTION

1. My name is Raymond D. Riley, and I have been retained by counsel for Petitioner Inari Agriculture, Inc. ("Inari" or "Petitioner") as an expert witness to provide analysis regarding U.S. Patent No. 11,696,545 (the "'545 Patent"), which I understand has been designated as EX1001. Specifically, I have been asked to consider the validity of claims 1-20 of the '545 Patent (the "Challenged Claims") in view of prior art, the non-obviousness and utility requirements, and the understanding of a person of ordinary skill in the art at the time of the invention as it relates to the '545 Patent. I have personal knowledge of the facts and opinions set forth in this declaration and believe them to be true. If called upon to do so, I would testify competently thereto.

2. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study, the substance of my expert opinions, or the outcome of any proceeding involving the challenged claims. I have no financial interest in the outcome of this matter or on the pending litigation between Petitioner and Patent Owner. My analysis here is based on my years of education, research, and experience, as well as my investigation and study of relevant materials, including those cited herein.

3. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

4. My analysis of the materials produced in this proceeding is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my expert opinions stated herein based on new information and on my continuing analysis of the materials already provided.

II. BACKGROUND AND QUALIFICATIONS

5. I am an expert in the field of plant breeding and genetics. I have studied, taught, practiced, and researched in this field for over 45 years. I have summarized in this section my educational background, work experience, and other relevant qualifications. My curriculum vitae, which I understand has been designated EX1004, describes my background and experience.

A. Academic Training

6. I earned my Bachelor of Science degree in Soil & Crop Science with a second major in Agribusiness Management from the University of Wisconsin – Platteville in 1977. I earned a Master of Science degree in Plant Breeding and

Genetics from the University of Nebraska in 1980. In 1981, I earned a Doctor of Philosophy degree, in Plant Breeding and Genetics with a minor in Organization Behavior and Performance, also from the University of Nebraska. My dissertation entitled "Heritability of Mature Plant Traits in Sand Bluestem," was directed to studies on inheritance of certain agronomically important traits in sand bluestem, a perennial tall-grass native to the Great Plains.

B. Selected Professional Experience

7. After completing my Doctor of Philosophy degree, I worked at Pioneer Hi-Bred International, Inc. ("PHI"), beginning in 1981. From 1981 to 1990, I was a research program manager and corn breeder. I was responsible for management of an integrated research program directed toward development of commercial corn. I was also responsible for commercial research interactions to effectively focus research efforts, communicate research results and enhance commercial success.

8. In that role, I developed several inbred and hybrids of commercial and germplasm significance. I was the co-inventor of a patent (U.S. Patent No. 5,491,295) for corn hybrid 3394, which at one point was the largest selling corn hybrid. PHI has stated that hybrid 3394 "became so dominant by the mid-90s that, by itself, it outsold the entire hybrid lineups of all competitor seed companies."

EX1019, "A Brief History of Corn – From Domestication to 1995," PHI (Dec. 19, 2022), https://www.pioneer.com/us/agronomy/domestication-of-corn.html.

9. From 1991 to 2000, I was a research director for PHI and, after DuPont's acquisition of PHI in October 1999, for DuPont. I was initially the research commercial liaison and director of corn breeding and product development efforts for Africa/Middle East/Pacific Rim. Later, I was responsible for North Central Corn-Belt corn product development. Later still, I was responsible for product characterization and commercialization (PCC) of corn for South America, Africa, Middle East, Asia and China. Each of these roles involved, among other things, working with or directing the activities of teams breeding and/or developing new inbred and hybrid corn varieties.

10. I then moved to Syngenta Seeds, where I worked from 2000 to 2015. From 2000 to 2003, I was Syngenta's Global Corn Seed Production Head based in Toulouse, France. From 2003 to 2004, I was the Global Head of Field Crops Research and Development. In these roles, I again worked directly with and/or directed the activities of teams breeding varieties of corn and other crops.

11. From 2004 to 2010, I was the head of NAFTA corn and soybean seeds research and development, based in Minnetonka, Minnesota. In that role, I developed a high-performance corn and soybean research and development team

that has repositioned Syngenta's corn and soybean product offerings to be among the best in the industry.

12. From 2010 to 2011, I was the global head, corn seeds research and development. In that role, I represented seeds research and development in the establishment of a global corn seeds strategy and managed Syngenta's global corn breeding and trait development portfolio.

13. From 2011 to 2014, I was the global head of germplasm technology. In that role, I led the establishment of a global cross crop plant breeding technical excellence program for application of breeding, statistical and emerging molecular biology technologies. I also established the "Syngenta Plant Breeding Academy" to enable ongoing state of the art skill development and networking of Syngenta scientists and our key collaborators.

14. From 2013 to 2014, I was the head of Traits Research, leading traits research teams responsible for GM (genetically modified) and non-GM traits for insect and disease resistance, yield, and stress tolerance. From 2014 to 2015, I was the Head of Computational Biology. In that role I established an integrated Computational Biology team to support Syngenta's research and development efforts spanning breeding, trait development (GM and Native) and chemistry.

15. From 2015 to 2018, I was the Senior Vice President of Product Development at Indigo Ag Inc. At Indigo, I led teams and projects focused on product development of microbiome-based crop production enhancing products.

16. Since 2018, I have worked as a consultant to a range of Ag Tech startups in areas spanning crop genetics, AI assisted breeding, gene editing, seed business strategy, biotech, microbial seed treatments, soil carbon sequestration and environmentally sustainable practices. Beginning in 2020 to present, I have also served as a member of the global Loam Bio Management Team at Loam Bio LLC, with a focus on research and development. Loam Bio develops programs to remove carbon from the atmosphere and store it in the soil, improving agricultural productivity.

17. As a leader of corn breeding teams and programs, it was my responsibility to ensure that investments in this area were delivering utility and supporting the commercial success of the company I was employed with, as well as the customers who utilized the developed product.

C. Patents

18. I am the inventor or a co-inventor of a number of patents in corn breeding and related fields including:

a. U.S. Patent No. 5,159,133 (EX1092) entitled "Inbred Corn Line PHV37;"

b. U.S. Patent No. 5,491,295 (EX1080) entitled "Hybrid Corn Plant and Seed;"

c. U.S. Patent No. 10,624,351 entitled "Modulated Nutritional Quality Traits in Seeds" (related patents: US 11,178,876; US 11,766,045);

d. U.S. Patent No. 10,640,783 entitled "Endophyte Compositions and Methods of Improvement of Plant Traits" (related patents: US 11,516,989); and

e. U.S. Patent No. 10,645,938 entitled "Endophyte Composition and the Methods for Improvement of Plant Traits."

III. LEVEL OF ORDINARY SKILL IN THE ART

19. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of one of ordinary skill at the time of the claimed invention, which I understand to be July 2, 2021—the filing date of the application that issued as the '545 Patent, and the earliest priority date to which the claims of the issued patent are entitled. I understand that the factors considered in determining the ordinary level of skill in a field of art include the level of education and experience of persons working in the field; the types of problems encountered in the field; the teachings of the prior art, and the sophistication of the technology at the time of the claimed invention. I understand that one of ordinary skill is not a specific real individual, but rather is a

hypothetical individual having the qualities reflected by the factors above. I understand that one of ordinary skill would also have knowledge from the teachings of the prior art, including the art cited below.

20. Taking these factors into consideration, on or before July 2, 2021, one of ordinary skill relating to the technology of the '545 Patent would have had a high level of skill. In particular, a POSA would have had a doctoral degree in plant breeding or a related field, at least five years of experience with corn breeding, and additional experience interfacing with laboratory-side personnel (including a computational biologist along with genetics specialists) as well as field-side personnel. Alternatively, additional experience could take the place of an advanced degree.

21. It has long been expected that substantial academic preparation was important to work as a corn breeder. For example, in a widely cited 1991 text entitled *Principles of Cultivar Development*, Walter Fehr described the academic experience expected for a plant breeder in terms that also applied in 2021:

> To be capable of planning and conducting an effective plant breeding research program, a person needs an appropriate undergraduate and graduate education. The education includes a mixture of formal courses, independent research experience in working with an active research program, and informal interaction with students and faculty. Academic courses include plant breeding and those disciplines that contribute to cultivar development. Independent research gives

> experience in planning, conducting, and interpreting experiments. Participation in an active research program is a means of obtaining practical experience with breeding techniques and methods. Informal interaction with students and faculty provides the opportunity to evaluate new ideas and concepts.

EX1016, Fehr, 8 (internal citation omitted). Indeed, the amount of education and experience required to run a successful breeding program has only increased over the years, especially as genetics, genomics, data science, and computational techniques have become increasingly important to breeding programs. In addition, an important aspect of the breeder's role is the ability to use breeding skills to create value for the company and enable business and customer (*i.e.*, farmer) success.

22. Before July 2, 2021, my level of skill in the art was at least that of one of ordinary skill. I am very familiar with the experience and knowledge of a POSA as of 2021. I held comparable positions to a POSA in the 1980s-90s. More recently, I have held positions in which I directed and/or worked with people who would be considered POSAs, including in leadership roles at PHI and Syngenta and in consulting roles. I am qualified to provide opinions concerning what one of ordinary skill would have known and understood at that time, and my analysis and conclusions herein are from the perspective of one of ordinary skill as of that date.

IV. MATERIALS CONSIDERED AND RELIED UPON

23. In reaching the conclusions described in this declaration, I have relied on the ’545 Patent, the prior art, and other documents and materials cited herein. For ease of reference, the full list of documents that I have considered is included in **Appendix A.**

24. These materials comprise patents, related documents, and printed publications. Each of these materials is a type of document that experts in my field would have reasonably relied upon when forming their opinions.

25. I have also relied on my education, training, research, knowledge, and personal and professional experience in the relevant technologies and systems that were already in use prior to, and within the timeframe of the earliest priority date of the claimed subject matter in the ’545 Patent, which is July 2, 2021.

V. LEGAL STANDARDS

26. I am not a lawyer and do not provide any legal opinions, but I have been advised that certain legal standards are to be applied by technical experts in forming opinions regarding meaning and validity of patent claims. I have applied the legal standards described below, which were provided to me by counsel for Petitioner.

A. Obviousness

27. I have been informed that a claim may be unpatentable under 35 U.S.C. § 103(a) if the subject matter described by the claim as a whole would have

been obvious in view of a prior art reference or in view of a combination of references at the time the alleged invention was made. I have been informed that obviousness is determined from the perspective of a hypothetical person of ordinary skill in the art ("POSA" or "person of ordinary skill") and that the challenged claims of the patent should be read from the point of view of such a person at the time the alleged invention was made. I have been informed that a hypothetical person of ordinary skill is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent in suit, and would thus have been familiar with each of the references cited herein, as well as the background knowledge in the art, and the full range of teachings they contain.

28. I have been informed that there are two criteria for determining whether prior art is analogous and thus can be considered prior art: (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 patentee's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the patentee is involved. I have also been informed that the field of endeavor of a patent is not limited to the specific point of novelty, the narrowest possible conception of the field, or the particular focus within a given field. I have also been informed that a reference is reasonably pertinent if, even though it may be in a different field from that of the patentee's endeavor, it is one which, because of

the matter with which it deals, logically would have commended itself to a patentee's attention in considering the problem.

29. I have also been informed that an analysis of whether an alleged invention would have been obvious should be considered in light of the scope and content of the prior art, the differences (if any) between the prior art and the alleged invention, and the level of ordinary skill in the pertinent art involved. I have been informed as well that a prior art reference should be viewed as a whole.

30. I have also been informed that in considering whether an invention for a claimed combination would have been obvious, I may assess whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the market place, and/or the background knowledge possessed by a person of ordinary skill. I have been informed that other principles may be relied on in evaluating whether an alleged invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results;

- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in

the same field or in a different one, so that if a person of ordinary skill can implement a predictable variation, the variation is likely obvious;

- If a technique has been used to improve one device, and a person of ordinary skill would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill;

- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing an explicit teaching, suggestion, or motivation to combine;

- Market demand, rather than scientific literature, can drive design trends and may show obviousness;

- In determining whether the subject matter of a patent claim would have been obvious, neither the particular motivation nor the avowed purpose of the named inventor controls;

- One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;

- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;

- "Common sense" teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle;

- A person of ordinary skill is also a person of ordinary creativity, and is not an automaton;

- A patent claim can be proved obvious by showing that the claimed combination of elements was "obvious to try," particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a person of ordinary skill would have had good reason to pursue the known options within his or her technical grasp; and

- One should be cautious of using hindsight in evaluating whether an alleged invention would have been obvious.

31. I have further been informed that, in making a determination as to whether or not the alleged invention would have been obvious to a person of ordinary skill, the Board may consider certain objective factors if they are present, such as: commercial success of products practicing the alleged invention; long-felt but unsolved need; teaching away; unexpected results; copying; and praise by others in the field. These factors are generally referred to as "secondary considerations" or "objective indicia" of nonobviousness. I have been informed, however, that for such objective evidence to be relevant to the obviousness of a claim, there must be a causal relationship (called a "nexus") between the claim and the evidence and that this nexus must be based on what is claimed and novel in the claim rather than something in the prior art. I also have been informed that even when they are present, secondary considerations may be unable to overcome primary evidence of obviousness (e.g., motivation to combine with predictable results) that is sufficiently strong.

32. I have been asked to consider the patentability of claims 1-20 (the "Challenged Claims") of the '545 Patent that are challenged in the Petition.

33. I have been informed that for PGRs, unpatentability must be shown under a preponderance of the evidence. I have been informed that to establish

something by a preponderance of the evidence one needs to prove it is more likely true than not true. I have concluded that the Challenged Claims are unpatentable under 35 U.S.C. § 103 (for obviousness) as described below, under both the preponderance of the evidence standard as well as the higher standard of clear and convincing evidence. The same is true for my conclusion, as also described below, that the Challenged Claims are unpatentable under 35 U.S.C. § 101 for lack of specific utility as well as under 35 U.S.C. § 112 for lack of written description or enablement.

B. Claim Construction

34. I have been informed that patent claims are construed from the viewpoint of a person of ordinary skill at the time of the alleged invention. I have been informed that patent claims generally should be interpreted consistent with their plain and ordinary meaning as understood by a person of ordinary skill in the relevant time period (i.e., at the time of the purported invention, or the so called "effective filing date" of the patent application), after reviewing the patent claim language, the specification and the prosecution history (i.e., the intrinsic record)

C. Utility

35. I have been informed that the statutory basis for the utility requirement is found in 35 U.S.C. § 101, which provides:

> Whoever invents or discovers any new and ***useful*** process, machine, manufacture, or composition of matter, or any new and ***useful***

improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title. (emphasis added)

36. I have been informed by counsel that the Supreme Court has interpreted the statute to mean that "one may patent only that which is 'useful.'" *Brenner v. Manson*, 383 U.S. 519, 528-29 (1966). Specifically, the utility must be (i) specific, practical, and substantial. *Grunenthal GMBH v. Alkem Lab'ys Ltd.*, 919 F.3d 1333, 1345 (Fed. Cir. 2019). The utility must be "substantial" meaning a utility that "provides a specific benefit in currently available form." *Ex parte Fisher*, 72 U.S.P.Q.2d 1020, 1025 (B.P.A.I. 2004).

37. Counsel has informed me that the courts have held that "inventions do not meet the utility requirement if they are 'objects upon which scientific research could be performed with no assurance that anything useful will be discovered in the end.'" *In re '318 Pat. Infringement Litig.*, 583 F.3d 1317, 1324 (Fed. Cir. 2009). For example, an application for a proposed drug to treat dementia was held unpatentable where the applicant's argument for utility was based only on "analytic reasoning" about the drug without any results of testing in animals or people. *Id.*, 1326-28.

38. Further, I also understand from counsel that the Supreme Court has cautioned that "a patent is not a hunting license," meaning that "[u]nless and until a process is refined and developed to [the] point—where specific benefit exists in

currently available form—there is insufficient justification for permitting an applicant to engross what may prove to be a broad field" by obtaining a patent. *Brenner*, 383 U.S. at 534-36. Counsel has informed me that, for example, in a case involving expressed sequence tags ("ESTs") in maize, the courts held that claims to specific ESTs were not patentable where the applicant's only alleged utility were general uses of ESTs and the claimed ESTs were not tied to any specific utility, nor differentiate the claimed ESTs from any other ESTs. *In re Fisher*, 421 F.3d 1365, 1365-68 (Fed. Cir. 2005). Because the applicant "only disclosed general uses for its claimed ESTs, not specific ones that satisfy §101," the claims were not patentable. *Id.* at 1374.

39. Finally, I understand that utility is determined as of the application filing date. *In re Brana*, 51 F.3d 1560, 1567 n.19 (Fed. Cir. 1995).

D. Written Description

40. I have been informed that the statutory basis for the written description requirement is found in 35 U.S.C. § 112(a), which provides in relevant part:

> (a) IN GENERAL.—The specification shall contain a ***written description*** of the invention…

41. I have been informed by counsel that a claim in a granted patent must be sufficiently supported by the disclosure in the patent's specification, read in the

context of what a person of ordinary skill in the art would have known at the time of the claimed invention. I understand that the basic inquiry for written description is whether the specification provides sufficient information for the person or ordinary skill to recognize that the named inventors possessed the full scope of the claimed invention.

42. In particular, I understand that "[t]he essence of the written description requirement is that a patent applicant, as part of the bargain with the public, must describe his or her invention so that the public will know what it is and that he or she has truly made the claimed invention." *AbbVie Deutschland GmbH & Co., KG v. Janssen Biotech, Inc*., 759 F.3d 1285, 1298 (Fed. Cir. 2014).

E. Enablement

43. I have been informed that the statutory basis for the enablement requirement, which is an additional requirement beyond the written description requirement, is found in 35 U.S.C. § 112(a), which provides in relevant part:

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and ***of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same***…

I have been informed that a claimed invention is not enabled under 35 U.S.C. § 112(a) if the specification does not teach those of ordinary skill in

the art how to make and use the invention as broadly as it is claimed, without undue experimentation.

44. I have been informed that the full scope of the claimed invention must be enabled. In other words, "[t]he more one claims, the more one must enable." *Amgen Inc. v. Sanofi*, 598 U.S. 594, 610 (2023).

45. I have been informed that the assessment of undue experimentation is based on the state of the art as of the filing date of the application to which the '545 Patent claims priority. In this case, I have been informed that date is July 2, 2021—the filing date of nonprovisional application 17/366,079.

46. I have been informed that a finding of undue experimentation must consider multiple factors to determine if there is sufficient evidence to support such a determination. I have been informed that these factors, which are referred to as Wands factors, include (1) the nature of the invention, (2) the relative skill of those in the art, (3) the breadth of the claims, (4) the presence or absence of working samples, (5) the amount of direction or guidance presented, (6), the state of the prior art, (7) the predictability or unpredictability of the art, and (8) the quantity of experimentation necessary.

47. I have been informed that to determine whether there is a reasonable correlation between the scope of the claims and the scope of enablement, the degree of predictability of the relevant art need to be considered. I have been

informed that chemical and physiological inventions, unlike mechanical and electrical inventions, are often considered "unpredictable" arts because a slight variation in method can yield an unpredictable result or may not function at all. ("[I]n cases involving chemicals and chemical compounds, which differ radically in their properties it must appear in an applicant's specification…, that the chemicals or chemical combinations included in the claims are capable of accomplishing the desired result."). Accordingly, "[t]ypically, patent applications claiming new [chemical methods of treatment are supported by test results." *In re '318 Patent Infringement Litig*. 583 F.3d at 1324 (Fed.Cir. 2009). I have been informed that in unpredictable arts, there must be some quantum of data or reasoning that supports the inventor's contention that a therapy operates as claimed. *See id*. at 1326. "While every aspect of a generic claim certainly need not have been carried out by an inventor, or exemplified in the specification, reasonable detail must be provided in order to enable members of the public to understand and carry out the invention." *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1366 (Fed. Cir. 1997).

48. I have been informed that the specification need not teach what is well known in the art. *Hybritech v. Monoclonal Antibodies, Inc*., 802 F.2d 1367, 1384 (Fed. Cir. 1986).

49. I have been informed that the determination of non-enablement must be based on the evidence as a whole.

VI. DESCRIPTION OF THE RELEVANT FIELD AND TIMEFRAME

50. I understand that the ’545 Patent issued from U.S. Patent Application No. 17/366,079, filed on July 2, 2021. I have been instructed by counsel to assume the relevant timeframe for my analysis in this declaration is on or before July 2, 2021.

51. Based on my review of this material, I believe that the relevant field for the purposes of the ’545 Patent is, as identified above, corn breeding. For example, the patent discusses the “continuing goal of maize breeders…to develop stable, high yielding maize varieties and hybrids that are agronomically sound with maximal yield over one or more different conditions and environments.” EX1001, 1:23-26.

VII. OVERVIEW OF THE ’545 PATENT

A. Subject Matter of the ’545 Patent

52. The ’545 Patent is directed to an inbred corn variety designated PH4CYJ, which originated from a cross between inbred line PH1KTF and inbred line PH1VNA. EX1001, 37:61-64. The ’545 Patent states that “[f]rom this cross, ears were selected based on genetic analysis predicting disease, insect, and agronomic phenotypic performance. Inbred PH4CYJ was developed by producing a doubled haploid from the F1 plants, selfing and using pedigree selection amongst

the D1 lines, and selfing and bulking from the subsequent generations." EX1001, 37:64-66 and 38:1-3. These techniques were well known to POSAs. For example, U.S. Patent No. 10,660,288 (EX1006) published before the priority date, included the same disclosure—including the use of inbred line PH1D84 as one of the parents. *See* EX1006; *see also* EX1020, Geiger, "Doubled Haploids in Hybrid Maize Breeding," Maydica 54:485-99, 486 (2009) ("After artificial chromosome doubling the successfully treated seedlings are selfed leading to completely homozygous and homogeneous progenies (DH lines)."); EX1021, Weber, "Today's Use of Haploids in Corn Plant Breeding" in Advances in Agronomy, Volume 123 (2014) ("Haploid plants with fertile sectors are self-pollinated if possible.").

53. Aside from the variety designation itself, the "Abstract," "Background," and "Summary" sections are essentially identical to those in multiple prior art patents such as Benson (EX1006) and Longenberger (EX1007) and disclose information that would have already been well known to POSAs prior to the '545 Patent's July 2, 2021 filing date.

54. For example, the Background sections of both Benson and the '545 patent conclude by identifying a "continuing goal of maize breeders…to develop stable, high yielding maize varieties and hybrids that are agronomically sound with

maximal yield over one or more different conditions and environments." EX1001, 1:23-26; Benson, 1:23-26; Longenberger, 1:32-26.

55. The "Detailed Description" section likewise closely tracks multiple prior art patents such as Longenberger and Benson. Similarities include:

- Similar "Definitions" sections (compare EX1001, 4:46-14:67 with Benson, 4:46-14:62; Longenberger, 4:46-15:2)

- Identical "Phenotypic Characteristics" sections other than the designations themselves (e.g., PH4CYJ versus PH47W4) (compare EX1001, 15:1-14 with Benson, 14:63-15:9 and Longenberger, 15:3-17)

- Essentially identical "Genotypic Characteristics" sections other than the designations themselves (compare EX1001, 15:1-17:38 with Benson, 15:10-17:37 and Longenberger, 15:18-17:45)

- Essentially identical sections on:

    - "Comparing … to Other Inbreds" (compare EX1001, 17:36-18:7 with Benson, 17:38-18:9 and Longenberger, 17:46-18:18);

    - "Development of Maize Hybrids" (compare EX1001, 18:8-19:3 with Benson, 18:10-19:3 and Longenberger, 18:19-19:12);

- "Combining Ability" (compare EX1001, 19:4-35 with Benson, 19:4-35 and Longenberger, 19:13-44);
- "Introduction of a New Trait or Locus" (compare EX1001, 19:36-21:37 with Benson, 19:36-21:46 and Longenberger, 19:45-21:55);
- "Male Sterility and Hybrid Seed Production" (compare EX1001, 21:38-23:12 with Benson, 21:47-23:31 and Longenberger, 21:56-23:39);
- "Develop[ing] Another Maize Plant" (compare EX1001, 31:40-32:4 with Benson, 32:30-33:12 and Longenberger, 32:38-33:2); and
- "Industrial Applicability" (compare EX1001, 36:21-37:59 with Benson, 37:11-38:52 and Longenberger, 37:21-65).

56. While the data in the '545 Patent's "Table 1" ("Variety Description Information") varies slightly from that in the prior art tables, the differences are insubstantial, as discussed in further detail in Section IX.A below. There is no basis in the '545 Patent or other reason to think that the traits would have fallen outside the range of expected outcomes from the breeding cross this line was developed from. *See, e.g.,* below, paragraphs 75-85 (comparing traits to prior art

including disclosed parent and siblings); paragraphs 86-92 (discussing statistical analysis).

57. Moreover, the fields themselves (e.g., "branch angle" and "tassel length") are taken verbatim from portions of a U.S. Department of Agriculture (USDA) form (EX1096) used in connection with applications for certificates under the Plant Variety Protection Act (PVPA). EX1008, 7; EX1009, 8; EX1010, 8. The characteristics in question facilitate assessing distinctiveness for purposes of the PVP—not utility or non-obviousness for purposes of the Patent Act. In order to identify a distinctive variety in the days before genotyping was available, the practice developed of identifying a new variety using the set of characteristics identified by the USDA in the PVPA form.

VIII. TECHNICAL BACKGROUND AND STATE OF THE ART

58. By 2021, the art of corn breeding was well developed. As one of the world's most important staple crops, Maize (*Zea mays*; commonly known as corn) has been the subject of well-developed breeding and selection techniques dating back roughly nine thousand years.

59. Modern cross techniques date back to 1867, when plant breeders began directing pollen from one maize plant to another. In 1878–1881, crossing maize varieties to grow the production of commercial cultivars was proposed. EX1012, Lee, "Modern Maize Breeding," in Bennetzen (ed.), *Maize Handbook*

(2009), 140-42. Maize genes important for commercially relevant traits also began to be discovered. *Id.* A revolutionary step in maize breeding began with the demonstration of 'hybrid vigor' or heterosis in crossed inbred lines in 1909. *See, e.g.,* EX1013, Byerlee, "The globalization of hybrid maize, 1921–70," *Journal of Global History* (2020), 15:1, 101-122 ("The exploitation of hybrid vigour was unique at the time to maize, which, unlike most other major crops, is an open-pollinating crop with separate male and female flowers. This characteristic greatly facilitated controlled pollination needed for in-breeding parent lines over several cycles, and then crossing the inbreds to produce hybrids. With the right combination of inbred parents, the yield gain was as much as 50% above the yield of the parental OPVs, but more commonly averaged 15–20%."); EX1015, Andorf, "Technological advances in maize breeding: past, present and future," Theoretical and Applied Genetics, 132:817–849 (2019). In 1933, the first hybrid maize created by crossing inbred lines was introduced, and maize breeding started entering the "hybrid era." *See* EX1013, Byerlee, 101; EX1012, Lee, 149.

60. Employment of modern genetics and molecular biology techniques in maize breeding started in the 1970s–1980s with the first regenerated plant from a cell culture and sequencing the first maize genes. EX1015, Andorf, 820-21. These modern techniques aided the identification of genes conferring desirable traits such as disease and/or insect resistance. Transgenic maize varieties began to emerge in

the late 1990s, and transgenic hybrids that could confer insect resistance, herbicide tolerance, high lysine content, and drought-resistance were commercialized. EX1011, Lundmark, "Genetically Modified Maize," *BioScience*, 57, 996 (2007).

61. Principles and methods of maize breeding and cultivar development to produce maize varieties with desirable traits have been described in various frequently cited textbooks and publications including, e.g., Fehr et al., Principles of Cultivar Development, (1987) (EX1016); Wych et al., Production of Hybrid Seed, Corn and Corn Improvement, Chapter 9 (1988) (EX1017); Lee et al., Handbook of Maize, Modern Maize Breeding (2009) (EX1012); and Andorf et al., Theor Appl Genet. 132(3):817-849 (2019) (EX1015). Such principles and techniques are also well known and routinely practiced by those skilled in the art of maize breeding.

62. By selecting appropriate varieties for crosses, it became routine over time to use cross breeding to adjust phenotypes successively to generate the changes and improvements in desired characteristics.

63. Fehr's text sets forth some of the reasons why inbred lines are desirable:

> One important purpose of inbreeding is the development of genotypes that can be maintained through multiple generations of seed production. Self-pollinated cultivars are reproduced for many generations without changes in their genetic composition. Reliable production of inbred

commercial hybrid seed of a species is dependent on the availability of inbred parents whose genotype can be maintained.

Inbreeding has been used to reduce the frequency of deleterious recessive alleles in genotypes that serve as parents of a synthetic or a vegetatively propagated cultivar. One selfed generation [in other words, pollinating a plant by itself] may permit the expression and subsequent elimination of deleterious alleles without excessive inbreeding depression occurring in lines selected for use as parents for population development.

Inbreeding increases the genetic variability among individuals in a population. Greater genetic variability among inbred progeny can increase the effectiveness of selection and the amount of genetic improvement in a breeding program.

EX1016, 106-107.

IX. GROUNDS 1-3: CLAIMS 1-20 ARE UNPATENTABLE AS OBVIOUS OVER THE PRIOR ART

64. In my opinion, Claims 1-20 are unpatentable as obvious over the prior art as of July 2, 2021. I describe in detail the basis for my opinion in this Section IX. At a high level, I reach this opinion because the variation from the original parent performance is very much within the range of what would be expected to be achieved by breeding a new line from the parental line.

65. As the ’545 Patent’s Variety Description Information (Table 1) confirms, the inbred PH4CYJ variety covered by claim 1 has characteristics very

similar to those in multiple other inbred varieties disclosed in the prior art. As discussed further below, to the extent there are differences, nothing in the specification suggests any reason why such differences were significant and/or unexpected as compared to prior art varieties.

66. Moreover, claims 2-20 recite standard applications for inbred corn variety (e.g., crossing the particular inbred variety with a different variety to create an F1 hybrid). Such applications would have been obvious for any known or obvious inbred corn line as of July 2, 2021.

A. Graham Factor Analysis Relevant to Grounds 1-3

67. I will now address: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) any secondary considerations identified by the Patent Owner. I understand from counsel that these are known as the "Graham" factors and form the basis for assessing whether a claimed invention would have been obvious at the time of the patent application in question (here, July 2, 2021).

1. Scope and Content of the Prior Art

68. I discussed the general state of the art in Section VIII above.

69. In addition, Smalley (EX1005), Smalley's related PVP certificate (EX1008),[1] Benson (EX1006),[2] Longenberger (EX1007), and Longenberger's related PVP certificate (EX1010)[3] all disclose inbred corn lines with

---

[1] I have generally relied on the data presented in Smalley (EX1005), but I note below several instances in which the related PVP certificate (EX1008) provides different information. These differences are within the normal range one would expect for different samples of the same variety and the differences do not change the conclusions I reach from the data in EX1005.

[2] I note that Benson also has a related PVP certificate dated August 20, 2021. I have relied on the data presented in Benson (EX1006), but I note one instance in which the related PVP certificate (EX1009) provides slightly different information. Specifically, the number of leaves above top ear is listed as 7 rather than 7.3. This difference is likely due to rounding and/or differences in environmental conditions where the traits were measured and, in any event, does not change the conclusions I reach from the data in EX1006.

[3] I understand that Longenberger's related PVP certificate issued in 2023. *See* EX1010, p. 1. Comparing Longenberger (EX1007) to EX1010 shows that the data in EX1007 is consistent with that in EX1010. Accordingly, I have relied on the data in EX1007.

characteristics very similar to those of the claimed 1PFHC43 as illustrated in the table below. The table is based on the "Table 1 – Variety Description Information" in each of the '545 Patent, Smalley, Benson, and Longenberger. It also includes a column for Anderson (U.S. Patent No. 7,718,856), which I understand the Patent Examiner identified as the "closest prior art." However, as the table reflects, the varieties disclosed in Smalley, Benson, and Longenberger are closer in numerous respects to the PH4CYJ variety claimed in the '545 Patent.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
Grain Texture	Dent	Flint	Dent	Dent	Flint-Dent[4]
MATURITY:					
Comparative Relative Maturity (days)	111	N/D	111	108	N/D
Emergence to 50% plants in silk (days)	55	N/D	52	51	65

[4] The related PVP Certificate reports a Flint grain texture. EX1094, 9.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
		(62)[5]			
Emergence to 50% plants in silk (heat units)	1348	N/D (1279.5)	1325	1299	1509[6]
Emergence to 50% plants in pollen shed (days)	54	N/D (61)	52	52	63
Emergence to 50% plants in pollen shed (heat units)	1325	(1264)	1325	1325	1463[7]
PLANT:					

[5] Maturity information in Smalley refers to heat units from planting, rather than from emergence. EX1005, Table 1. To allow for a comparison, I have substituted the maturity information from the related PVP Certificate. EX1008, 7.

[6] The related PVP Certificate reports an Emergence to 50% plants in silk heat units value of 1508.6. EX1094, 9.

[7] The related PVP Certificate reports an Emergence to 50% plants in pollen shed heat units value of 1462.8. EX1094, 9.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
Plant height (to tassel tip) (cm), mean (SE)	213.3 (11.86)	194.9 (1.47)[8]	211.4 (7.41)	207 (6.1)	244.0 (11.99)
Ear height (to base of top ear node) (cm), mean (SE)	72.3 (10.78)	62.9 (1.24)[9]	78 (3.83)	75.1 (9.31)	87.6 (8.86)
Length of Top Ear Internode (cm), mean (SE)	13.3 (0.95)	15.1 (0.22)[10]	17 (2.53)	16.7 (1.98)	16.2 (1.94)
Number of Nodes Above Ground, mean (SE)	12.9 (1.41)	N/D	13.2 (1.11)	11.9 (0.77)	N/D

[8] The related PVP Certificate reports a mean plant height of 200.4 cm with standard deviation of 7.54 and sample size of 20. EX1008, 7.

[9] The related PVP Certificate reports a mean ear height of 65.5 cm with standard deviation of 6.76 and sample size of 20. EX1008, 7.

[10] The related PVP Certificate reports a mean length of Top Ear Internode of 15.1 cm with standard deviation of 1.02 and sample size of 20. EX1008, 7.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
Anthocyanin of Brace Roots (1 = absent, 2 = faint, 3 = moderate, 4 = dark)	2	2	1	2	4
LEAF					
Width of Ear Node Leaf (cm), mean (SE)	9.1 (0.83)	9.5 (0.10)[11]	10.2 (0.65)	9.3 (0.62)	9.6 (0.65)
Length of Ear Node Leaf (cm), mean (SE)	84.3 (4.89)	75.5 (0.54)[12]	87 (2.29)	83.9 (4.7)	86.8 (5.43)

[11] The related PVP Certificate reports a mean width of ear node leaf of 9.8 cm with standard deviation of 0.62 and sample size of 20. EX1008, 7.

[12] The related PVP Certificate reports a mean length of ear node leaf of 78.8 cm with standard deviation of 2.65 and sample size of 20. EX1008, 7.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
Number of Leaves Above Top Ear, mean (SE)	6.1 (0.92)	6.3 (0.09)[13]	7.3 (0.94)[14]	5.9 (0.85)	7.1 (0.76)
Leaf Angle (degrees) (at anthesis, 2nd leaf above top ear to the stalk), mean (SE)	35.5 (6.87)	22.5 (0.64)[15]	34.3 (6.57)	26.3 (4.44)	26.1 (3.96)
Leaf Color	V. Dark Green	V. Dark Green	V. Dark Green	V. Dark Green	V. Dark Green
Leaf Sheath Pubescence	7	2[16]	2	4	2

[13] The related PVP Certificate reports a mean number of leaves above top ear of 6.5 with standard deviation of 0.83 and sample size of 20. EX1008, 7.

[14] The related PVP Certificate reports a mean number of leaves above top ear of 7. EX1009, 7.

[15] The related PVP Certificate reports a mean leave angle of 22.5 degrees with standard deviation of 3.44 and sample size of 20. EX1008, 7.

[16] The related PVP Certificate reports a leaf sheath pubescence value of 1. EX1008, 7.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
(1 = none to 9 = peach-like fuzz)					
TASSEL					
Number of Primary Lateral Branches, mean (SE)	2 (1.3)	0.0 (0.24)[17]	0.4 (0.58)	1.5 (1.24)	5.4 (1.80)
Branch Angle from Central Spike (degrees), mean (SE)	18.3 (9.57)	27.5 (5.70)[18]	15 (5.35)	38.9 (18.73)	42.8 (11.00)
Tassel Length (from peduncle	57.6 (4.15)	51.9 (0.60)[19]	58.8 (5.57)	56.5 (4.59)	58.8 (3.30)

[17] The related PVP Certificate reports a mean number of primary lateral branches of 0.1 with standard deviation of 0.22 and sample size of 20. EX1008, 7.

[18] The related PVP Certificate reports a mean branch angle from central spike of 25 degrees and sample size of 1. EX1008, 7.

[19] The related PVP Certificate reports a mean tassel length (from peduncle node to tassel tip) of 49.1 with standard deviation of 2.04 and sample size of 20. EX1008, 7.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
node to tassel tip) (cm), mean (SE)					
Peduncle Length (from top leaf node to lower branch) (cm), mean (SE)	27.6 (4.57)	23.4 (0.46)	25.7 (5.14)	21.3 (3.74)	22.9 (2.08)
Central Spike Length (cm), mean (SE)	27.2 (1.69)	N/D	29.2 (2.58)	30.9 (3.26)	N/D
Flag Leaf Length (cm) (from flag leaf collar to tassel tip), mean (SE)	43.1 (4.54)	N/D	33.4 (3.71)	36.4 (4.28)	N/D
Pollen Shed (0 = male sterile to 9 = heavy shed)	3	1[20]	8	7	5
Bar Glumes (1 = absent, 2 = present)	1	1	1	1	1
Anther Color	Light Red	Red	Pink	Pale Yellow	Light Red

[20] The related PVP Certificate reports a pollen shed value of 2. EX1008, 7.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
EAR (Unhusked ear)					
Silk Color	Light Red	Light Green	Yellow	Light Red	Light Red
Fresh Husk Color	Light Green	Med. Green	Light Green	Light Green	Med. Green
Dry Husk Color	White	White	White	Buff	Buff
Ear position at dry husk stage (1 = upright, 2 = horizontal, 3 = pedant)	1	1[21]	3	1	1
Husk Tightness (1 = very loose to 9 = very tight)	9	7[22]	4	7	7
Husk Extension (at harvest) (1 = short (ears exposed), 2 = medium (<	3	2	2	2	2

[21] The related PVP Certificate reports an ear position at dry husk stage value of 2. EX1008, 8.

[22] The related PVP Certificate reports a husk tightness value of 8. EX1008, 8.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
8 cm), 3 = long (8-10 cm), 4 = very long (> 10cm))					
Length of Interior Husk (cm), mean (SE)	20.2 (1.11)	N/D	16.9 (2.7)	20.2 (2.84)	N/D
EAR (husked ear data)					
Shank Length (cm), mean (SE)	6.1 (1.33)	8.2 (0.31)[23]	9.1 (1.16)	8.9 (1.79)	8.7 (1.54)
Ear Length (cm), mean (SE)	15.3 (0.89)	15.9 (0.20)[24]	14.1 (1.09)	17 (0.87)	14.9 (1.04)
Ear Diameter at mid-point	40.4 (1.57)	40.3 (0.35)[25]	41.9 (1.56)	36.1 (2.26)	45.0 (1.31)

[23] The related PVP Certificate reports a mean shank length of 9.2 cm with standard deviation of 1.85 and sample size of 20. EX1008, 8.

[24] The related PVP Certificate reports a mean ear length of 15.7 cm with standard deviation of 1.38 and sample size of 20. EX1008, 8.

[25] The related PVP Certificate reports a mean ear diameter at mid-point of 39.7 mm with standard deviation of 0.35 and sample size of 20. EX1008, 8.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
(mm), mean (SE)					
Ear Weight (gm), mean (SE)	126 (15.79)	127.3 (3.06)[26]	121.1 (17.56)	107.8 (25.95)	138.4 (19.23)
Number of Kernel Rows, mean (SE)	14.2 (0.96)	14.6 (0.24)[27]	16.5 (1.12)	14 (1.3)	14.1 (0.70)
Number of Kernels Per Row, mean (SE)	27.2 (2.15)	N/D	27 (4.2)	25.4 (4.85)	N/D
Kernel Rows (1 = indistinct, 2 = distinct)	2	2	2	2	2
Row Alignment (1 = straight, 2 = slightly curved, 3 = spiral)	1	2	1	1	2

[26] The related PVP Certificate reports a mean ear weight of 121.6 gm with standard deviation of 24.79 and sample size of 20. EX1008, 8.

[27] The related PVP Certificate reports a mean number of kernel rows of 14.5 with standard deviation of 1.43 and sample size of 20. EX1008, 8.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
Ear Taper (1 = slight cylindrical, 2 = average, 3 = extreme conical)	1	2	1	1	2
KERNEL (Dried)					
Kernel Length (mm), mean (SE)	10.9 (0.78)	10.9 (0.12)[28]	10.4 (0.59)	8.7 (1.27)	12.3 (0.68)
Kernel Width (mm), mean (SE)	8.3 (0.79)	8.6 (0.11)[29]	7.2 (0.74)	7.5 (0.68)	8.9 (0.70)
Kernel Pericarp Color	Clear	N/D	Clear	Clear	N/D
Aleurone Color Pattern	Homozygous	Homozygous	Homozygous	Homozygous	Homozygous
Aleurone Color	Clear	Yellow	Clear	Clear	Yellow

[28] The related PVP Certificate reports a mean kernel length of 10.8 mm with standard deviation of 0.55 and sample size of 20. EX1008, 8.

[29] The related PVP Certificate reports a mean kernel length of 8.8 mm with standard deviation of 0.55 and sample size of 20. EX1008, 8.

	'545 Patent (PH4CYJ)	**Smalley (PH1KTF)**	**Benson (PH47W4)**	**Longenberger (PH47K2)**	**Anderson (PHE2E)**
Hard Endosperm Color	Yellow-Orange	Yellow	Yellow-Orange	Yellow-Orange	Yellow
Weight per 100 Kernels (unsized sample) (gm), mean (SE)	33.1	[34.0 (2.83)][30]	26.1	24.3	33.8 (1.64)
COB					
Cob Diameter at mid-point (mm), mean (SE)	23.7 (1.2)	24.4 (0.21)[31]	22.5 (1.25)	20.3 (1.37)	23.4 (0.71)
Cob Color	Red	Pink-Orange	White	White	Red

70. Smalley, Benson, and Longenberger likewise disclose that the disclosed inbred lines provide "source[s] of breeding material that may be used to

[30] Weight per 100 Kernels is not provided. EX1005, Table 1. To allow for a comparison, I have provided the information from the related PVP Certificate. EX1008, 8.

[31] The related PVP Certificate reports a mean cob diameter at mid-point of 24.0 mm with standard deviation of 1.08 and sample size of 20. EX1008, 8.

develop new maize inbred varieties." EX1005, 28:36-39; EX1006, 32:32-35; EX1007, 30:41-43.

71. Indeed, as discussed further in paragraph 94 below, the PH1D84 variety disclosed in Smalley was used as the parent for numerous other inbred varieties as confirmed by other PHI patents. The varieties disclosed in Benson and Longenberger have been used as parents of varieties claimed in other patents. Benson is directed to PH47W4, which is identified as a parent in US Patent No. 10,881,064 ("Maize hybrid X13N252"). EX1062. Longenberger is directed to PH47K2, which is identified as a parent in US Patent No. 10,863,705 ("Maize Hybrid X08N769") (EX1060).

72. It should also be noted that the specific measurement outcomes of many of the listed traits of any given inbred line will differ based on environmental conditions the plants are grown in, thus the use of comparative measurements to known lines *under the same conditions* is necessary to differentiate a particular inbred line for many of the traits in Table 1. Accordingly, slight differences in a given trait as reported in the respective Table 1 entries would not be sufficient on their own to distinguish an inbred line for many of the traits—much less to establish unexpected results as compared to the earlier lines.

2. Differences Between the Prior Art and the Claimed Invention

73. From a POSA's perspective, any differences between the prior art and the claimed invention are insubstantial and insignificant. Both the claims and the prior art are directed to stable inbred maize varieties for use in a variety of industrial applications as well as breeding other inbred and/or hybrid lines. Indeed, virtually all of the '545 Patent's specification is drawn verbatim from Benson (as indicated in the above-noted comparison, EX1101) and is also highly similar to the disclosures in Smalley and Longenberger.

74. Moreover, as illustrated in the above table, the disclosed characteristics of the claimed PH4CYJ plant and its associated crop (i.e., corn ears) are highly similar to the disclosed characteristics of the identified prior art maize lines. Simply put, the disclosed properties concerning the claimed PH4CYJ variety fall well within the mainstream of corn phenotypes observed long before the '545 Patent's 7/2/2021 effective filing date, as will become apparent in the following paragraphs 75-85, which include comparisons to both the prior art Smalley (EX1005), Benson (EX1006), and Longenberger (EX1007) patents, as well as comparisons to other similar plant varieties to the claimed PH4CYJ. It should also be noted that a POSA would be familiar with extensive genetic stock collections of corn showing considerable variation with respect to the traits described in

paragraphs 75-85. A POSA would therefore be able to prepare crosses with these and other known varieties to achieve variations in the traits.

75. I will now address the characteristics set forth in Table 1 "Variety Description Information" of the '545 Patent as compared to the corresponding data for Smalley, Benson, and Longenberger, shown in the table above at paragraph 69, as well as compared to the corresponding data in various prior art varieties as discussed in paragraph 94 below. As an initial matter, however, I note (as also discussed in paragraph 72 above) that the data for each variety is not directly comparable given the potentially different environmental conditions in which the varieties were grown. Unlike earlier PHI patents (as discussed in more detail in Section X.A below), the '545 Patent lacks any head-to-head data such as strip test data permitting such comparisons.

76. Grain type, dent for the '545 Patent, is the same as that reported for the sibling Benson and many prior art varieties:

TYPE:	**Compared to Smalley, Benson, Longenberger**	**Prior art Varieties[32]**
Grain Texture (Dent)	Same as Benson and Longenberger.	Smalley (PH1KTF) - Flint Benson (PH47WF) - Dent Longenberger (PH47K2) - Dent

[32] In the charts in paragraphs 76-85, varieties are omitted where data for criteria is not available in the patent.

		8,563,836 (PH1CJ6) – Dent-Flint 10,687,499 (PH47SK) - Dent 9,549,515 (PH25RT) - Dent 10,405,509 (PH2SNA) - Dent 10,694,700 (PH25RN) - Dent 8,907,160 (PH1V5T) - Dent 10,219,469 (PH435M) - Dent 9,894,864 (PH2CV9) - Dent 9,992,952 (PH2R6R) – Flint-Dent 10,264,751 (PH2RA2) – Flint-Dent 9,848,571 (PH2RK6) – Flint-Dent

77. The designation "dent" indicates grain having dent characteristics. The parent (Smalley's PH1KTF) has flint grain, whereas the sibling that shares the same parent PH1KTF (Benson's PH47W4; Benson, 39:5) has dent grain. Accordingly, a cross of PH1KTF and another parent may be dent. Therefore, PH4CYJ's dent grain would have been an expected and obvious result. Finally, Longenberger also discloses the dent grain as the '545 patent.

78. The "Maturity" section addresses criteria related to the time to various stages observed for the line. The emergence to various stages of maturity is highly dependent on a number of factors including: the geographic location where the samples were planted, the soil conditions at the site, the weather conditions prevailing that season, and when within the season the crop was planted. But the '545 Patent does not disclose such factors or even other data from which one could determine them (e.g., the location and growing season where the plants reflected in the table were grown nor the performance of other reference materials under the

conditions where data was collected). As a result, the "Maturity" information presented in the '545 Patent, presented alone and without any comparative data, does not permit a definitive conclusion as to whether any of the results is significantly different from any other. Nonetheless, the results for PH4CYJ for most of the criteria falls within the range established by Smalley, Benson, and Longenberger and certainly falls within the range of easily deliverable performance from a range of parental source materials. Accordingly, the Maturity data is not unexpected as compared to the data reported in Smalley, Benson, and Longenberger. Additionally, the values for PH4CYJ also fall within the range reported for other prior art varieties, as shown in the table below.

MATURITY:	**Compared to Smalley, Benson, Longenberger**	**Prior Art Varieties**
Comparative Relative Maturity (Days) (111)	Similar to Benson (111 days) and Longenberger (108 days), and Smalley do not report.	Benson (PH47WF) - 111 Longenberger (PH47K2) - 108 8,563,836 (PH1CJ6) – N/D 10,687,499 (PH47SK) - 110 9,549,515 (PH25RT) – N/D 10,405,509 (PH2SNA) - 103 10,694,700 (PH25RN) - 101 8,907,160 (PH1V5T) – N/D 10,219,469 (PH435M) - 97 9,894,864 (PH2CV9) – 115 9,992,952 (PH2R6R) - 114 10,264,751 (PH2RA2) – 113 9,848,571 (PH2RK6) – 112

Emergence to 50% of plants in silk (days) (55)	Within range of Smalley, Benson Longenberger	Smalley (PH1KTF) - 62 Benson (PH47WF) - 52 Longenberger (PH47K2) - 51 8,563,836 (PH1CJ6) - 66 10,687,499 (PH47SK) - 52 9,549,515 (PH25RT) - 54 10,405,509 (PH2SNA) - 60 10,694,700 (PH25RN) - 47 8,907,160 (PH1V5T) - 62 10,219,469 (PH435M) - 57 9,894,864 (PH2CV9) - 63 9,992,952 (PH2R6R) - 68 10,264,751 (PH2RA2) – 63 9,848,571 (PH2RK6) – 63
Emergence to 50% of plants in silk (heat units) (1348)	Most similar to Benson (1325)	Smalley (PH1KTF) – 1279.5 Benson (PH47WF) - 1325 Longenberger (PH47K2) - 1299 8,563,836 (PH1CJ6) - 1350 10,687,499 (PH47SK) - 1325 9,549,515 (PH25RT) – 1231 10,405,509 (PH2SNA) - 1272 10,694,700 (PH25RN) - 1183 8,907,160 (PH1V5T) - 1349 10,219,469 (PH435M) - 1183 9,894,864 (PH2CV9) - 1352 9,992,952 (PH2R6R) - 1492 10,264,751 (PH2RA2) – 1363 9,848,571 (PH2RK6) –1352
Emergence to 50% of plants in pollen shed (days) (54)	Within range of Smalley, Benson, Longenberger	Smalley (PH1KTF) - 61 Benson (PH47WF) - 52 Longenberger (PH47K2) - 52 8,563,836 (PH1CJ6) - 67 10,687,499 (PH47SK) – 53 9,549,515 (PH25RT) – 55 10,405,509 (PH2SNA) - 61 10,694,700 (PH25RN) - 48 8,907,160 (PH1V5T) - 62 10,219,469 (PH435M) - 58 9,894,864 (PH2CV9) - 65 9,992,952 (PH2R6R) - 67

		10,264,751 (PH2RA2) – 65 9,848,571 (PH2RK6) – 65
Emergence to 50% of plants in pollen shed (heat units) (1325)	Similar to Benson (1325), Longenberger (1325)	Smalley (PH1KTF) - 1264 Benson (PH47WF) – 1325 Longenberger (PH47K2) - 1325 8,563,836 (PH1CJ6) - 1382 10,687,499 (PH47SK) - 1352 9,549,515 (PH25RT) - 1253 10,405,509 (PH2SNA) - 1302 10,694,700 (PH25RN) - 1212 8,907,160 (PH1V5T) - 1349 10,219,469 (PH435M) - 1212 9,894,864 (PH2CV9) - 1402 9,992,952 (PH2R6R) - 1462 10,264,751 (PH2RA2) –1409 9,848,571 (PH2RK6) – 1402

79. The next category "Plant" includes characteristics related to the corn plant. Each of these characteristics falls within the range established by Smalley, Benson, and Longenberger, or is similar to one or more of them. Additionally, the values for PH4CYJ also fall within the range reported for sibling varieties or are similar to them, as shown in the table below. Additionally, the values for PH4CYJ also fall within the range reported for other prior art varieties, as shown in the table below. I note that length of top ear internode for PH4CYJ is slightly shorter than Smalley, Benson, and Longenberger. However, the standard error for the measurement of 0.95, which means that values for Smalley falls within the 95% confidence interval for this characteristic (i.e., ±1.96xSE), which is 11.4 cm to 15.2 cm, as discussed below at paragraphs 86-92. Additionally, the value given for PH4CYJ's length of top ear internode falls within the range of the other prior art

varieties. I note that the plant height (213.3 cm) is taller than Smalley, Benson, and Longenberger, but that each of the heights falls within the 95% confidence interval for plant height, which is 190.1 cm to 236.5 cm. *See* Appendix B. Additionally, the value given for PH4CYJ's mean plant height falls within the range of the other prior art varieties. Ear length and length of top ear internode are also dependent on the environmental conditions under which the plant is grown. Length of top ear internode also has minimal commercial significance, at least within the range of measurements presented here. Brace root anthocyanin refers to pigmentation levels in a portion of corn's root system. *See* EX1034, Merriam-Webster, 52 (definition of "anthocyanin" "any of various soluble glycoside pigments producing blue to red coloring in flowers and plants"). Specifically:

PLANT:	**Compared to Smalley, Benson, Longenberger**	**Prior Art Varieties**
Plant height (cm), mean (SE) (213.3 (11.86))	Most similar to Benson (211.4 (7.41)	Smalley (PH1KTF) - 194.9 (1.47) Benson (PH47WF) – 211.4 (7.41) Longenberger (PH47K2) – 207 (6.1) 8,563,836 (PH1CJ6) – 198.7 (7.48) 10,687,499 (PH47SK) – 204.4 (5.33) 9,549,515 (PH25RT) – 207.5 (17.99) 10,405,509 (PH2SNA) – 214.4 (2.11) 10,694,700 (PH25RN) – 183.1 (9.76) 8,907,160 (PH1V5T) – 182.5 (6.25) 10,219,469 (PH435M) – 213.5 (4.01) 9,894,864 (PH2CV9) – 235.6 (12.92) 9,992,952 (PH2R6R) – 248.3 (4.82) 10,264,751 (PH2RA2) – 229.8 (9.45)

		9,848,571 (PH2RK6) – 235.4 (5.83)
Ear height (cm), mean (SE) (-1std) (72.3 (10.78))	Within range of Smalley, Benson, Longenberger	Smalley (PH1KTF) – 62.9 (1.24) Benson (PH47WF) – 78 (3.83) Longenberger (PH47K2) – 75.1 (9.31) 8,563,836 (PH1CJ6) – 61.8 (6.04) 10,687,499 (PH47SK) – 77.4 (6.14) 9,549,515 (PH25RT) – 75.7 (8.24) 10,405,509 (PH2SNA) – 91 (9.7) 10,694,700 (PH25RN) – 81.2 (6.72) 8,907,160 (PH1V5T) – 62.3 (6.1) 10,219,469 (PH435M) – 79.9 (11.17) 9,894,864 (PH2CV9) – 98.7 (9.63) 9,992,952 (PH2R6R) – 101.1 (5.01) 10,264,751 (PH2RA2) – 89.3 (5.35) 9,848,571 (PH2RK6) – 88.7 (4.57)
Length of top ear internode (cm), mean (SE) (13.3 (0.95))	Most similar to Smalley (15.1(0.22) cm)	Smalley (PH1KTF) – 15.1(0.22) Benson (PH47WF) – 17 (2.53) Longenberger (PH47K2) – 16.7 (1.98) 8,563,836 (PH1CJ6) – 14.1 (1.71) 10,687,499 (PH47SK) – 17.2 (0.91) 9,549,515 (PH25RT) – 12.6 (1.05) 10,405,509 (PH2SNA) – 17 (1.63) 10,694,700 (PH25RN) – 17.2 (1.46) 8,907,160 (PH1V5T) – 12.7 (1.35) 10,219,469 (PH435M) – 19.7 (0.91) 9,894,864 (PH2CV9) – 16.1 (0.77) 9,992,952 (PH2R6R) – 16.7 (1.1) 10,264,751 (PH2RA2) – 13.6 (2.11) 9,848,571 (PH2RK6) – 15.3 (1.73)
Number of nodes above ground, mean (SE) (12.9 (1.41))	Not reported in Smalley, within range of Benson and Longenberger.	Smalley (PH1KTF) – N/D Benson (PH47WF) – 13.2 (1.11) Longenberger (PH47K2) – 11.9 (0.77) 8,563,836 (PH1CJ6) – N/D 10,687,499 (PH47SK) – 11.3 (0.7) 9,549,515 (PH25RT) – 13.5 (0.69) 10,405,509 (PH2SNA) – 12 (0) 10,694,700 (PH25RN) – 13.8 (0.81) 8,907,160 (PH1V5T) – 13.6 (0.77) 10,219,469 (PH435M) – 12.3 (0.77) 9,894,864 (PH2CV9) – 15 (1.02)

		9,992,952 (PH2R6R) – 13 (0.67) 10,264,751 (PH2RA2) – 13.4 (0.73) 9,848,571 (PH2RK6) – 12.9 (0.54)
Anthocyanin of Brace Roots (1 = absent, 2 = faint, 3 = moderate, 4 = dark) (2)	Same as Smalley, Longenberger.	Smalley (PH1KTF) - 2 Benson (PH47WF) – 1 Longenberger (PH47K2) - 2 8,563,836 (PH1CJ6) - 4 10,687,499 (PH47SK) - 2 9,549,515 (PH25RT) - 2 10,405,509 (PH2SNA) - 2 10,694,700 (PH25RN) - 1 8,907,160 (PH1V5T) - 2 10,219,469 (PH435M) - 4 9,894,864 (PH2CV9) - 2 9,992,952 (PH2R6R) - 2 10,264,751 (PH2RA2) – 2 9,848,571 (PH2RK6) – 1

80. The next category "Leaf" includes characteristics related to the corn plant's leaves. Each of these characteristics falls within or is similar to the range established by Smalley, Benson, and Longenberger and other prior art varieties. For example, PH4CYJ's width of ear node leaf is similar to Longenberger's 9.3 cm. Moreover, since PH4CYJ's value is reported with a standard error of 0.83, the Smalley measurement falls within the 95% confidence interval for this value, as do the Benson value. Similarly, for length of ear node leaf, PH4CYJ's 84.3 cm is similar to Longenberger's 83.9 cm, and Smalley's 75.5 cm and Benson's 87 cm fall within the 95% confidence interval for PH4CYJ's value and is within the range reported for other prior art varieties. Also similarly, for leaf angle, PH4CYJ's 35.5 degrees is similar to Benson's 34.3 degrees. Since PH4CYJ's value is reported

with a standard error of 6.87, Smalley's 22.5 degrees and Longenberger's 26.3 degrees fall within the 95% confidence interval for PH4CYJ's value and is within the range reported for other prior art varieties. Leaf angle is also dependent on environmental conditions. EX1064 ("Previous research has shown that corn plants can alter their leaf angle in response to their environment."). In particular, leaf angle tends to be more upright when the plants are planted more densely. Id. Finally, for leaf sheath pubescence, while PH4CYJ's value (7) is higher than the values of Smalley, Benson, and Longenberger, it is within the range reported for other prior art varieties. Additionally, leaf sheath pubescence is not a unique trait or a trait of perceived value in the marketplace. The value is assigned based on a qualitative assessment by an observer. There can also be errors in estimation of this trait based on the skill and alertness of the individual making the assessment. *See, e.g.,* EX1009, 7 ("Rate on scale from 1 = none to 9 = like peach fuzz"). Specifically:

LEAF:	**Compared to Smalley, Benson, Longenberger**	**Prior Art Varieties**
Width of Ear Node Leaf (cm), mean (SE) (9.1 (0.83))	Most similar to Longenberger (9.3 cm).	Smalley (PH1KTF) – 9.5 (0.10) Benson (PH47WF) – 10.2 (0.65) Longenberger (PH47K2) – 9.3 (0.62) 8,563,836 (PH1CJ6) – 9.2 (0.65) 10,687,499 (PH47SK) – 9.9 (0.57) 9,549,515 (PH25RT) – 7.2 (0.41) 10,405,509 (PH2SNA) – 9.3 (0.54)

		10,694,700 (PH25RN) – 8.7 (0.48) 8,907,160 (PH1V5T) – 10.2 (0.89) 10,219,469 (PH435M) – 8.2 (0.4) 9,894,864 (PH2CV9) – 9.7 (0.48) 9,992,952 (PH2R6R) – 9.7 (0.48) 10,264,751 (PH2RA2) – 8.7 (0.65) 9,848,571 (PH2RK6) – 8.5 (0.67)
Length of ear node leaf (cm), mean (SE) (84.3 (4.89))	Most similar to Longenberger (83.9 cm)	Smalley (PH1KTF) – 75.5 (0.54) Benson (PH47WF) – 87 (2.29) Longenberger (PH47K2) – 83.9 (4.7) 8,563,836 (PH1CJ6) – 77.2 (3.17) 10,687,499 (PH47SK) – 81.3 (3.81) 9,549,515 (PH25RT) – 74.3 (3.18) 10,405,509 (PH2SNA) – 79.6 (2.11) 10,694,700 (PH25RN) – 84.7 (2.35) 8,907,160 (PH1V5T) – 69.4 (3.12) 10,219,469 (PH435M) – 75.6 (2.5) 9,894,864 (PH2CV9) – 86.1 (1.28) 9,992,952 (PH2R6R) – 95.2 (3.44) 10,264,751 (PH2RA2) – 93.2 (5.37) 9,848,571 (PH2RK6) – 93.7 (3.9)
Number of leaves above top ear, mean (SE) (6.1 (0.92))	Within range of Smalley, Longenberger, Hoffbeck	Smalley (PH1KTF) – 6.3 (0.09) Benson (PH47WF) – 7.3 (0.94) Longenberger (PH47K2) – 5.9 (0.85) 8,563,836 (PH1CJ6) – 5.7 (0.75) 10,687,499 (PH47SK) – 6.2 (0.68) 9,549,515 (PH25RT) – 6.2 (0.52) 10,405,509 (PH2SNA) – 5.4 (0.48) 10,694,700 (PH25RN) – 5.2 (0.49) 8,907,160 (PH1V5T) – 5.3 (0.57) 10,219,469 (PH435M) – 5.5 (0.5) 9,894,864 (PH2CV9) – 6.4 (0.57) 9,992,952 (PH2R6R) – 5.1 (0.44) 10,264,751 (PH2RA2) – 6.5 (0.67) 9,848,571 (PH2RK6) – 5.7 (0.48)
Leaf Angle (degrees), mean (SE) (35.5 (6.87))	Most similar to Benson (34.3 degrees)	Smalley (PH1KTF) – 22.5 (0.64) Benson (PH47WF) – 34.3 (6.57) Longenberger (PH47K2) – 26.3 (4.44) 8,563,836 (PH1CJ6) – 25.3 (4.99) 10,687,499 (PH47SK) – 28 (6)

		9,549,515 (PH25RT) – 21.1 (4.01) 10,405,509 (PH2SNA) – 28.8 (6.87) 10,694,700 (PH25RN) – 36.5 (7.76) 8,907,160 (PH1V5T) – 33 (4.31) 10,219,469 (PH435M) – 26 (5.61) 9,894,864 (PH2CV9) – 23.7 (2.33) 9,992,952 (PH2R6R) – 26.9 (2.89) 10,264,751 (PH2RA2) –25.1 (3.46) 9,848,571 (PH2RK6) – 22.6 (3.51)
Leaf Color (V. Dark Green)	Same as Smalley, Benson, Longenberger	Smalley (PH1KTF) – V. Dark Green Benson (PH47WF) – V. Dark Green Longenberger (PH47K2) – V. Dark Green 8,563,836 (PH1CJ6) – V. Dark Green 10,687,499 (PH47SK) – V. Dark Green 9,549,515 (PH25RT) – V. Dark Green 10,405,509 (PH2SNA) – V. Dark Green 10,694,700 (PH25RN) – V. Dark Green 8,907,160 (PH1V5T) – V. Dark Green 10,219,469 (PH435M) – V. Dark Green 9,894,864 (PH2CV9) – V. Dark Green 9,992,952 (PH2R6R) – V. Dark Green 10,264,751 (PH2RA2) – V. Dark Green 9,848,571 (PH2RK6) – V. Dark Green
Leaf Sheath Pubescence (1 - none to 9 - peach-like fuzz) (7)	Within range reported for prior art varieties.	Smalley (PH1KTF) - 2 Benson (PH47WF) - 2 Longenberger (PH47K2) - 4 8,563,836 (PH1CJ6) - 8 10,687,499 (PH47SK) - 3 9,549,515 (PH25RT) - 6 10,405,509 (PH2SNA) - 4 10,694,700 (PH25RN) - 7 8,907,160 (PH1V5T) - 4 10,219,469 (PH435M) - 2 9,894,864 (PH2CV9) - 8 9,992,952 (PH2R6R) - 3 10,264,751 (PH2RA2) – 1 9,848,571 (PH2RK6) – 7

81. The next category "Tassel" includes characteristics related to the corn tassel. Each of these characteristics falls within or is similar to the range established by Smalley, Benson, and Longenberger, as well as the other sibling varieties (i.e., aside from Benson). For example, PH4CYJ's number of primary lateral branches is 2 and with a reported standard error of 1.3. Smalley's 0.00 value and Benson's 0.4 value fall within the 95% confidence interval for PH4CYJ's value. Additionally, PH4CYJ's peduncle length is 27.6 cm and with a reported standard error of 4.57. Smalley's 23.4 cm value and Longenberger's 22.7 cm value fall within the 95% confidence interval for PH4CYJ's value. For flag leaf length, PH4CYJ's value is 43.1 cm with a reported standard error of 4.54 and Benson's value is 33.4 cm with a standard error of 4.28. The 95% confidence interval for PH4CYJ's value and Benson's value overlap. I also note that larger flag leaves on inbred plants are not generally considered to be favorable as they can interfere with pollen shed/disbursement when an inbred is used as a male (or in parental seed increases) and when an inbred is used as a female they can result in increased (and undesirable) self-fertilization if tassels are covered by the flag leaf and not identified and removed during detasseling for hybrid seed production. As for anther color, while the anther color of PH4CYJ is light red, and seemingly different from that of Smalley, Benson, and Longenberger, there are other prior art varieties with the same anther color as PH4CYJ. Additionally, the difference

could be an interpretation of the individual taking the measurements or impact of sunlight conditions. Anther color is not of known value and the anthocyanin to make the color can be lacking or, alternatively, increased under some conditions. Specifically:

TASSEL:	**Compared to Smalley, Benson, Longenberger**	**Prior Art Varieties**
Number of primary lateral branches, mean (SE) (2 (1.3))	Most similar to Longenberger (1.5) and within range prior art varieties	Smalley (PH1KTF) – 0.0 (0.24) Benson (PH47WF) – 0.4 (0.58) Longenberger (PH47K2) – 1.5 (1.24) 8,563,836 (PH1CJ6) – 2.2 (1.26) 10,687,499 (PH47SK) – 5.4 (1.5) 9,549,515 (PH25RT) – 1.1 (0.89) 10,405,509 (PH2SNA) – 13.8 (2.79) 10,694,700 (PH25RN) – 11.3 (3.02) 8,907,160 (PH1V5T) – 8.2 (2.24) 10,219,469 (PH435M) – 9 (1.92) 9,894,864 (PH2CV9) – 3.7 (1.31) 9,992,952 (PH2R6R) – 7.7 (1.1) 10,264,751 (PH2RA2) – 3.7 (0.78) 9,848,571 (PH2RK6) – 11.2 (1.66)
Branch angle from central spike (degrees), mean (SE) (18.3 (9.57))	Within range of Smalley, Benson, Longenberger	Smalley (PH1KTF) – 27.5 (5.70) Benson (PH47WF) – 15 (5.35) Longenberger (PH47K2) – 38.9 (18.73) 8,563,836 (PH1CJ6) – 37.4 (10.77) 10,687,499 (PH47SK) – 11.5 (3.91) 9,549,515 (PH25RT) – 22.7 (7.96) 10,405,509 (PH2SNA) – 15.3 (6.8) 10,694,700 (PH25RN) – 14.5 (5.68) 8,907,160 (PH1V5T) – 39 (16.72) 10,219,469 (PH435M) – 38.5 (7.26) 9,894,864 (PH2CV9) – 29.3 (10.92) 9,992,952 (PH2R6R) – 41.2 (11.03) 10,264,751 (PH2RA2) – 35.5 (7.89) 9,848,571 (PH2RK6) – 8.5 (6.04)

Tassel Length (from peduncle node to tassel tip) (cm), mean (SE) (57.6 (4.15))	Most similar to Longenberger (56.5 cm) and within range of Smalley, Benson, Longenberger	Smalley (PH1KTF) – 51.9 (0.60) Benson (PH47WF) – 58.8 (5.57) Longenberger (PH47K2) – 56.5 (4.59) 8,563,836 (PH1CJ6) – 54.7 (2.76) 10,687,499 (PH47SK) – 51.6 (4.23) 9,549,515 (PH25RT) – 54.2 (2.28) 10,405,509 (PH2SNA) – 59.9 (3.39) 10,694,700 (PH25RN) – 58.2 (3.21) 8,907,160 (PH1V5T) – 52.2 (4.38) 10,219,469 (PH435M) – 53.6 (3.89) 9,894,864 (PH2CV9) – 52.9 (5.68) 9,992,952 (PH2R6R) – 60.3 (5.41) 10,264,751 (PH2RA2) – 55.3 (4.21) 9,848,571 (PH2RK6) – 51.5 (3.07)
Peduncle Length (from top leaf node to lower branch) (cm), mean (SE) (27.6 (4.57))	Most similar to Benson (25.7 cm)	Smalley (PH1KTF) – 23.4 (0.46) Benson (PH47WF) – 25.7 (5.14) Longenberger (PH47K2) – 21.3 (3.74) 8,563,836 (PH1CJ6) – 25.5 (2.31) 10,687,499 (PH47SK) – 22.7 (4.33) 9,549,515 (PH25RT) – 21.4 (1.79) 10,405,509 (PH2SNA) – 26.1 (3.04) 10,694,700 (PH25RN) – 22.9 (3.17) 8,907,160 (PH1V5T) – 19.1 (2.7) 10,219,469 (PH435M) – 14.4 (0.79) 9,894,864 (PH2CV9) – 15.1 (1.92) 9,992,952 (PH2R6R) –16.2 (0.91) 10,264,751 (PH2RA2) –24.8 (2.8) 9,848,571 (PH2RK6) – 13.5 (1.12)
Central Spike Length (cm), mean (SE) (27.2 (1.69))	Similar to Benson (29.2 cm). Not reported in Smalley.	Smalley (PH1KTF) – N/D Benson (PH47WF) – 29.2 (2.58) Longenberger (PH47K2) – 30.9 (3.26) 8,563,836 (PH1CJ6) – N/D 10,687,499 (PH47SK) – 26.9 (3.03) 9,549,515 (PH25RT) – 29.6 (1.9) 10,405,509 (PH2SNA) – 22.6 (1.59) 10,694,700 (PH25RN) – 23.5 (2.25) 8,907,160 (PH1V5T) -26 (2.99) 10,219,469 (PH435M) – 25.8 (1.81) 9,894,864 (PH2CV9) – 23 (2.67) 9,992,952 (PH2R6R) – 31.6 (3.09)

		10,264,751 (PH2RA2) – 21 (1.3) 9,848,571 (PH2RK6) – 23 (2.81)
Flag Leaf Length (from flag leaf collar to tassel tip) (cm), mean (SE) (43.1 (4.54))	Within range of prior art varieties.	Smalley (PH1KTF) – N/D Benson (PH47WF) – 33.4 (3.71) Longenberger (PH47K2) – 36.4 (4.28) 8,563,836 (PH1CJ6) – N/D 10,687,499 (PH47SK) – 31.1 (2.83) 9,549,515 (PH25RT) – 39.5 (2.44) 10,405,509 (PH2SNA) – 46.4 (2.26) 10,694,700 (PH25RN) –44.2 (2.93) 8,907,160 (PH1V5T) – 39 (3.35) 10,219,469 (PH435M) –39.6 (3.17) 9,894,864 (PH2CV9) – 39.5 (4.69) 9,992,952 (PH2R6R) – 44.8 (3.44) 10,264,751 (PH2RA2) – 40.2 (3.66) 9,848,571 (PH2RK6) – 38.5 (2.92)
Pollen Shed (0 - male sterile, 9 - heavy shed) (3)	Within range of Smalley, Benson, Longenberger, and prior art varieties	Smalley (PH1KTF) - 1 Benson (PH47WF) - 8 Longenberger (PH47K2) - 7 8,563,836 (PH1CJ6) - 3 10,687,499 (PH47SK) - 5 9,549,515 (PH25RT) - 4 10,405,509 (PH2SNA) - 6 10,694,700 (PH25RN) - 7 8,907,160 (PH1V5T) - 7 10,219,469 (PH435M) - 1 9,894,864 (PH2CV9) - 5 9,992,952 (PH2R6R) - 7 10,264,751 (PH2RA2) – 1 9,848,571 (PH2RK6) – 7
Bar Glumes (glume bands) (1 = absent, 2 = present) (1)	Same as Smalley, Benson, Longenberger	Smalley (PH1KTF) - 1 Benson (PH47WF) - 1 Longenberger (PH47K2) - 1 8,563,836 (PH1CJ6) - 1 10,687,499 (PH47SK) - 1 9,549,515 (PH25RT) - 1 10,405,509 (PH2SNA) - 1 10,694,700 (PH25RN) - 1 8,907,160 (PH1V5T) - 1 10,219,469 (PH435M) – N/D

		9,894,864 (PH2CV9) – N/D 9,992,952 (PH2R6R) – N/D 10,264,751 (PH2RA2) – 1 9,848,571 (PH2RK6) – N/D
Anther Color (Light Red)	Most similar to Benson (Pink)	Smalley (PH1KTF) - Red Benson (PH47WF) - Pink Longenberger (PH47K2) – Pale Yellow 8,563,836 (PH1CJ6) - Red 10,687,499 (PH47SK) – Pale Yellow 9,549,515 (PH25RT) - Pink-Orange 10,405,509 (PH2SNA) – Pale Yellow 10,694,700 (PH25RN) – Pale Yellow 8,907,160 (PH1V5T) – Green Yellow 10,219,469 (PH435M) – Light Red 9,894,864 (PH2CV9) – Green Yellow 9,992,952 (PH2R6R) – Pale Yellow 10,264,751 (PH2RA2) – Pale Yellow

82. The next category "Ear (Unhusked ear)" includes characteristics related to the unhusked corn ear. Each of these characteristics falls within or is similar to the range established by Smalley, Benson, Longenberger, and other prior art varieties. PH4CYJ's husk tightness value is 9 and husk extension value is 3, which are within range of prior art varieties, though the values are higher than that of Smalley, Benson, and Longenberger. These differences (like many other differences of PH4CYJ) can be the result of many factors, including reduced vigor of the line, different stress conditions, and/or timing of data collection. For example, if the corn ear does not fill out well or if ear traits (kernel rows, kernels per row, etc.) are reduced, the ear is more likely to have more husk cover. Additionally, if the data was taken early in the season, husk tightness is usually

high, (e.g., a 9) for all varieties. Overall, the differences in the husk tightness and husk extension values do not reflect an unexpected result from the perspective of a POSA. I also note that husk tightness and extension may be affected by the environmental conditions in which the plant is grown and are qualitative traits that are subject to interpretation. It is not apparent that there are any significant differences in such qualitative and environmentally-affected traits because the '545 Patent lacks trial comparative data relative to other inbreds of stated characteristics for these traits, which would be needed to reach a meaningful conclusion. Specifically:

EAR (Unhusked ear):	**Compared to Smalley, Benson, Longenberger**	**Prior Art Varieties**
Silk Color (Light Red)	Same as Longenberger.	Smalley (PH1KTF) – Light Green Benson (PH47WF) - Yellow Longenberger (PH47K2) – Light Red 8,563,836 (PH1CJ6) - Red 10,687,499 (PH47SK) – Pale Yellow 9,549,515 (PH25RT) - Light Red 10,405,509 (PH2SNA) – Light Green 10,694,700 (PH25RN) – Light Green 8,907,160 (PH1V5T) - Pink 10,219,469 (PH435M) - Red 9,894,864 (PH2CV9) - Pink 9,992,952 (PH2R6R) – Light Green 10,264,751 (PH2RA2) – Light Green 9,848,571 (PH2RK6) – Light Green
Fresh Husk Color (Light Green)	Same as Benson and Longenberger.	Smalley (PH1KTF) – Med. Green Benson (PH47WF) – Light Green Longenberger (PH47K2) – Light Green

		8,563,836 (PH1CJ6) – Med. Green 10,687,499 (PH47SK) – Med. Green 9,549,515 (PH25RT) – Med. Green 10,405,509 (PH2SNA) – Med. Green 10,694,700 (PH25RN) – Light Green 8,907,160 (PH1V5T) – Med. Green 10,219,469 (PH435M) – Med. Green 9,894,864 (PH2CV9) – Med. Green 9,992,952 (PH2R6R) – Light Green 10,264,751 (PH2RA2) – Light Green 9,848,571 (PH2RK6) – Med. Green
Dry Husk Color (White)	Same as Smalley and Benson.	Smalley (PH1KTF) - White Benson (PH47WF) - White Longenberger (PH47K2) - Buff 8,563,836 (PH1CJ6) - White 10,687,499 (PH47SK) - White 9,549,515 (PH25RT) - White 10,405,509 (PH2SNA) - White 10,694,700 (PH25RN) - White 8,907,160 (PH1V5T) - White 10,219,469 (PH435M) - Buff 9,894,864 (PH2CV9) - Buff 9,992,952 (PH2R6R) - Buff 10,264,751 (PH2RA2) –White 9,848,571 (PH2RK6) – Buff
Ear position at dry husk stage (1 = upright, 2 = horizontal, 3 = pedant) (1)	Same as Smalley and Longenberger.	Smalley (PH1KTF) - 1 Benson (PH47WF) - 3 Longenberger (PH47K2) - 1 8,563,836 (PH1CJ6) - 2 10,687,499 (PH47SK) - 3 9,549,515 (PH25RT) - 2 10,405,509 (PH2SNA) - 1 10,694,700 (PH25RN) - 1 8,907,160 (PH1V5T) - 1 10,219,469 (PH435M) - 1 9,894,864 (PH2CV9) - 1 9,992,952 (PH2R6R) - 1 10,264,751 (PH2RA2) – 1 9,848,571 (PH2RK6) – 1

Husk Tightness (1 - very loose, 9 - very tight) (9)	Most similar to Smalley (7) and within range of prior art varieties.	Smalley (PH1KTF) - 7 Benson (PH47WF) - 4 Longenberger (PH47K2) - 7 8,563,836 (PH1CJ6) - 2 10,687,499 (PH47SK) - 5 9,549,515 (PH25RT) - 7 10,405,509 (PH2SNA) - 5 10,694,700 (PH25RN) - 7 8,907,160 (PH1V5T) - 2 10,219,469 (PH435M) - 5 9,894,864 (PH2CV9) - 9 9,992,952 (PH2R6R) - 9 10,264,751 (PH2RA2) – 8 9,848,571 (PH2RK6) – 7
Husk Extension (at harvest) (1 = short, ear exposed; 2 = medium, <8cm; 3 = long, 8-10cm; 4 = very long, >10cm) (3)	Similar as Smally, Benson Longenberger, and within range of prior art varieties	Smalley (PH1KTF) – 2 Benson (PH47WF) - 2 Longenberger (PH47K2) - 2 8,563,836 (PH1CJ6) - 2 10,687,499 (PH47SK) - 2 9,549,515 (PH25RT) - 2 10,405,509 (PH2SNA) - 2 10,694,700 (PH25RN) - 2 8,907,160 (PH1V5T) – N/D 10,219,469 (PH435M) – 2 9,894,864 (PH2CV9) – N/D 9,992,952 (PH2R6R) - 4 10,264,751 (PH2RA2) – 3
Length of interior husk (cm), mean (SE) (20.2 (1.11))	Most similar to Longenberger (20.2 cm).	Smalley (PH1KTF) – N/D Benson (PH47WF) – 16.9 (2.7) Longenberger (PH47K2) – 20.2 (2.84) 8,563,836 (PH1CJ6) – N/D 10,687,499 (PH47SK) – 19 (2) 9,549,515 (PH25RT) – 20.5 (0.92) 10,405,509 (PH2SNA) – 22 (0.93) 10,694,700 (PH25RN) – 20.4 (1.54) 8,907,160 (PH1V5T) – 21.3 (1.33) 10,219,469 (PH435M) – 19 (0.69) 9,894,864 (PH2CV9) – 22.6 (1.06) 9,992,952 (PH2R6R) –27 (1.05) 10,264,751 (PH2RA2) –14.6 (1.44)

		9,848,571 (PH2RK6) – 21.5 (0.65)

83. The next category "Ear (husked ear data)" includes characteristics related to the husked corn ear. Each of these characteristics falls within or is similar to the range established by Smalley, Benson, Longenberger, and the prior art varieties. For example, PH4CYJ's ear length is within range of the ear length value of Smalley, Benson, and Longenberger. Additionally, PH4CYJ's shank length has a value of 6.1 cm with a reported standard error of 1.33. Smalley's 8.2 cm shank length value falls within the 95% confidence interval for PH4CYJ's value. Benson's 9.1 cm shank length value has a reported standard error of 1.16, and the 95% confidence interval for PH4CYJ's value overlap with the 95% confidence interval for Benson's value. The shank length of value of PH4CYJ does not reflect an unexpected result from the perspective of a POSA. Specifically:

EAR (husked ear data):	**Compared to Smalley, Benson, Longenberger**	**Prior Art Varieties**
Shank Length (cm), mean (SE) (6.1 (1.33))	Within range of prior art varieties.	Smalley (PH1KTF) – 8.2 (0.31) Benson (PH47WF) – 9.1 (1.16) Longenberger (PH47K2) – 8.9 (1.79) 8,563,836 (PH1CJ6) – 9.7 (1.74) 10,687,499 (PH47SK) – 9 (1.43) 9,549,515 (PH25RT) – 11.9 (3.24) 10,405,509 (PH2SNA) – 9.8 (1.32) 10,694,700 (PH25RN) – 12.8 (4.94)

		8,907,160 (PH1V5T) – 11.7 (2.68) 10,219,469 (PH435M) – 8.9 (1.52) 9,894,864 (PH2CV9) – 6.8 (1.23) 9,992,952 (PH2R6R) – 9.4 (1.13) 10,264,751 (PH2RA2) – 5.9 (0.98) 9,848,571 (PH2RK6) – 9.9 (1.82)
Ear Length (cm), mean (SE) (15.3 (0.89))	Within range of Smalley, Benson, Longenberger	Smalley (PH1KTF) – 15.9 (0.20) Benson (PH47WF) – 14.1 (1.09) Longenberger (PH47K2) – 17 (0.87) 8,563,836 (PH1CJ6) – 15.2 (0.79) 10,687,499 (PH47SK) – 15.8 (1.05) 9,549,515 (PH25RT) – 15.1 (0.66) 10,405,509 (PH2SNA) – 17.6 (0.61) 10,694,700 (PH25RN) –14.6 (0.86) 8,907,160 (PH1V5T) – 16.7 (0.83) 10,219,469 (PH435M) – 13.8 (1) 9,894,864 (PH2CV9) – 18.9 (0.7) 9,992,952 (PH2R6R) – 15.5 (1.56) 10,264,751 (PH2RA2) – 13.4 (1.15) 9,848,571 (PH2RK6) – 15.5 (0.9)
Ear Diameter at mid-point (mm), mean (SE) (40.4 (1.57))	Most similar to Smalley (40.3 cm)	Smalley (PH1KTF) – 40.3 (0.35) Benson (PH47WF) – 41.9 (1.56) Longenberger (PH47K2) – 36.1 (2.26) 8,563,836 (PH1CJ6) – 44.7 (1.90) 10,687,499 (PH47SK) – 44.8 (2.22) 9,549,515 (PH25RT) – 40.9 (1.56) 10,405,509 (PH2SNA) – 39 (2.24) 10,694,700 (PH25RN) – 41.1 (1.93) 8,907,160 (PH1V5T) – 44.1 (1.29) 10,219,469 (PH435M) – 43 (2.58) 9,894,864 (PH2CV9) – 47.8 (2.63) 9,992,952 (PH2R6R) – 47.3 (1.39) 10,264,751 (PH2RA2) – 40.6 (1.47) 9,848,571 (PH2RK6) – 42.3 (1.2)
Ear Weight (gm), mean (SE) (126 (15.79))	Most similar to Smalley (127.3 g)	Smalley (PH1KTF) – 127.3 (3.06) Benson (PH47WF) – 121.1 (17.56) Longenberger (PH47K2) – 107.8 (25.95) 8,563,836 (PH1CJ6) – 131.3 (22.72) 10,687,499 (PH47SK) – 155.4 (26.25) 9,549,515 (PH25RT) – 114 (15.55)

		10,405,509 (PH2SNA) – 99.6 (18.75) 10,694,700 (PH25RN) – 111.9 (17.1) 8,907,160 (PH1V5T) – 135.9 (18.65) 10,219,469 (PH435M) – 125 (22.03) 9,894,864 (PH2CV9) – 167 (33.17) 9,992,952 (PH2R6R) – 149.1 (19.72) 10,264,751 (PH2RA2) – 115.8 (22.65) 9,848,571 (PH2RK6) – 131.7 (6.69)
Number of Kernel Rows, mean (SE) (14.2 (0.96))	Within range of Smalley, Benson, Longenberger	Smalley (PH1KTF) – 14.6 (0.24) Benson (PH47WF) – 16.5 (1.12) Longenberger (PH47K2) – 14 (13) 8,563,836 (PH1CJ6) – 15.1 (1.23) 10,687,499 (PH47SK) – 15.4 (1.69) 9,549,515 (PH25RT) – 13.8 (1.11) 10,405,509 (PH2SNA) – 13.9 (1.68) 10,694,700 (PH25RN) – 16.4 (1.53) 8,907,160 (PH1V5T) – 19.5 (1.28) 10,219,469 (PH435M) – 16.9 (2.13) 9,894,864 (PH2CV9) – 16.6 (0.92) 9,992,952 (PH2R6R) – 14.6 (1.43) 10,264,751 (PH2RA2) – 13.4 (1.29) 9,848,571 (PH2RK6) – 15.4 (1.39)
Number of Kernels per Row, mean (SE) (27.2 (2.15))	Most similar to Benson (27).	Smalley (PH1KTF) – N/D Benson (PH47WF) – 27 (4.2) Longenberger (PH47K2) – 25.4 (4.85) 8,563,836 (PH1CJ6) – N/D 10,687,499 (PH47SK) – 32 (3.32) 9,549,515 (PH25RT) – 27 (2.49) 10,405,509 (PH2SNA) – 25.8 (1.5) 10,694,700 (PH25RN) – 24.7 (2.37) 8,907,160 (PH1V5T) – 30.3 (3.67) 10,219,469 (PH435M) – 25.2 (3.11) 9,894,864 (PH2CV9) – 33.9 (3.55) 9,992,952 (PH2R6R) – 30.9 (4.95) 10,264,751 (PH2RA2) – 21.5 (4.15) 9,848,571 (PH2RK6) – 29.6 (2.6)
Kernel Rows (1 = indistinct, 2 = distinct) (2)	Same as Smalley, Benson Longenberger.	Smalley (PH1KTF) - 2 Benson (PH47WF) - 2 Longenberger (PH47K2) - 2 8,563,836 (PH1CJ6) - 2

		10,687,499 (PH47SK) - 2 9,549,515 (PH25RT) - 2 10,405,509 (PH2SNA) - 2 10,694,700 (PH25RN) -1 8,907,160 (PH1V5T) - 2 10,219,469 (PH435M) - 2 9,894,864 (PH2CV9) - 2 9,992,952 (PH2R6R) - 2 10,264,751 (PH2RA2) – 2 9,848,571 (PH2RK6) –2
Row Alignment (1 - straight, 2 - slightly curved, 3 - spiral) (1)	Same as Benson, Longenberger.	Smalley (PH1KTF) - 2 Benson (PH47WF) - 1 Longenberger (PH47K2) - 1 8,563,836 (PH1CJ6) - 2 10,687,499 (PH47SK) - 1 9,549,515 (PH25RT) - 1 10,405,509 (PH2SNA) - 2 10,694,700 (PH25RN) - 2 8,907,160 (PH1V5T) - 1 10,219,469 (PH435M) - 2 9,894,864 (PH2CV9) - 1 9,992,952 (PH2R6R) - 1 10,264,751 (PH2RA2) – 1 9,848,571 (PH2RK6) – 1
Ear Taper (1 = slight cylindrical, 2 = average, 3 = extreme conical) (1)	Same as Benson, Longenberger.	Smalley (PH1KTF) - 2 Benson (PH47WF) - 1 Longenberger (PH47K2) - 1 8,563,836 (PH1CJ6) - 2 10,687,499 (PH47SK) - 1 9,549,515 (PH25RT) - 1 10,405,509 (PH2SNA) - 2 10,694,700 (PH25RN) - 2 8,907,160 (PH1V5T) - 2 10,219,469 (PH435M) - 2 9,894,864 (PH2CV9) - 3 9,992,952 (PH2R6R) - 1 10,264,751 (PH2RA2) – 1 9,848,571 (PH2RK6) – 1

84. The next category "kernel" includes characteristics related to the dried kernel. Each of these characteristics falls within or is similar to the range established by Smalley, Benson, and Longenberger, and the prior art varieties. For example, Smalley (8.6 mm) and Benson (7.2 mm) report kernel width falling within the 95% confidence interval for the PH4CYJ (6.8 to 9.8 mm). Additionally, PH4CYJ's value of 8.3 mm falls within the range reported by the prior art varieties. The weight per 100 kernels for PH4CYJ (33.1g) is similar to Smalley (34 g) and falls within the range reported by other prior art varieties. Specifically:

KERNEL (Dried):	**Compared to Smalley, Benson, Longenberger**	**Prior Art Varieties**
Kernel Length (mm), mean (SE) (10.9 (0.78))	Most similar to Smalley (10.9 mm)	Smalley (PH1KTF) – 10.9 (0.12) Benson (PH47WF) – 10.4 (0.59) Longenberger (PH47K2) – 8.7 (1.27) 8,563,836 (PH1CJ6) – 11.6 (0.61) 10,687,499 (PH47SK) – 12.1 (0.73) 9,549,515 (PH25RT) – 11 (0.46) 10,405,509 (PH2SNA) – 10.2 (0.71) 10,694,700 (PH25RN) – 10.2 (0.42) 8,907,160 (PH1V5T) – 11.6 (0.7) 10,219,469 (PH435M) – 11.4 (0.73) 9,894,864 (PH2CV9) – 9.9 (1) 9,992,952 (PH2R6R) – 12.1 (0.52) 10,264,751 (PH2RA2) – 11.8 (0.52) 9,848,571 (PH2RK6) – 11.3 (0.41)
Kernel Width (mm), mean (SE) (8.3 (0.79))	Within range of Smalley, Benson, Longenberger.	Smalley (PH1KTF) – 8.6 (0.11) Benson (PH47WF) – 7.2 (0.74) Longenberger (PH47K2) – 7.5 (0.68) 8,563,836 (PH1CJ6) – 8.6 (0.51) 10,687,499 (PH47SK) – 8.3 (0.74)

		9,549,515 (PH25RT) – 8.1 (0.34) 10,405,509 (PH2SNA) – 8.9 (0.74) 10,694,700 (PH25RN) – 8.3 (0.84) 8,907,160 (PH1V5T) – 7.9 (0.39) 10,219,469 (PH435M) – 8.2 (0.49) 9,894,864 (PH2CV9) – 6.6 (0.68) 9,992,952 (PH2R6R) – 9.4 (0.6) 10,264,751 (PH2RA2) – 8.7 (0.57) 9,848,571 (PH2RK6) – 8.4 (0.64)
Kernel Pericarp Color (Clear)	Same as Benson and Longenberger (colorless).	Smalley (PH1KTF) – N/D Benson (PH47WF) – clear Longenberger (PH47K2) - colorless 8,563,836 (PH1CJ6) – N/D 10,687,499 (PH47SK) - Clear 9,549,515 (PH25RT) - Clear 10,405,509 (PH2SNA) - Clear 10,694,700 (PH25RN) - Clear 8,907,160 (PH1V5T) - Clear 10,219,469 (PH435M) - Clear 9,894,864 (PH2CV9) - Clear 9,992,952 (PH2R6R) - Clear 10,264,751 (PH2RA2) – Clear 9,848,571 (PH2RK6) – Clear
Aleurone Color Pattern (Homozygous)	Same as Smalley, Benson, Longenberger.	Smalley (PH1KTF) - Homozygous Benson (PH47WF) - Homozygous Longenberger (PH47K2) - Homozygous 8,563,836 (PH1CJ6) - Homozygous 10,687,499 (PH47SK) - Homozygous 9,549,515 (PH25RT) - Homozygous 10,405,509 (PH2SNA) - Homozygous 10,694,700 (PH25RN) – Homozygous 8,907,160 (PH1V5T) - Homozygous 10,219,469 (PH435M) - Homozygous 9,894,864 (PH2CV9) - Homozygous 9,992,952 (PH2R6R) - Homozygous 10,264,751 (PH2RA2) – Homozygous 9,848,571 (PH2RK6) – Homozygous
Aleurone Color (Clear)	Same as Benson, Longenberger.	Smalley (PH1KTF) – Yellow Benson (PH47WF) – Clear Longenberger (PH47K2) – Clear

		8,563,836 (PH1CJ6) – Yellow 10,687,499 (PH47SK) – Clear 9,549,515 (PH25RT) – Yellow 10,405,509 (PH2SNA) – Yellow 10,694,700 (PH25RN) – Clear 8,907,160 (PH1V5T) – Yellow 10,219,469 (PH435M) – Yellow 9,894,864 (PH2CV9) – Yellow 9,992,952 (PH2R6R) – White 10,264,751 (PH2RA2) –Clear 9,848,571 (PH2RK6) – Yellow
Hard Endosperm Color (Yellow-Orange)	Same as Benson, Longenberger.	Smalley (PH1KTF) – Yellow Benson (PH47WF) – Yellow-Orange Longenberger (PH47K2) – Yellow-Orange 8,563,836 (PH1CJ6) – Yellow 10,687,499 (PH47SK) – Yellow 9,549,515 (PH25RT) – Yellow 10,405,509 (PH2SNA) -Yellow 10,694,700 (PH25RN) – Yellow 8,907,160 (PH1V5T) – Yellow 10,219,469 (PH435M) – Yellow 9,894,864 (PH2CV9) – Yellow 9,992,952 (PH2R6R) – White 10,264,751 (PH2RA2) – White 9,848,571 (PH2RK6) – Yellow
Weight per 100 Kernels (unsized sample) (g), mean (33.1)	Most similar to Smalley (34.0 g)	Smalley (PH1KTF) – 34.0 (2.83) Benson (PH47WF) – 26.1 Longenberger (PH47K2) – 24.3 8,563,836 (PH1CJ6) – 28.5 (0.71) 10,687,499 (PH47SK) – 37.4 9,549,515 (PH25RT) – N/D 10,405,509 (PH2SNA) – 33.1 10,694,700 (PH25RN) – 27 8,907,160 (PH1V5T) – N/D 10,219,469 (PH435M) – 30.8 9,894,864 (PH2CV9) – N/D 9,992,952 (PH2R6R) – 34.6 10,264,751 (PH2RA2) – 34.5 9,848,571 (PH2RK6) – 29.3

85. The next category "cob" includes characteristics related to the cob. Each of these characteristics falls within or is similar to the range established by Smalley, Benson, and Longenberger, and the other prior art varieties. For example, the 95% confidence interval for PH4CYJ's cob diameter measurement (21.3 to 26.1 cm) and the cob diameters of Smalley (24.4 cm) and Benson (22.5 cm) both fall within the 95% confidence interval of PH4CYJ's value. The cob diameter for PH4CYJ also falls within the range reflected in the prior art. The cob color of PH4CYJ also matches that of prior art varieties. Specifically:

COB:	**Compared to Smalley, Benson, Longenberger**	**Prior Art Varieties**
Cob Diameter at mid point (mm), mean (SE) (23.7 (1.2))	Most similar to Hoffbeck (23.1 mm)	Smalley (PH1KTF) – 24.4 (0.21) Benson (PH47WF) – 22.5 (1.25) Longenberger (PH47K2) – 20.3 (1.37) 8,563,836 (PH1CJ6) – 24.4 (1.62) 10,687,499 (PH47SK) – 23.3 (1.64) 9,549,515 (PH25RT) – 23.4 (0.98) 10,405,509 (PH2SNA) – 25.3 (1.46) 10,694,700 (PH25RN) – 24.2 (2.23) 8,907,160 (PH1V5T) – 24.2 (1.41) 10,219,469 (PH435M) – 24.1 (1.17) 9,894,864 (PH2CV9) – 27 (1.53) 9,992,952 (PH2R6R) – 25 (1.11) 10,264,751 (PH2RA2) – 21.6 (0.74) 9,848,571 (PH2RK6) – 22.8 (1.5)
Cob Color (Red)	Within range of prior art varieties.	Smalley (PH1KTF) – Pink-Orange Benson (PH47WF) - White Longenberger (PH47K2) - White 8,563,836 (PH1CJ6) - Red 10,687,499 (PH47SK) - White 9,549,515 (PH25RT) - Red

		10,405,509 (PH2SNA) – Pink-Orange 10,694,700 (PH25RN) – Red 8,907,160 (PH1V5T) -White 10,219,469 (PH435M) - Red 9,894,864 (PH2CV9) – Pink-Orange 9,992,952 (PH2R6R) - White 10,264,751 (PH2RA2) – White 9,848,571 (PH2RK6) – Pink-Orange

86. As previewed above, statistical analysis also confirms that the traits presented in the '545 Patent, Table 1, are not significantly different from the prior art. For most of the data types, Table 1 shows a value (*i.e.*, a mean) and a standard error (SE). *See* EX1001, Table 1. With this information, it is possible to calculate a 95% confidence interval around the mean indicating, with 95% confidence, that the actual value falls within that interval.

87. When using standard error, the "95% confidence interval is obtained as the values 1.96×SE either side of the mean." EX1035, Altman, "Standard deviations and standard errors," Brit. Med. J., 331:903 (2005).

88. If a number falls outside of the 95% confidence interval, that provides an indication that the value is at a commonly accepted level of difference to be considered statistically different from the reported value. On the other hand, if a value is inside of that range, then it is not shown to be statistically different. It should be noted that these statistical difference calculations are highly conservative as the confidence intervals are based on the environmental variation in the data

used to make the measurement determination but do not consider the increased variation expected when measurements are taken from several diverse environments not represented in the statistical information provided on each of the referenced measurements. In other words, the confidence interval ranges would be even broader (and the overlap between the varieties greater) if the calculations accounted for this additional degree of environmental variation.

89. The values reported in Smalley provide a value, standard deviation, and number of measurements. This data may be used to generate standard error using the formula: SE = SD/√(sample size). EX1035, Altman. Then, the 95% confidence interval may be calculated as ± 1.96×SE, as described above. This analysis omits traits for which there is no statistical information, such as colors and integer values for ear position, husk tightness, and the like.

90. The results are presented in Appendix B. As shown in Appendix B, the values given for Smalley all fall within the 95% confidence interval for the '545 Patent data in almost every line, indicated by the green highlighting. Additionally, as discussed above, each of these values are still consistent with what is observed in other prior art inbred lines. Moreover, there is no indication that the slight differences have practical significance. Indeed, the '545 Patent's specification does not indicate any such significance—much less suggest the differences constitute a surprising or unexpected result. In addition, the genetic

analysis selection criteria described in the selection of the line of the ’545 Patent, which I would have assumed to be among the primary breeding objectives for this breeding project, did not refer to any of these traits. *See* EX1001, 37:64-66 (“ears were selected based on genetic analysis predicting disease, insect, and agronomic phenotypic performance”). In fact, the values provided in the ‘545 Patent’s specification reflect to a POSA pretty poor indication of any breeding changes, much less progress.

91. Notably, this analysis is highly conservative in that it (1) focuses solely on the data sets in the ’545 Patent and Smalley (i.e., without any data concerning the second parent, for which no data is available) and (2) assumes for the sake of analysis that the data sets are comparable as well as repeatable (despite the different growing conditions that the datasets are likely to have come from).

92. Appendix B also shows the values for Benson with green highlighting showing the values falling within the 95% confidence interval for PH4CYJ’s values. As reflected in Appendix B, most of the values reported in Benson fall within the 95% confidence interval for the PH4CYJ’s values. The only exceptions are Benson’s values for length of top ear internode, flag leaf length, length of interior husk, shank length, and number of kernel rows. However, reviewing the 95% confidence interval for the Benson data (shown in the last two columns of Appendix B) shows that the 95% confidence intervals overlap for all of length of

top ear internode, flag leaf length, length of interior husk, shank length, and number of kernel rows. These calculations further confirm my conclusion that the Variety Description Information reflected in the '545 Patent falls within the mainstream of what POSAs would have expected based on prior art corn varieties as of July 2021.

3. Level of Ordinary Skill in the Art

93. The level of skill in the art in the corn breeding field as of 2021 was high. *See* Section III. Consistent with that high level of skill and the routine nature of crossing inbred lines to create new varieties, including crossing inbreds to create other inbreds with similar characteristics to the parent inbred, the Patent Owner itself repeatedly used the PH1KTFvariety (disclosed in Smalley) as one of the parent lines when breeding other maize varieties.

94. Specifically, the PH1KTF variety (disclosed in Smalley) is disclosed in at least twenty-two other patents, including one inbred patent (EX1006) and thirteen hybrid patents (EX1044- EX1056) issued more than one year before the '545 Patent's July 2, 2021 filing date, and another eight inbred patents issued more recently and filed before or the same day as the '545 Patent (EX1036-EX1043), as reflected in the tables below.

Patents to Inbreds Identifying PH1KTF Variety (disclosed in Smalley) as a Parent Issued More Than One Year Before '545 Patent Filing Date		
Patent	**Issuance Date**	**Breeding History**
Benson (EX1006) ("Maize Inbred PH47W4")	2020-05-26	38:54-61 ("Inbred Maize variety PH47W4 was developed by the following method. A cross was made between inbred line PH1KTF and inbred line PH18FC. Inbred PH47W4 was developed by selfing the F1 plants, producing a doubled haploid from the F2 generation, selfing and using pedigree selection amongst the D1 lines, and selfing and bulking from the subsequent generations.")

Patents to Hybrids Identifying PH1KTF Variety (disclosed in Smalley) as a Parent Issued More Than One Year Before '545 Patent Filing Date		
Patent	**Issuance Date**	**Breeding History**
9,872,475 (EX1044) ("Maize Hybrid X05K660")	2018-01-23	41:19-21 ("hybrid maize variety X05K660, representative seed produced by crossing a first plant of variety PH1KTF with a second plant of variety PH2RNJ")
9,699,995 (EX1045) ("Maize Hybrid X08F037")	2017-07-11	13:21-23 ("Pioneer Brand Hybrid Maize Variety X08F037 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH1CP1.")
9,686,949 (EX1046) ("Maize Hybrid X08H731")	2017-06-27	15:12-13 ("Pioneer Brand Hybrid Maize Variety X08H731 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH2DNB.")
9,456,566 (EX1047)	2016-10-04	13:28-30 ("Pioneer Brand Hybrid Maize Variety X08D453 is a single

Patents to Hybrids Identifying PH1KTF Variety (disclosed in Smalley) as a Parent Issued More Than One Year Before '545 Patent Filing Date		
Patent	**Issuance Date**	**Breeding History**
("Maize Hybrid X08D453")		cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH1V5T.")
9,357,733 (EX1048) ("Maize Hybrid X03F667")	2016-06-07	13:16-18 ("Pioneer Brand Hybrid Maize Variety X03F667 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH1W4R.")
9,161,503 (EX1049) ("Maize Hybrid X08D455")	2015-10-20	13:8-10 ("Pioneer Brand Hybrid Maize Variety X08D455 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH128Z.")
9,024,152 (EX1050) ("Maize Hybrid X13D063")	2015-05-05	13:8-10 ("Pioneer Brand Hybrid Maize Variety X13D063 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH1KYM.")
9,006,540 (EX1051) ("Maize Hybrid X08D456")	2015-04-14	13:8-10 ("Pioneer Brand Hybrid Maize Variety X08D456 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH1C98.")
9,000,277 (EX1052) ("Maize Hybrid X08C921")	2015-04-07	13:6-8 ("Pioneer Brand Hybrid Maize Variety X08C921 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH17JT.")
9,000,280 (EX1053) ("Maize Hybrid X08D452")	2015-04-07	13:8-10 ("Pioneer Brand Hybrid Maize Variety X08D452 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH1M6A.")

Patents to Hybrids Identifying PH1KTF Variety (disclosed in Smalley) as a Parent Issued More Than One Year Before ’545 Patent Filing Date		
Patent	**Issuance Date**	**Breeding History**
8,993,859 (EX1054) (“Maize Hybrid X13D062”)	2015-03-31	13:6-8 (“Pioneer Brand Hybrid Maize Variety X13D062 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PH183H.”)
8,962,949 (EX1055) (“Maize Hybrid X08C923”)	2015-02-24	13:6-8 (“Pioneer Brand Hybrid Maize Variety X08C923 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1KTF and PHW0V.”)
8,889,966 (EX1056) (“Maize Hybrid X08C922”)	2014-11-18	13:8-10 (“Pioneer Brand Hybrid Maize Variety X08C922 is a single cross, yellow endosperm maize variety and can be made by crossing inbreds PH1 KTF and PH17R8.”)

Patents to Inbred Identifying PH1KTF Variety (disclosed in Smalley) as a Parent Issued Less Than One Year Before ’545 Patent Filing Date		
Patent	**Issuance Date**	**Breeding History**
10,765,076 (EX1043) (“Maize inbred PH41A3”)	2020-09-08	38:58-64 (“Inbred Maize variety PH41A3 was developed by the following method. A cross was made between inbred line PH1KTF and inbred line PH18G5. Inbred PH41A3 was developed by producing a doubled haploid from the F1 plants, selfing and using pedigree selection amongst the D1 lines, and selfing and bulking from the subsequent generations.”)

Patents to Inbred Identifying PH1KTF Variety (disclosed in Smalley) as a Parent Issued Less Than One Year Before '545 Patent Filing Date		
Patent	**Issuance Date**	**Breeding History**
10,827,697 (EX1041) ("Maize inbred PH46TZ")	2020-11-10	38:55-61 ("Inbred Maize variety PH46TZ was developed by the following method. A cross was made between inbred line PH1KTF and inbred line PH1D84. Inbred PH46TZ was developed by producing a doubled haploid from the F1 plants, selfing and using pedigree selection amongst the F1 lines, and selfing and bulking from the subsequent generations.")
10,863,699 (EX1042) ("Maize inbred PH481R")	2020-12-15	38:64-39:3 ("Inbred Maize variety PH481R was developed by the following method. A cross was made between inbred line PH1V5F and inbred line PH1KTF. Inbred PH481R was developed by selfing the F1 plants, producing a doubled haploid from the F2 generation, selfing and using pedigree selection amongst the D1 lines, and selfing and bulking from the subsequent generations.")
11,432,497 (EX1040) ("Maize inbred PH4BZY")	2022-09-06	38:49-57 ("PH4BZY is an elite corn inbred line originated from a cross between inbred line PH1KTF and inbred line PH1TGN. ... From this cross, ears were selected based on genetic analysis predicting disease, insect, and agronomic performance. Inbred PH4BZY was developed by producing a doubled haploid from the F1 plants, selfing and using pedigree selection amongst the D1 lines, and selfing and bulking from the subsequent generations.")

Patents to Inbred Identifying PH1KTF Variety (disclosed in Smalley) as a Parent Issued Less Than One Year Before '545 Patent Filing Date		
Patent	**Issuance Date**	**Breeding History**
11,432,496 (EX1039) ("Maize inbred PH4CBV")	2022-09-06	38:42-51 ("Inbred Maize variety PH4CBV was developed by the following method. PH4CBV is an elite corn inbred line originated from a cross between inbred line PH1CJB and inbred line PH1KTF. …From this cross, ears were selected based on genetic analysis predicting disease, insect, and agronomic performance. Inbred PH4CBV was developed by producing a doubled haploid from the F1 plants, selfing and using pedigree selection amongst the D1 lines, and selfing and bulking from the subsequent generations.")
11,439,108 (EX1038) ("Maize inbred PH47MY")	2022-09-13	38:54-56 ("Inbred Maize variety PH47MY was developed by the following method. A cross was made between inbred line PH18G5 and inbred line PH1KTF. Inbred PH47MY was developed by selfing the F1 plants, and selfing and using ear-to-row (pedigree) selection from the F2 to F8 generations, and bulking the F9 seed.")
11,712,009 (EX1037) ("Maize inbred 1PWDK10")	2023-08-01	38:9-17 ("1PWDK10 is an elite corn inbred line originated from a cross between inbred line PH1JYB and inbred line PH1KTF. From this cross, ears were selected based on genetic analysis predicting disease, insect, and agronomic phenotypic performance. Inbred IPWDK10 was developed by producing a doubled haploid from the F2 plants, selfing

Patents to Inbred Identifying PH1KTF Variety (disclosed in Smalley) as a Parent Issued Less Than One Year Before '545 Patent Filing Date		
Patent	**Issuance Date**	**Breeding History**
		and using pedigree selections amongst the D1 lines, and selfing and bulking from the subsequent generations.")
11,723,334 (EX1036) ("Maize inbred PH47K7")	2023-08-15	38:52-61 ("PH47K7 is an elite corn inbred line originated from a cross between inbred line PH18G5 and inbred line PH1KTF. From this cross, ears were selected based on genetic analysis predicting disease, insect, and agronomic phenotypic performance. Inbred PH47K7 was developed by producing a doubled haploid from the F1 plants, selfing and using pedigree selection amongst the D1 lines, and selfing and bulking from the subsequent generations.")

95. Likewise, Patent Owner also used the PH1VNA variety (i.e., the other parent—aside from PH1KTF —used to create the claimed PH4CYJ variety) for at least one other cross, as disclosed in a separate patent application filed the same day as that for the '545 Patent. *See* US Patent No. 11,666,020 (EX1058), 38:25-34 ("Inbred Maize variety 1PFHC43was developed by the following method. 1PFHC43is an elite corn inbred line originated from a cross between inbred line PH1VNA and inbred line PH1D84. From this cross, ears were selected based on genetic analysis predicting disease, insect, and agronomic phenotypic performance.

Inbred 1PFHC43was developed by producing a doubled haploid from the F1 plants, selfing and using pedigree selection amongst the D1 lines, and selfing and bulking from the subsequent generations.").

96. Corn breeding indeed was a sophisticated science by 2021, with multi-disciplinary teams harnessing computational biology and sophisticated understandings of the corn genome (which had been sequenced in 2009, per EX1018, Schnable et al., "The B73 Maize Genome: Complexity, Diversity, and Dynamics," Science, 2009, 326:1112) to create new varieties incorporated desired phenotypical features. These breeding efforts focused not only on the hybrid varieties sold to farmers, but also the "inbred" varieties used as the basis to create future hybrids.

97. As stated in each of the '545 Patent, the virtually identical Longenberger prior art, and the Benson prior art disclosing an inbred sibling, "[a] continuing goal of maize breeders is to develop stable, high yielding maize varieties and hybrids that are agronomically sound with maximal yield over one or more different conditions and environments." EX1001, 1:23-26; EX1006, 1:23-26; EX1007, 1:23-26. Given the competitive nature of the market, constant evolution and improvement of a company's inbred lines was a commercial imperative.

98. And the high level of skill in the modern corn breeding field confirms such capability—POSAs were capable of breeding inbred lines to create essentially any desired inbred phenotypical trait in descendent inbred lines, at least within the ranges made possible by the existing gene pool as confirmed by the existence of the trait in one or more preexisting corn varieties (as is the case with all of the identified characteristics in the '545 Patent, as discussed in paragraphs 75-85 above). For example, changes in grain color could be incorporated via established techniques such as locus conversions. EX1005, 16:47-50 ("Desired traits that may be transferred through locus conversion include…grain color (white)"); EX1006, 20:5-8 (same); EX1007, 20:14-16 (same).

4. Secondary Considerations

99. The '545 Patent's specification does not suggest any purportedly unexpected results or other potential secondary considerations of non-obviousness. On the contrary, the minor variations reflected in the reported properties of the claimed variety as compared to prior art varieties are well within the bounds of what a POSA would expect in the ordinary course of plant breeding.

100. As an initial matter, the '545 Patent does not report comparative data that would be useful in assessing the performance or utility of the claimed variety. For example, Table 1 only shows values for the claimed variety and no comparative data. Table 1 also does not include characteristics such as seeding

vigor or stand count that might be used to show superior characteristics for an inbred line, much less grain yield stalk quality, or other key agronomic traits of a commercial corn hybrid, nor does it list performance for the traits included in the genetic analysis-based section of disease, insect, and agronomic phenotypic performance. *See* EX1001, 38:10-39:27. The '545 Patent also does not report data about the performance of any hybrids developed from the claimed inbreds. Data about hybrids would be critical to determining the value and utility of the inbred. For example, the hybrid might be judged with respect to characteristics such as selection index, yield, percentage moisture, disease, insect, agronomic phenotypic performance, and percentage barren plants. None of these are presented in the '545 Patent.

B. Ground 1: Claims 1-20 Are Unpatentable as Obvious Over Smalley (EX1005) and the Corresponding PVPA Certificate (EX1008)

101. Smalley and the corresponding PVPA Certificate disclose PH1KTF —one of the two parent varieties of the PH4CYJ variety claimed in the '545 Patent.

102. Smalley discloses that PH1KTF can be used "[t]o Develop Another Maize Plant" and in particular is a "source of breeding material that may be used to develop new maize inbred varieties." EX1005, 28:34-39. It also discloses specific cross breeding techniques for producing such "new inbred" varieties. EX1005,

2:43-49. In particular, Smalley discloses using PH1KTF to derive new maize seeds that are genetically and physically similar to PH1KTF. EX1005, 31:17-51.

103. Smalley discloses that it is beneficial to further breed PH1KTF:

> The development of a maize hybrid in a maize plant breeding program involves three steps: (1) the selection of plants from various germplasm pools for initial breeding crosses; (2) the selfing of the selected plants from the breeding crosses for several generations to produce a series of varieties, such as PH1KTF, which, although different from each other, breed true and are highly uniform; and (3) crossing the selected varieties with different varieties to produce the hybrids. **During the inbreeding process in maize, the vigor of the varieties decreases, and so one would not be likely to use PH1KTF directly to produce grain. However, vigor is restored when PH1KTF is crossed to a different inbred variety to produce a commercial F1 hybrid.** An important consequence of the homozygosity and homogeneity of the inbred variety is that the hybrid between a defined pair of inbreds may be reproduced indefinitely as long as the homogeneity of the inbred parents is maintained.

EX1005, 14:64-15:13 (emphasis added).

104. Consistent with these disclosures, PH1KTF had repeatedly been used as one of the parents for other maize varieties, including at least seven inbreds (one of which I understand constitute indisputable prior art issued more than a year before the '545 Patent's July 2, 2021 filing date) and thirteen hybrids (all

indisputable prior art issued more than a year before the '545 Patent's July 2, 2021 filing date). Paragraph 94 above includes a table reflecting such previous crosses.

105. As Smalley itself discloses and these other crosses confirm, POSAs would have had reasons to use PH1KTF as the starting point to create other inbred lines.

106. POSAs would have had a reasonable expectation of obtaining an inbred maize variety with PH1KTFas a parent, particularly given (1) the routine nature of the breeding techniques involved and (2) the multiple other instances already reported in which PH1KTFhad been used as a parent to obtain other inbred lines.

1. Claim 1: Variety PH4CYJ

107. Claim 1 encompasses a seed, plant part, or plant cell of variety PH4CYJ. Variety PH4CYJ's disclosed characteristics are highly similar to those in the PH1KTF parent, and nothing in the specification or otherwise in the intrinsic record suggests any property that a POSA familiar with well-known breeding techniques and the prior art as described herein would have viewed as surprising or unexpected over PH1KTF. See paragraphs 75-92 above. The record does not explain the significance of any differences between the claimed variety and known varieties. To the extent such differences exist, there is no basis from which to conclude they are significant or unexpected as compared to the PH1KTF variety

disclosed in Smalley and touted therein as a potential starting point for future inbred lines.

108. Indeed, none of the differences have any material commercial significance. In particular, none of them are relevant to the underlying goal identified in the ’545 Patent of developing “stable, high yielding maize varieties and hybrids that are agronomically sound with maximal yield over one or more different conditions and environments.” EX1001, 1:23-26. Nor are they relevant to the nature of the ’545 Patent’s disclosed “Industrial Applicability.” EX1001, 36:21-65.

109. For example, while the ’545 Patent discloses a plant height of 213.3 cm and Smalley discloses a plant height of 194.9 cm, the height of an inbred variety, at least within the range exhibited by these two varieties, is of marginal relevance (at most) to the value of an inbred variety. Because the ’545 patent presents no data on hybrid crosses of the ’545 Patent, it is impossible to determine the degree to which any height variation is inherited by hybrid crosses of the PH4CYJ and, to the extent it is inherited, what impact it has on performance of the hybrid cross. Similarly, characteristics of the ear of the PH4CYJ (such as ear diameter and ear weight) are only relevant to the extent that are inherited in the hybrid cross, which is not disclosed in the ’545 Patent. Even then, the traits are only commercially relevant if they impact yield or other value hybrid

characteristics. This is because, as discussed below at paragraphs 168-173, even those characteristics that are specifically relevant in an inbred crop (e.g., those that improve seed production) are ultimately valuable to the extent they provide seed that will yield a satisfactory hybrid crop. In any event, there is no showing that the varieties claimed in the '545 Patent provide improved hybrid producibility or any relevant inbred trait.

110. Accordingly, claim 1 would have been obvious over Smalley and the corresponding PVPA Certificate.

111. I have been informed that the Examiner distinguished the claimed PH4CYJ over the prior art on the basis that a prior art inbred line "exhibits distinct aleurone color and genetic background." These distinguishing features are not a basis to distinguish the '545 Patent's PH4CYJ from Smalley for the following reasons:

a. Aleurone Color. PH4CYJ is described as having a clear aleurone color, whereas Smalley has a yellow aleurone color.[33] For many

[33] Aleurone refers to a separate internal layer closer to the surface (the kernel pericarp), but still not exposed. *See* EX1034, Merriam-Webster, 30 (definition of "aleurone" "protein matter in the form of minute granules or grains occurring in seeds in endosperm or in a special peripheral layer").

applications, the color of the aleurone is entirely irrelevant. Whether or not the aleurone color matters at all depends in part on the color of the endosperm.[34] The color of the endosperm and aleurone together have some relevance to a food-grade crop because some customers may prefer to use either white corn or yellow corn for consistency of a product's appearance. In the case of white food grade corn, a clear aleurone may be preferred so as not to give a yellow color to the product. However, the PH4CYJ has yellow-orange endosperm, so the product would also be yellow-orange, regardless of the clear color of the aleurone. Smalley discloses a yellow endosperm and aleurone. Accordingly, the combination of yellow-orange endosperm and clear aleurone for PH4CYJ does not constitute a material difference over Smalley's PH1KTF variety with its yellow endosperm and aleurone. Additionally, the aleurone color differences in the discussed range

---

[34] Endosperm refers to a corn seed's starchy interior. *See* EX1034, Merriam-Webster, 412 (definition of "endosperm" "a nutritive tissue in seed plants formed within the embryo sac by division of the endosperm nucleus").

represent a trait that would be easily incorporated in a corn variety by a POSA.

b. Genetic Background. The ’545 Patent’s PH4CYJ was bred from a cross of Smalley’s PH1KTF with another variety (PH1VNA) that has not been disclosed. EX1001, 37:62-64. Accordingly, PH4CYJ shares a portion of its genetic background with Smalley’s PH1KTF. In any event, the ’545 Patent does not disclose the genome of the PH4CYJ and does not identify any particular degree of similarity or difference as relevant.

112. The anther is simply the pollen-containing structure within a male flower (called a “tassel”). *See* EX1034, Merriam-Webster, 52 (definition of “anther” “the part of a stamen that produces and contains pollen and is usu[ally]. borne on a stalk”). The color of the anther does not have any technical or commercial significance to the crop. It is used for identification purposes only and can be environmentally influenced.

113. As discussed above at paragraphs 75-85, each of the characteristics shown in the ’545 Patent, Table 1 is either within the range established by the prior art, is not technically or economically relevant, or both, even without taking into consideration the increased variance from comparison of data collected across multiple uncharacterized environments.

114. Accordingly, claim 1 would have been obvious over Smalley and the corresponding PVPA Certificate.

2. Claims 2-20: Variations and Hybrids Related to PH4CYJ

115. Claims 2-20 likewise would have been obvious over Smalley and the corresponding PVPA Certificate. They recite variations, hybrids, and related methods concerning the claimed inbred line:

Claim 2
The plant part of claim 1, wherein the plant part is an ovule or pollen.
Claim 3
An F1 hybrid maize seed of PH4CYJ produced by crossing the plant or plant part of claim 1 with a different maize plant.
Claim 4
An F1 hybrid maize plant or plant part produced by growing the maize seed of claim 3, wherein the plant part comprises at least one somatic cell of the F1 hybrid maize plant of PH4CYJ.
Claim 5
A method for producing a second maize plant, the method comprising applying plant breeding techniques to the F1 plant or plant part of claim 4 to produce the second maize plant.
Claim 6
A method for producing a second maize plant or plant part, the method comprising doubling haploid seed generated from a cross of the plant or plant part of claim 4 with an inducer variety, thereby producing the second maize plant or plant part.
Claim 7
A method of making a commodity plant product comprising silage, starch, fat, syrup or protein, the method comprising producing the commodity plant product from the maize plant or plant part of claim 4.
Claim 8
A method of producing a maize seed derived from the variety PH4CYJ, comprising:
a) crossing the plant of claim 1 with itself or a second plant to produce progeny seed; and

b) growing the progeny seed to produce a progeny plant and crossing the progeny plant with itself or a different plant to produce maize seed derived from the variety PH4CYJ.
Claim 9
A method for producing nucleic acids, the method comprising isolating nucleic acids from the seed, plant, plant part, or plant cell of claim 1.
Claim 10
A converted seed, plant, plant part or plant cell of inbred maize variety PH4CYJ, representative seed of the maize variety PH4CYJ having been deposited under NCMA accession number 202212062,
wherein the converted seed, plant, plant part or plant cell comprises a locus conversion, and
wherein the plant or a plant grown from the converted seed, plant part or plant cell comprises the locus conversion and otherwise comprises all of the physiological and morphological characteristics of maize variety PH4CYJ when grown under the same environmental conditions.
Claim 11
The converted seed, plant, plant part or plant cell of claim 10, wherein the locus conversion confers a property selected from the group consisting of male sterility, site-specific recombination, abiotic stress tolerance, altered phosphate, altered antioxidants, altered fatty acids, altered essential amino acids, altered carbohydrates, herbicide tolerance, insect resistance and disease resistance.
Claim 12
A maize seed produced by crossing the plant or plant part of claim 10 with a different maize plant.
Claim 13
A hybrid maize plant or plant part produced by growing the seed of claim 12, wherein the plant part comprises at least one cell of the hybrid maize plant.
Claim 14
A method for producing a second maize plant, the method comprising applying plant breeding techniques to the plant or plant part of claim 13 to produce the second maize plant.
Claim 15

A method for producing a second maize plant or plant part, the method comprising doubling haploid seed generated from a cross of the plant or plant part of claim 13 with an inducer variety, thereby producing the second maize plant or plant part.
Claim 16
A method of making a commodity plant product comprising silage, starch, fat, syrup or protein, the method comprising producing the commodity plant product from the maize plant or plant part of claim 13.
Claim 17
A method for producing nucleic acids, the method comprising isolating nucleic acids from the seed, plant, plant part, or plant cell of claim 10.
Claim 18
An F1 hybrid seed of PH4CYJ produced by crossing a plant or plant part of inbred maize variety PH4CYJ
further comprising a transgene, representative seed of the inbred maize variety PH4CYJ having been deposited under NCMA accession number 202212062 with a different maize plant,
wherein the transgene is inherited by the F1 hybrid seed,
wherein the transgene was introduced into inbred maize variety PH4CYJ by backcrossing or genetic transformation.
Claim 19
A method of producing progeny seed, the method comprising crossing a plant grown from the seed of claim 18 with itself or a second plant to produce progeny seed.
Claim 20
A method of making a commodity plant product comprising silage, starch, fat, syrup or protein, the method comprising producing the commodity plant product from a maize plant or plant part of grown from the F1 hybrid seed of claim 18.

116. Claims 2-20 indeed essentially mirror analogous claim sets in multiple prior art patents (U.S. Patent Nos 10,492,410 (EX1067); 10,492,411 (EX1068); 10,492,412 (EX1069); 10,492,413 (EX1070); and 10,492,414 (EX1071)) directed

to other inbred corn varieties—confirming that using and/or modifying the PH4CYJ inbred line in those ways likewise would have been obvious.

a. Claim 2: Ovule or Pollen From the Inbred Line of Claim 1

117. Claim 2 depends from claim 1 and requires that "the plant part" be "an ovule" or "pollen." Smalley discloses that a "plant part" includes "pollen" and "ovules." EX1005, 9:6-9. POSAs would have recognized that inbred lines created from PH1KTF likewise include both ovules and pollen. *See also* EX1067, U.S. Patent No. 10,492,410, 44:4-6 ("wherein the plant part is an ovule or pollen").

b. Claims 3-8: Hybrids and Related Uses Derived From 1PFHC43

118. Claim 3 is to "[a]n F1 hybrid maize seed of PH4CYJ produced by crossing the plant or plant part of claim 1 with a different maize plant." Smalley discloses that hybrids are generated by crossing two inbred varieties (such as PH1KTF itself and/or other inbred lines such as those Smalley discloses can be created using PH1KTF as the starting point. *See* EX1005, 12:48-49 ("Inbred maize variety PH1KTF may be used as a male or female in the production of the first generation F1 hybrid."), 28:35-39. Further, Smalley discloses that "F1" hybrids—meaning the "first generation" of the cross—are the focus when developing "commercial hybrids" because they are "more vigorous than their inbred parents." EX1005, 14:42-50. Indeed, Smalley discloses details about

hybrids. *See* EX1005, 15:57-16:5 (Hybrid Comparisons), Table 3. Claim 3 is obvious in view of these disclosures in addition to the above-discussed reasons concerning claim 1. POSAs would have had reason to create the PH1KTF inbred variety using PH1KTF as the starting point, and would further have had reason to use that inbred variety to create F1 hybrid seeds for commercialization.

119. Claim 4 is to a plant or plant part produced by growing the F1 hybrid seed of claim 3, and in particular to "at least one somatic cell of the F1 hybrid maize plant of PH4CYJ." It is obvious for the same reasons as claim 3 given that the purpose of creating an F1 hybrid seed is to grow an F1 hybrid plant. In its relevant sense, "somatic" is defined as "of, relating to, or affecting the body esp[ecially] as distinguished from the germ plasm." EX1106, Merriam-Webster's Ninth New Collegiate Dictionary (1984) (defining somatic). "Somatic" does not narrow claim 4 in any significant way because a "[a]n F1 hybrid maize plant or plant part produced by growing the maize seed of claim 3," which is an F1 hybrid maize seed of PH4CYJ (as provided in claim 3, from which claim 4 depends), will necessarily include a somatic cell of the F1 hybrid maize plant of PH4CYJ. In short, a plant grown from a seed of a given variety has somatic cells of that variety.

120. Claim 5 concerns "[a] method for producing a second maize plant" by "applying plant breeding techniques to the F1 plant or plant part of claim 4." Claim 5 would have been obvious given Smalley's disclosure that plant breeding

techniques can be used to cross an "F1 hybrid" with either another F1 hybrid or another inbred line. EX1005, 15:14-24.

121. Claim 6 concerns "[a] method for producing a second maize plant or plant part, the method comprising doubling haploid seed generated from a cross of the plant or plant part of claim 4 with an inducer variety." Claim 6 would have been obvious for the same reasons as claim 5 and in further view of Smalley's disclosure of the use of "Haploid induction systems" for maize in which "haploid plants from any genotype" may be created "by crossing a selected variety (as female) with an inducer variety." EX1005, 30:28-41. Smalley's claim 7 likewise parallels challenged claim 6 and further confirms the obviousness of crossing an inbred maize line, F1 hybrid or other derived breeding materials with an inducer variety to produce haploid seed. EX1005, 41:55-60.

122. Claim 7 concerns "[a] method of making a commodity plant product comprising silage, starch, fat, syrup or protein, the method comprising producing the commodity plant product from the maize plant or plant part of claim 4." Claim 7 would have been obvious for the same reasons as claim 4 in further view of Smalley's disclosure that the invention included a "method of harvesting the grain of the F1 plant of variety PH1KTF and using the grain in a commodity," such as "starches, syrups, proteins, and sugars." EX1005, 34:3-7. POSAs would have understood that F1 hybrids created from the inbred line of claim 1 (which would

have been obvious as discussed above) could be used for the same generic application.

123. Claim 8 concerns "[a] method of producing a maize seed derived from the variety PH4CYJ, comprising: (a) crossing the plant of claim 1 with itself or a second plant to produce progeny seed; and (b) growing the progeny seed to produce a progeny plant and crossing the progeny plant with itself or a different plant to produce maize seed derived from the variety PH4CYJ." Claim 8 would have been obvious for the same reasons as claim 5, which concerns a more specific method of generating a second-generation progeny plant derived from PH4CYJ in which the first-generation plant is an F1 hybrid. *See also* EX1005, 41:37-54 (Smalley's claims 3-6).

124. Claims 3-8 likewise mirror analogous claim sets in multiple prior art patents directed to other inbred corn varieties—further confirming that it would have been obvious to use the PH4CYJ variety (itself obvious as detailed in Section IX.B.1) for hybridization purposes as claims 3-8 specify:

Claim in '020 Patent	**Analogous Claim in each of EX1067-EX1070[35]**

[35] U.S. Patent No. 10,492,410 (EX1067); U.S. Patent No. 10,492,411 (EX1068); U.S. Patent No. 10,492,412 (EX1069); U.S. Patent No. 10,492,413 (EX1070); and U.S. Patent No. 10,492,414 (EX1071).

3	3
4	5
5	6
6	7
7	8
8	9[36]

c. Claim 9: Nucleic Acids Isolated From PH4CYJ

125. Claim 9 concerns "[a] method for producing nucleic acids" by "isolating nucleic acids from the seed, plant, plant part, or plant cell of claim 1." Claim 9 would have been obvious for the same reasons as claim 1 in view of a POSA's knowledge that it was routine to isolate nucleic acids from inbred maize lines—as confirmed by Smalley. EX1005, 8:52-54 (defining nucleic acid as "[a]n acidic, chainlike biological macromolecule…"); *see also* EX1067, U.S. Patent No. 10,492,410, 44:42-44 ("method for producing nucleic acids, the method comprising isolating nucleic acids from the seed, plant, plant part, or plant cell of claim 1"); EX1072, U.S. Patent No. 10,011,828, Abstract ("isolating DNA from

[36] Claim 9 in the prior art discloses an additional step of an additional cross to create a subsequent generation, but encompasses the steps of challenged claim 8.

biological materials such as seeds"); EX1073, U.S. Patent No. 8,927,214, Title ("Method and compositions for dual extraction of protein and nucleic acid").

d. Claims 10-17: Converted Seeds of PH4CYJ

126. Claim 10 concerns "[a] converted seed, plant, plant part or plant cell of inbred maize variety PH4CYJ" with "a locus conversion" such that ""the plant or a plant grown form from the converted seed, plant part or plant cell comprises the locus conversion and otherwise comprises all of the physiological and morphological characteristics of maize variety PH4CYJ when grown under the same environmental conditions."

127. Claim 10 would have been obvious for the same reasons as claim 1 (concerning variety PH4CYJ) in further view of a POSA's knowledge that locus conversions such as those recited in claim 10 were a routine technique to incorporate desirable traits into inbred maize lines—as further confirmed by Smalley's disclosure that "[o]ne or more locus conversion traits" such as "male sterility, insect control, disease control or herbicide tolerance" can "be introduced into a single corn variety." EX1005, 7:43-52; *see also id.*, 16:46-60; 16:61-65 ("triple stacks" of loci); 42:13-19 (claim to inbred variety PH1KTF with "a locus conversion" that "confers a trait selected" from the same group of traits recited in challenged claim 10). Further, locus conversion technology was sufficiently

advanced such that the additional trait(s) could be introduced without impacting the plant's "physiological and morphological characteristics."

128. Prior art U.S. Patent Nos 10,492,410 (EX1067); 10,492,411 (EX1068); 10,492,412 (EX1069); 10,492,413 (EX1070); and 10,492,414 (EX1071) all include essentially identical claims, including the same list of properties and the same limitation on the number of locus conversions—further confirming the obviousness of incorporating such locus conversions into inbred lines such as PH1KTF. EX1067, 44:45-61; EX1068, 44:42-58; EX1069, 44:32-48; EX1070, 44:36-52; EX1071, 44:34-50.

129. Claim 11 depends from claim 10 and requires that the "confers a property selected from the group consisting of male sterility, site-specific recombination, abiotic stress tolerance, altered phosphate, altered antioxidants, altered fatty acids, altered essential amino acids, altered carbohydrates, herbicide tolerance, insect resistance and disease resistance." It would have been obvious to a POSA to select a property "from the group consisting of herbicide tolerance, insect resistance, and disease resistance" at least because Smalley identified these three as "traits of interest." EX1005, 14:34-35 (referring to "traits of interest such as herbicide tolerance, insect or disease resistance"). The obviousness of claim 11 is further confirmed by the inclusion of an analogous dependent claim—reciting the exact same three-member group—in other of PO's prior art patents. E.g.,

EX1067, 44:62-65. Smalley uses the term "altered phosphorus" where claim 11 refers to "altered phosphate." Both are referring to the same thing: phosphorus is an element that is obtained and used by plants as phosphate (i.e., phosphate ion (PO_4^{3-}), hydrogen phosphate (HPO_4^{2-}), or dihydrogen phosphate ion ($H_2PO_4^-$)). *See* EX1033 (defining phosphorus and phosphate). "[A]ltered phosphorus" or "altered phosphate" refers to improving the ability of the plant to use phosphorus efficiently. See EX1005, 26:4-7 (referring to "[a]ltered phosphorus content" by introduction of a gene "adding more free phosphate"). It has long been appreciated that improving a corn variety's ability to use phosphorus efficiently can reduce the amount of phosphorus to be added via fertilizers. *See also* EX1065, Fageria, "Phosphorus-Use Efficiency by Corn Genotypes," J. Plant Nutrition, 20:1267, 1276 (1997) ("Phosphorous (P) deficiency is a principal yield-limiting factor for annual crop production in acid soils of temperate as well as tropical regions."; "The use of P-efficient genotypes to increase and/or stabilize crop production has become increasingly attractive in recent years due to the high cost of fertilizers and to pollution problems.").

130. Claims 12-17 depend directly or indirectly from claim 10 and otherwise parallel the limitations of claims 3-7 and 9, respectively. They would have been obvious for the same reasons as claim 10 and in further view of the above-discussed reasons why dependent claims 3-7 and 9 would have been

obvious. The above discussions apply equally to converted seeds incorporating locus conversions, which impart additional properties but otherwise do not impact the variety or how it can be used. PO's other prior art patents likewise include analogous dependent claims. *E.g.*, EX1071, 44:62-45:11.

e. Claims 18-20: F1 Hybrid Derived From Variety PH4CYJ with a Transgene

131. Much like dependent claim 3, claim 18 recites an F1 hybrid seed produced by crossing a plant or plant part of PH4CYJ with another variety. However, it includes the additional requirement that (1) "PH4CYJ further compris[es] a transgene"; (2) "the transgene is inherited by the F1 hybrid seed;" and (3) the transgene was incorporated by "backcrossing or genetic transformation." As Smalley discloses, incorporating a transgene into a corn variety is one particular technique for incorporating a locus conversion (as discussed in connection with claim 10). EX1005, 7:43-52. Smalley also discloses that backcrossing is a technique for incorporating locus conversions in general and transgenes in particular. EX1005, 16:8-37. Claim 18 would have been obvious for the same reasons as above-discussed claims 3 and 10 and in further view of these additional disclosures in Smalley. PO's other prior art patents likewise include claims directed to the inclusion of a "transgene" incorporated "by backcrossing or genetic transformation." *E.g.*, EX1067, 44:9-14.

132. Claim 19 concerns "[a] method of producing progeny seed" by "crossing a plant grown from the seed of claim 18 with itself or a second plant to produce progeny seed." It parallels above-discussed claim 5 aside from (1) the more specific requirement concerning the nature of the starting F1 hybrid seed; and (2) the fact that claim 19 refers to "progeny seed" rather than a "plant" itself. Claim 19 accordingly would have been obvious for the reasons discussed above in connection with claims 5 and 19.

133. In particular, POSAs would have understood that Smalley's disclosure that plant breeding techniques can be used to cross an "F1 hybrid" with either another F1 hybrid or another inbred line (EX1005, 15:14-24) was applicable to F1 hybrids created by crossing inbred varieties incorporating transgenes.

134. Claim 20 parallels claim 7 (i.e., "a method of making a commodity plant product….") aside from reciting the plant of claim 18 rather than claim 4. Claim 20 would have been obvious for the same reasons as claim 7.

C. Ground 2: Claims 1-20 Are Unpatentable as Obvious Over Benson (EX1006)

135. Benson discloses PH47W4—a prior art inbred variety that shares a parent variety (PH1KTF) in common with the '545 Patent's PH4CYJ and has very similar properties. EX1006, 38:56-57. Benson was not of record during prosecution despite its common parent variety and similar properties to the '545 Patent's PH4CYJ variety, as explained herein at paragraphs 69-92 and Appendix

B. For example, Benson's Table 1 reports "dent" grain texture—identical to that disclosed in the '545 Patent. EX1001, 38:15; EX1006, 39:5. The values reported for 20 of the 25 characteristics in Benson fall within the 95% confidence interval for the '545 Patent. *See* Appendix B. Each of the remaining five characteristics have overlapping confidence intervals. *Id.*

136. Benson discloses that PH47W4 can be used "to Develop Another Maize Plant" and in particular is a "source of breeding material that may be used to develop new maize inbred varieties." EX1006, 32:30-35. It also discloses specific cross breeding techniques for producing such "new inbred" varieties. *Id.*, 5:38-44. In particular, Benson discloses using PH47W4 to derive new maize seeds that are genetically and physically similar to PH47W4. EX1006, 32:30-35.

137. Consistent with these disclosures, PH47W4 was previously used as one of the parents for at least one hybrid corn variety. EX1062, 11:19-24.

138. As Benson itself discloses, POSAs would have had reason to use PH47W4 as the starting point to create other inbred lines. The nature of the maize market confirms the reasons to create a wide array of new varieties using PH47W4 as the starting point.

139. POSAs would have had a reasonable expectation of obtaining an inbred maize variety with PH47W4 as a parent, particularly given (1) the routine nature of the breeding techniques involved, (2) Benson's disclosure of preparing

new inbred varieties (EX1006, 5:38-44, 32:32-42), and (3) the previous instance already reported in which PH47W4 had been used as a parent to obtain another line.

1. Claim 1

140. Claim 1 encompasses a seed, plant part, or plant cell of variety PH4CYJ. PH4CYJ's disclosed characteristics are highly similar to PH47W4's as disclosed in Benson, and nothing in the '545 Patent's specification or otherwise in the intrinsic record suggests any property of PH4CYJ that POSAs would have viewed as surprising or unexpected over PH47W4. *Supra* §IX.A.2.

141. Comparing the values disclosed in Benson against the 95% confidence intervals for the values disclosed in the '545 Patent shows that 20 of the 25 values fall within the confidence interval and each of the remaining five have overlapping confidence intervals. *See* Appendix B (green highlighting indicating values within range). This demonstrates that the differences for most measurements are likely not statistically significant. The only characteristics falling outside the 95% confidence interval are: length of top ear internode, length of interior husk, flag leaf length, shank length, and number of kernel rows. *See* Appendix B. However, there is no indication, even if these characteristics are physically different, that the differences have any meaning to the performance of the plant or have any commercial significance. Of course, it remains unclear the

degree to which any difference may be due to difference in growing conditions and location for the samples. In any event, as discussed for the respective characteristics at paragraphs 75-85, the values for PH4CYJ all fall within or are similar to the ranges established by the prior art.

142. The record does not explain the significance of any differences between the claimed variety and known varieties. To the extent such differences exist, there is no basis from which to conclude they are significant or unexpected as compared to the PH47W4 variety disclosed in Benson and touted therein as a potential starting point for future inbred lines. Indeed, none of the differences have any material commercial significance. In particular, none of them are relevant to the underlying goal identified in the '545 Patent of developing "stable, high yielding maize varieties and hybrids that are agronomically sound with maximal yield over one or more different conditions and environments." EX1001, 1:23-26. Nor are they relevant to the nature of the '545 Patent's disclosed "Industrial Applicability." EX1001, 36:21-65.

143. Again considering the two characteristics relied upon by the Examiner (see paragraph 111), I conclude that these features are not a basis to distinguish the '545 Patent's PH4CYJ from Benson for the following reasons:

a. Aleurone Color. PH4CYJ and PH47W4 both have clear aleurone. *See* paragraph 69. As described above at paragraph 111, because

PH4CYJ has yellow-orange endosperm and thus a product would also be yellow, the combination of yellow endosperm and clear aleurone for PH4CYJ does not constitute a material difference over Benson's clear aleurone and yellow-range endosperm.

b. Genetic Background. The '545 Patent's PH4CYJ was bred from a cross of Smalley's PH1KTF with another variety (PH1VNA) that has not been disclosed. EX1001, 37:62-64. Benson's PH47W4 was derived as a cross between PH1KTF and another variety. Accordingly, PH4CYJ shares a portion of its genetic background with Benson's PH47W4. In any event, the '545 Patent does not disclose the genome of the PH4CYJ and does not identify any particular degree of similarity or difference as relevant.

144. As discussed above at paragraphs 69-92, each of the characteristics shown in the '545 Patent, Table 1 is either within the range established by the prior art, is not technically or economically relevant, or both. Accordingly, claim 1 would have been obvious over Benson.

2. Claims 2-20

145. Claims 2-20 are likewise unpatentable as obvious over Benson for the same reasons detailed immediately above concerning claim 1 and for the additional reasons explained in §IX.B.2 concerning why claims 2-20 are obvious over

Smalley. The obviousness is further confirmed by PO's other prior art patents (EX1067-EX1071) including analogous claims related to other inbred corn lines. Benson has disclosures paralleling Challenged Claims 2-20 and/or disclosures in Smalley identified in §IX.B.2 concerning claims 2-20. In particular:

	Relevant Disclosures in Benson (EX1006))
Claim 2	12:32-39 ("plant part" includes "pollen" and "ovules")
Claims 3 and 12	40:24-25 ("An F1 hybrid maize seed produced by crossing the plant or plant part of claim 1 with a different maize plant")
Claims 4 and 13	40:24-25 ("An F1 hybrid maize seed produced by crossing the plant of claim 3 with a different maize plant.")
Claims 5, 14, and 19	40:29-32 ("A method for producing a second maize plant, the method comprising applying plant breeding techniques to the Fl plant or plant part of claim 4 to produce the second maize plant.")
Claims 6 and 15	40:33-37 ("A method for producing a second maize plant or plant part, the method comprising doubling haploid seed generated from a cross of the plant or plant part of claim 4 with an inducer variety, thereby producing the second maize plant or plant part.")

	Relevant Disclosures in Benson (EX1006))
Claims 7, 16, and 20	37:20-34 ("Maize is used as human food, livestock feed, and as raw material in industry. …The maize wet-milling industry can provide maize starch, maize syrups, and dextrose for food use. … non-grain portions of the [maize] plant, [are] also used extensively as livestock feed.")[37]
Claim 8	40:24-32 ("3. An F1 hybrid maize seed produced by crossing the plant or plant part of claim 1 with a different maize plant. 4. An Fl hybrid maize plant or plant part produced by growing the maize seed of claim 3, wherein the plant part comprises at least one cell of the Fl hybrid maize plant. 5. A method for producing a second maize plant, the method comprising applying plant breeding techniques to the F1 plant or plant part of claim 4 to produce the second maize plant.")
Claims 9 and 17	16:6-57 ("Methods of isolating nucleic acids from maize plants … are well known in the art. … A method comprising, isolating

[37] Numerous prior art patents disclosed the specific list of "silage, starch, fat, syrup or protein" recited in claims 7, 16 and 20. *See,* e.g., EX1067-71.

	Relevant Disclosures in Benson (EX1006))
	nucleic acids, such as DNA, from a plant, a plant part, plant cell or a seed of the maize plants disclosed herein is provided."); 40:50-53 ("A method for producing nucleic acids, the method comprising isolating nucleic acids form the seed, plant, plant part, or plant cell of claim 1."); 42:1-3 (similar)*See* EX1067, 44:42-44 ("method for producing nucleic acids, the method comprising isolating nucleic acids from the seed, plant, plant part, or plant cell of claim 1"); EX1072 , U.S. Patent No., 10,011,828, Abstract ("isolating DNA from biological materials such as seeds"); EX1073, U.S. Patent No. 8,927,214, Title ("Method and compositions for dual extraction of protein and nucleic acid").
Claim 10	18:4-5 ("locus conversion of PHH5G PH47W4 for herbicide tolerance"); 18:6-7 15:36-37 ("locus conversion for insect or disease resistance"); 20:26-29 ("At least one, at least two or at least three and less than ten, …may be introduced"); 11:21-29 ("A locus conversion refers to plants within a variety that have been modified in a manner that retains the overall genetics of the variety…").

	Relevant Disclosures in Benson (EX1006))
	Desired traits that may be transferred through backcross conversion include, but are not limited to, waxy starch, sterility (nuclear and cytoplasmic), fertility restoration, grain color (white), nutritional enhancements, drought tolerance, nitrogen utilization, altered fatty acid profile, increased digestibility, low phytate, industrial enhancements, disease resistance (bacterial, fungal, or viral), insect resistance, and herbicide tolerance or resistance."). *See also* EX1067, 44:62-65 ("wherein the fewer than six locus conversions confer a property selected from the group consisting of herbicide tolerance, insect resistance and disease resistance").
Claim 18	23:45-47 ("In some embodiments, a transformed variant of PH47W4 may comprise at least one transgene…"); 24:44-48 ("a backcrossing approach is commonly used to move a transgene from a transformed maize plant to an elite inbred variety, and the resulting progeny would then comprise the transgenic event(s)"); 20:39-41("Transgenes transferred via backcrossing typically function as a dominant single gene trait

	Relevant Disclosures in Benson (EX1006))
	and are relatively easy to classify."); 23:31-32:29 (identifying particular types of transgenes).

146. I also note that Benson's own claims 2-20 parallel Challenged Claims 2-20—confirming that the derivatives, variations, and uses recited in those claims were not inventive over the new variety recited in claim 1.

Claim in '545	Corresponding Claim in Benson
2	2 (EX1006, 40:22-23)
3	3 (40:24-25)
4	4 (40:26-28)
5	5 (40:29-32)
6	6 (40:33-37)
7	7 (40:38-41)
8	8 (40:42-49)
9	9 (40:50-53)
10	10 (40:54-62)
11	11 (40:63-41:2)
12	12 (41:3-4)

Claim in ’545	Corresponding Claim in Benson
13	13 (41:5-7)
14	14 (41:8-11)
15	15 (41:12-16)
16	16 (41:17-20)
17	17 (42:1-3)
18	18 (42:4-11)
19	19 (42:12-14)
20	20 (42:15-18)

The unpatentability of claims 2-20 is further confirmed by PO’s other prior art patents (EX1067-EX1071) including analogous claims related to other inbred corn lines.

D. Ground 3: Claims 1-20 Are Unpatentable As Obvious Over Longenberger (EX1007)

147. Longenberger discloses PH47K2—a prior art inbred variety with traits very similar to those of the PH4CYJ variety claimed in the ’545 Patent.

148. Longenberger discloses that PH47K2 can be used “to Develop Another Maize Plant” and in particular is a “source of breeding material that may

be used to develop new maize inbred varieties." EX1006, 32:38-43. It also discloses specific cross breeding techniques for producing such "new inbred" varieties. Id., 5:38-45. In particular, Longenberger discloses using PH47K2 to derive new maize seeds that are genetically and physically similar to PH47K2. EX1006, 18:19-19:44.

149. Consistent with these disclosures, PH47K2 was previously used as one of the parents for another maize variety—a hybrid line disclosed in prior art. EX1060, US Patent No. 10,863,705, 11:19-21.

150. As Longenberger itself discloses and the other prior art cross confirms, POSAs would have had reason to use PH47K2 as the starting point to create other inbred lines. The nature of the maize market confirms the reasons to create a wide array of new varieties using PH47K2 as the starting point.

151. POSAs would have had a reasonable expectation of obtaining an inbred maize variety with PH47K2 as a parent, particularly given (1) the routine nature of the breeding techniques involved, (2) Longenberger's disclosure that its claimed variety can be "used to develop new maize inbred varieties" (EX1007, 32:38-43) and (3) the previous instance already reported in which PH47K2 had been used as a parent to obtain another line.

1. Claim 1

152. Claim 1 encompasses a seed, plant part, or plant cell of variety PH4CYJ. PH4CYJ's disclosed characteristics are highly similar to PH47K2's as disclosed in Longenberger, and nothing in the '545 Patent's specification or otherwise in the intrinsic record suggests any property of PH4CYJ that POSAs would have viewed as surprising, unexpected, or commercially valuable over PH47K2. *Supra* §IX.A.2. The record does not explain the significance of any differences between the claimed variety and known varieties. To the extent such differences exist, there is no basis from which to conclude they are significant or unexpected as compared to the PH47K2 variety disclosed in Longenberger and touted therein as a potential starting point for future inbred lines.

153. Comparing the values disclosed in Longenberger against the 95% confidence intervals for the values disclosed in the '545 Patent shows that most of the values (18 out of 25) fall within the confidence interval and each of the remaining seven have overlapping confidence intervals. *See* Appendix B (green highlighting indicating values within range). This demonstrates that the differences for most measurements are likely not statistically significant. The only characteristics falling outside the 95% confidence interval are: length of top ear internode, branch angle from central spike, central spike length, shank length, ear diameter at mid-point, kernel length, and cob diameter. *See* Appendix B.

However, there is no indication, even if these characteristics are physically different, that the differences have any meaning to the performance of the plant or have any commercial significance. Of course, it remains unclear the degree to which any difference may be due to difference in growing conditions and location for the samples. In any event, as discussed for the respective characteristics at paragraphs 75-85, the values for PH4CYJ all fall within or are similar to the ranges established by the prior art.

154. Indeed, none of the differences have any material commercial significance. In particular, none of them are relevant to the underlying goal identified in the '545 Patent of developing "stable, high yielding maize varieties and hybrids that are agronomically sound with maximal yield over one or more different conditions and environments." EX1001, 1:23-26. Nor are they relevant to the nature of the '545 Patent's disclosed "Industrial Applicability." EX1001, 36:20-65.

155. Again considering the two characteristics relied upon by the Examiner (see paragraph 111), I conclude that these features are not a basis to distinguish the '545 Patent's PH4CYJ from Longenberger for the following reasons:

a. Aleurone Color. PH4CYJ and PH47K2 both have clear aleurone. *See* paragraph 69. As described above at paragraph 111, because PH4CYJ has yellow-orange endosperm and thus a product would also

be yellow, the combination of yellow endosperm and clear aleurone for PH4CYJ does not constitute a material difference over Longenberger's clear aleurone and yellow-range endosperm.

b. Genetic Background. The '545 Patent's PH4CYJ was bred from a cross of Smalley's PH1KTF with another variety (PH1VNA) that has not been disclosed. EX1001, 37:62-64. Longenberger's PH47K2 was bred from a cross of inbred lines PH1D84 and PH12K5. EX1007, 38:55-61. In the first place, the '545 Patent does not disclose the genome of the PH4CYJ and does not identify any particular degree of similarity or difference as relevant. Additionally, although a relationship between PH4CYJ and PH47K2 is not apparent on the face of the '545 Patent and Longenberger, the two families were at least intercrossed a number of times before the filing date of the '545 Patent. *See, e.g.,* EX1041, U.S. Patent No. 10,827,697, 38:55-57 (cross of PH1KTF and PH1D84); EX1107, U.S. Patent No 9,693,531, 18:56-58 (cross of PH12K5 and PHFOD); EX1108, U.S. Patent No 9,642,322, 18:47-49 (same); EX1109, U.S. Patent No. 9,426,963, 12:52-55 (cross of PHCCW and PHWON); *see also* EX1005, Smalley, 12:35-37 (PHFOD and PHWON were crossed to yield

PH1KTF); EX1110, U.S. Patent No. 8,759,636, 12:35-37 (PHCCW and PHE4N were crossed to yield PH1D84).

156. As discussed above at paragraphs 75-85, each of the characteristics shown in the '545 Patent, Table 1 is either within the range established by the prior art, is not technically or economically relevant, or both. Accordingly, claim 1 would have been obvious over Longenberger.

2. Claims 2-20

157. Claims 2-20 are likewise unpatentable as obvious over Longenberger for the same reasons detailed immediately above concerning claim 1 and for the additional reasons explained in §IX.B.2 concerning why claims 2-20 are obvious over Smalley and as further confirmed by PO's other prior art patents (EX1067-1071) including analogous claims related to other inbred corn lines. Longenberger has disclosures paralleling the disclosures in Smalley identified in §IX.B.2 concerning claims 2-20.

158. In particular:

	Relevant Disclosures in Longenberger (EX1007)
Claim 2	12:40-47 ("plant part" includes "pollen" and "ovules"); 41:14-15 ("The plant part of claim 1, wherein the plant part is an ovule or pollen")

	Relevant Disclosures in Longenberger (EX1007)
Claims 3-4 and 12-13	18:20-28 ("F1 hybrids" sought as "commercial hybrids" because they "are more vigorous than their inbred parents")
Claims 5, 14, and 19	18:67-19:1 (disclosing crossing "F1 hybrid" with "third inbred")
Claims 6 and 15	34:22-26 (disclosing "[h]aploid induction systems" in which "haploid plants from any genotype" may be created "by crossing a selected variety (as female) with an inducer variety")
Claims 7, 16, and 20	37:60-65 ("The seed of maize variety PH47K2, the plant produced from the seed, the hybrid maize plant produced from the crossing of the variety, hybrid seed, and various parts of the hybrid maize plant and transgenic versions of the foregoing, can be utilized for human food, livestock feed, and as a raw material in industry.")
Claim 8	18:67-19:1 (disclosing crossing "F1 hybrid" with "third inbred"); 41:22-25 (claim 5)
Claim 10	18:12-13 ("locus conversion of PH47K2 for herbicide tolerance"); 18:15-16 ("locus conversion for insect or disease resistance");

	Relevant Disclosures in Longenberger (EX1007)
	19:45-51 ("PH47K2 represents a new base genetic variety into which a new locus may be introgressed"); 11:28-36 ("A locus conversion refers to plants within a variety that have been modified in a manner that retains the overall genetics of the variety and further comprises one or more loci with a specific desired trait, such as male sterility, insect resistance, disease resistance or herbicide tolerance or resistance."); 42:11-17 ("locus conversion confers a property selected from the group consisting of male sterility, site-specific recombination, abiotic stress tolerance, altered phosphate, altered antioxidants, altered fatty acids, altered essential amino acids, altered carbohydrates, herbicide tolerance, insect resistance and disease resistance")
Claim 11	20:35-43 ("At least one, at least two or at least three and less than ten, less than nine, less than eight, less than seven, less than six, less than five or less than four locus conversions may be introduced into the plant by backcrossing, introgression or transformation to express the desired trait")

	Relevant Disclosures in Longenberger (EX1007)
Claim 18	11:34-36 ("Examples of single locus conversions include… transgenes"); 20:48-50 ("Transgenes transferred via backcrossing typically function as a dominant single gene trait and are relatively easy to classify."); 26:4-32:37 (identifying particular types of transgenes)

159. Longenberger's own claims 2-20 likewise parallel Challenged Claims 2-10 and 12-20:

Claim in '545	Corresponding Claim in Longenberger
2	2 (EX1007, 41:15-16)
3	3 (41:17-18)
4	4 (41:19-21)
5	5 (41:22-25)
6	6 (41:26-30)
7	7 (41:31-34)
8	8 (41:35-42)
9	9 (41:43-45)
10	10 (41:46-55)

Claim in ’545	Corresponding Claim in Longenberger
11	11 (42:11-17)
12	12 (42:18-19)
13	13 (42:20-22)
14	14 (42:23-26)
15	15 (42:27-31)
16	16 (42:32-35)
17	17 (42:36-38)
18	18 (42:39-46)
19	19 (42:47-49)
20	20 (42:50-54)

160. The unpatentability of claims 2-20 is further confirmed by PO’s other prior art patents (EX1067-1071) with analogous claims (including claims paralleling claim 11) related to other inbred corn lines. *E.g.*, EX1067, 44:62-65.

X. GROUND 4: CLAIMS 1-20 LACK SPECIFIC UTILITY

161. Claims 1-20 are unpatentable for the separate and independent reason that the claimed invention “lacks a specific and substantial utility” as required by §101. I describe in detail the basis for my opinion in this Section X. At a high level, I reach this opinion because the utility described in the ’545 Patent is lacking

as compared to the stated purpose and use as well as the prior methods established by POSAs for describing utility.

162. Nothing in the ’545 Patent’s specification suggests any “specific benefit” provided by the claimed invention. Nothing in this particular patent’s specification establishes that claims 1-20 are a “useful improvement” over earlier corn varieties.

163. Here, however, the ’545 Patent only disclosed general uses for the PH4CYJ variety, not specific utility that satisfies §101. The specification’s “Industrial Applicability” section is essentially identical to that in Benson and very similar to those in Smalley and Longenberger. *See* EX1001, 36:21-65; EX1005, 34:1-38; EX1006, 37:12-55; EX1007, 37:21-65. Nothing in the record suggests any utility specific to the PH4CYJ variety itself beyond that generic to any species of corn.

164. Likewise, to the extent the ’545 Patent suggests particular phenotypical differences between the claimed PH4CYJ variety and prior art varieties, it never even expressly identifies such differences—much less explains why they confer some specific benefit not already available from the prior art. Instead, as I previously noted, the relevant table (“Variety Description Information”) is drawn essentially verbatim from certain fields in a form (EX1096) prepared by the USDA and used in connection with PVPA certificates.

165. Nothing in the ’545 Patent suggests any reason why the claimed variety’s properties have such characteristics and the potential for significant utility. Any suggestion to that effect would instead necessarily flow from POSAs’ preexisting knowledge concerning corn in general rather than being based on the specification’s actual disclosures regarding the claimed variety in particular.

166. For example, if one assumed for the sake of analysis that the claimed variety’s length of ear node leaf (which falls within the range of Smalley, Benson, and Longenberger (see paragraph 80) somehow established the variety’s specific utility because POSAs would recognize some alleged benefit, such a conclusion would simply confirm the obviousness of claims. Achieving such phenotypical variations through breeding techniques was well within the level of ordinary skill in the art as of July 2021, though no utility is apparent.

167. I have reviewed the ’545 Patent with reference to the utility requirement of §101. I have concluded that the ’545 Patent does not disclose that the claimed subject matter has specific utility.

168. Given that the claimed maize variety is an inbred variety, POSAs would understand that any such utility would be in the form of generating beneficial hybrids when crossed. This understanding is corroborated by the descriptions in the ’545 Patent of the Combining Ability and Hybrid comparisons (EX1001,19:4-35) and the ’545 Patent’s description of Industrial Applicability

(EX1001, 36:21-65). However, the patent shows no data on such characteristics, nor of performance on the very relevant traits described in the patent as genetic analysis-based selection criteria.

169. As explained above, the standard practice in the industry is for seed producers to develop inbred varieties that are crossed with other inbred varieties to yield a hybrid variety. That seed producer then sells the hybrid variety to farmers to be grown as an agricultural crop. Accordingly, with a limited exception I discuss below, it is the quality of the ultimate *hybrid* variety that is of the greatest interest to determining whether the inbred as value. A hybrid variety is judged by many characteristics, which include the yield, comparative relative maturity (CRM), disease resistance, quality of the corn grain for a particular purpose (e.g., food grade, milling, livestock feed, cellulose, fuel, etc.), and the like.

170. Characteristics to be improved by plant breeding include: yield, resistance to pests, seed composition, forage quality, tolerance to mineral stresses, tolerance to environmental stresses, adaptability to mechanization, standability (the ability to remain upright), stability of performance across years and locations, and photoperiod response (the amount of light required by the variety). EX1016, Fehr at 2-7.

171. The partial exception to the value of the inbred variety being in the hybrid varieties, as discussed in the previous paragraph, is that there are certain

breeding characteristics in the inbred variety that affect its ability to yield a good hybrid crop. These parental traits of an inbred line include, for example, the ability of the male plant to provide sufficient pollen, the yield potential of a female parent, and the ability of the female parent to produce high quality seed which maintains seed performance and viability. However, this is only a partial exception, because the ultimate goal is still to achieve a successful hybrid crop. Furthermore, even if parental traits of the inbred line were the objectives of the breeding program, the measured traits and asserted benefits (utility), as outlined above, would have been different that the trait values disclosed in Table 1 of the ’545 Patent.

172. In addition to the normal commercial market of the company breeding the inbred line, there is also a market for selling/licensing inbred varieties to other seed producers. However, the value of the inbred variety on this market is also based on the same considerations as stated above, that is, the quality of the hybrid variety produced and quality of the inbred as a breeding stock, and not on the trait values described in Table 1 of the ’545 Patent.

173. The upshot of the foregoing if that one needs actual data about the performance of the inbred variety based on its ability to be used as a parent to breed a hybrid with superior customer value and seed production traits in order to determine whether it has utility. A corn breeding program will most certainly generate any number of inbred varieties that are substantially useless if those lines

cannot generate a good hybrid as judged by the commercial business and their customers.

174. I have carefully reviewed the ’545 Patent to try to identify any disclosure showing that the claimed inbred variety has been shown to have utility for its intended purpose, i.e., as a parental line capable of breeding suitable hybrids. I do not see any such indication. The section on Industrial Applicability (36:21-65) describes ways in which corn may be used, but in no way ties the claimed inbred to any of these uses. Nor do the reported traits tie the claimed inbred to any of these uses. Moreover, the section appears identical to that of numerous other PHI patents as discussed above.

A. Analysis of Patents at Issue in *J.E.M. Ag Supply*

175. Counsel informs me that the 17 patents in the chart below were at issue in the case *J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred Int'l, Inc*. and that, in that case, the Supreme Court held that newly developed plant breeds were eligible for utility patent protection if the claims satisfy all statutory requirements, including utility and non-obviousness. 534 U.S. 124, 127, 145 (2001).

176. A review of the patents at issued in *J.E.M.*, which were PHI’s patents, shows that each included at least some comparisons, supported with data, between the claimed variety and earlier varieties.

177. For example, U.S. Patent No. 5,491,295 (EX1080, "Niebur," on which I am a co-inventor as discussed in Section II.C above), described Hybrid 3394 as "characterized by superior yield for maturity, excellent seedling vigor, very good roots and stalks, and exceptional stay green." EX1080, 2:66-3:3. Niebur included Example 1 comparing Hybrid 3394 with nine other hybrids, including six PHI hybrids and three from other suppliers. EX1080, 8:15-18:35. Among many other points of comparison, the Example 1 data showed that "[hybrid] 3394 has higher yield and grain harvest moisture, but lower test weight than [hybrid] 3503"; "[hybrid] 3394 has higher yield, grain harvest moisture, and test weight than [hybrid] 3417"; "[hybrid] 3394 is higher yielding but has lower grain moisture and test weight than [hybrid] 3398"; "[hybrid] 3394 outyields and has higher test weight but slightly lower grain moisture than [hybrid] 3379"; and so on with respect to the other comparators. EX1080, 8:18-54.

178. Niebur Example 2 provides strip test data comparing hybrid 3394 to the same six PHI hybrids and two of the three competitor hybrids used in Example 1. A strip test is a method for growing two or more varieties under substantially the same conditions so that data obtained for the varieties may be compared. The "strip" is a set of rows of a particular variety that is adjacent to a second strip with a second variety, and so on. Niebur describes a typical example in which strips of different hybrids were grown to obtain the comparative data presented in Niebur:

> Comparison data was collected from strip tests that were grown by farmers. Each hybrid was grown in strips of 4, 6, 8, 12, etc. rows in fields depending on the size of the planter used. The data was collected from strip tests that had the hybrids in the same area and weighed. … The number of comparisons represent the number of locations or replications for the two hybrids that were grown in the same field in close proximity and compared.

EX1080, 17:41-51. All of the other patents at issue in the *Pioneer v. J.E.M.* case also included strip test and/or other comparative data permitting direct comparisons. By contrast, the '545 Patent does not include any strip test data or other comparative information.

179. As summarized in Niebur, "[t]he results show Pioneer Brand Hybrid 3394 had a yield advantage over compared hybrids except Pioneer Hybrid 3398 where it had a disadvantage of 2.8 bushels per acre. 3394 had a slight moisture disadvantage against Pioneer Hybrids 3503, 3417, and 3362, and Garst Hybrid 8532. [Hybrid] 3394 showed a greater income advantage to the farmer based on adjusted gross income over all hybrids compared except Pioneer Hybrid 3398 where the disadvantage was $4.18 per acre. With the exception of Pioneer Hybrid 3398, 3394's yield and income advantage plus its advantage for other characteristics over these hybrids will make it an important addition for most of the areas where these hybrids are grown." EX1080, 17:58-18:67.

180. Finally, in Example 3, Niebur included a comparison of key characteristics for the claimed hybrid 3394 as compared to the other six PHI hybrids and three competitor hybrids. EX1080, 19:58-21:39. In view of the data, Niebur concludes that "[hybrid] 3394 yielded well for its maturity, yielding equally well at both high and low plant population densities" and had "very good stay green and seedling vigor compared to the other hybrids." 20:65-21:1. In sum, "[hybrid] 3394 has overall excellent yield and agronomic characteristics which should make it an important hybrid in its area of adaptation." EX1080, 21:2-3.

181. Indeed, hybrid 3394 exhibited superior stay green as compared to hybrid 3398, which exceeded performance of hybrid 3394 in other categories. EX1080, Table 3 (showing STGR of 8 for 3384 compared to 3 for hybrid 3398); 5:10-14 (defining stay green ("STGR") as "the measure of plant health near the time of black layer formation (physiological maturity)"; "A high score indicates better late-season plant health…").

182. In short, the '295 Patent included data demonstrating that hybrid 3394 was superior in at least some significant characteristics as compared to other hybrids.

183. In another example, U.S. Patent No. 5,453,564 (EX1040, "Chapman"), discloses inbred corn line PHTE4. EX1078, Title. Chapman describes PHTE4 as a variety that "produces hybrids that are high yielding and

flower early. PHTE4 hybrids have above average seedling vigor, test weight and staygreen. PHTE4 hybrids also have above average resistance to brittle stalks." EX1078, 7:13-16. Chapman discloses "the traits and characteristics of inbred corn line PHTE4 … in comparison with other inbreds and in hybrid combination." EX1078, 9:62-65.

184. Chapman's Tables 3A-3E present comparisons between inbred line PHTE4, on the one hand, and inbred lines PHN15, PHNV4, PHJ40, PHT46, and PHBW8, respectively. EX1078, col. 11-16. From these data, Chapman concludes that "PHTE4 has lower yield and grain harvest moisture but higher test weight compared to PHN15"; "PHTE4 has lower yield and higher grain harvest moisture than PHNV4"; "PHTE4 has higher yield and grain harvest moisture but lower test weight compared to PHJ40"; "PHTE4 has a higher yield than PHT46"; "PHTE4 has lower yield and grain harvest moisture but higher test weight compared to PHBW8." EX1078, 9:67-10:26.

185. Chapman's Table 4A compares "PHNV4 to PHTE4 crossed to the same inbred testers"; Table 4B compares "PHNV4 to PHTE4 crossed to the same kinbred testers"; Table 4C compares "PHTE4 to PHBW8 crossed to the same kinbred testers." EX1078, col. 15-18. From this data, Chapman conclude that "[t]he PHTE4 hybrids have higher yield and grain harvest moisture" as well as "better seedling vigor and higher early stand count" when compared to the PHNV

4 hybrids, and higher grain harvest moisture and better seedling vigor than the PHRE1 hybrids. EX1078, 10:33-43.

186. Finally, Chapman's Tables 5A and 5B compare hybrids of PHTE4 to hybrids of PHBW8 and PHRE1, respectively. EX1078, col. 17-18. Chapman concludes that PHTE4 and PHBWB shows similar yield when test weight when crossed to the same inbred, but "[t]he PHTE4 hybrid is taller with higher ear placement compared to the PHBW8 hybrid." EX1078, 10:53-54. The "PHTE4 hybrid has significantly higher grain harvest moisture," better test weight, and lower ear placement than the PHRE1 hybrid. EX1078, 10:57-59.

187. Accordingly, Chapman discloses information showing that the claim PHNV4 was superior in at least some relevant respects.

188. Examples of disclosures for these and the other patents in the *J.E.M.* case are set forth in the following chart:

Hybrid	Patent No.	Notable Disclosures
3394	5,491,295 (EX1080)	**"Hybrid Corn Plant & Seed"** 2:66-3:3 ("This hybrid corn plant is characterized by superior yield for maturity, excellent seedling vigor, very good roots and stalks, and exceptional stay green.

Hybrid	Patent No.	Notable Disclosures
		It is widely adapted, but performs best in the Central and Eastern Corn Belt.") 4:50-55 ("defining "PERCENT WINS": "For yield, moisture, income, populations, stand, roots, and test weight, it would be the percentage of comparisons that the hybrid to be patented yielded more, had lower harvest moisture percentage, had greater income per acre, had better stalks, had better roots, and had higher test weight, respectively, in strip tests.") 5:36-45 ("Pioneer Brand Hybrid 3394 is a single cross, yellow endosperm, dent corn hybrid with superior yield in its maturity. It has stable yield across environments, has above average grain appearance with average test weight, and has exceptional stay green. 3394 has excellent seedling vigor and very good drought tolerance. The inventor has observed that the leaf angle is semi upright and the leaf is short

Hybrid	Patent No.	Notable Disclosures
		and wide, which is a unique characteristic of this hybrid. The hybrid has the potential to form an abscision layer and drop ears free from the husk.") 8:15-18:35 (Example 1 – "Research Comparisons" of Hybrid 3394 against nine other hybrids—six from Pioneer and three from competitors) 17:40-20:55 (Example 2 – "Strip Test Data for Hybrid 3394 against nine other hybrids—six from Pioneer and three from competitors) 20:58-21:4 (Example 3 – "Comparison of Key Characteristics for Hybrid 3394…)
	5,506,367 (EX1083)	**"Inbred Corn Line PHP38"** 6:20-36 ("Inbred corn line PHP38 is a yellow, dent corn inbred that provides an acceptable male or female parental line in crosses for producing first generation

Hybrid	Patent No.	Notable Disclosures
		F1 corn hybrids. PHP38 is best adapted to the central and eastern regions of the United States. Hybrids of PHP38 also possess very good drought tolerance and stability of yield which makes them extremely well-adapted for the hot, arid growing areas of the Western United States. The inbred can be used to produce hybrids from approximately 111-126 relative maturity based on the Minnesota Relative Maturity Rating System for harvest moisture of grain. PHP38 should make a good female since it has acceptable yield, good early vigor, and good early stand establishment. PHP38 would also be acceptable as a male because of its pollen yield. The inbred in hybrid combination has excellent stay green and overall disease tolerance. PHP38 has excellent stalks and above average roots. PHP38 hybrids generally have very good grain quality and high test weight.")

Hybrid	Patent No.	Notable Disclosures
		11:44-20:45 (“Inbred and Hybrid Performance of PHP38”)
	5,567,861 (EX1087)	**“Inbred Corn Line PHN46”** 6:7-16 (“Inbred corn line PHN46 is a yellow, dent corn inbred that provides an acceptable male parental line in crosses for producing first generation F1 corn hybrids. PHN46 is best adapted to the Central Corn Belt of the United States. The inbred can be used to produce hybrids from approximately 110-122 relative maturity based on the Minnesota Relative Maturity Rating System for harvest moisture of grain. PHN46 should make an excellent male since it has high pollen yield. The inbred in hybrid combination has good yield, stay green, stalks, and roots.”) 9:63-24:40 (“Inbred and Hybrid Performance of PHN46”)

Hybrid	Patent No.	Notable Disclosures
3489	5,557,035 (EX1086)	**"Hybrid Corn Plant & Seed (3489)"** 4:41-43 ("3489 is a very high yielding, widely adapted, stable 108 CRM hybrid. 3489 has above average yield across all environments.") 7:24-38 ("Pioneer Brand Hybrid 3489 has exceptional yield for its maturity. The hybrid is widely adapted and very stable which will make it an excellent companion hybrid to many of the hybrids in its area of adaptation….It has had top yield for four straight years beginning with very early experimental topcross testing. Compared to the closest existing hybrid (3417), 3489 has resistance to brittle stalk, resistance to heavy infection of common rust, tolerance to less solar radiation and the ability to withstand excessive wet soil conditions.")
	5,444,178 (EX1077)	**"Inbred Corn Line PHHB4"**

Hybrid	Patent No.	Notable Disclosures
		7:16-26 ("PHHB4 brings together more yield in hybrids than either parental line. In hybrid combination PHHB4 has desirable plant and ear height, resistance to brittle stalk, and resistance to common rust. Hybrids of PHHB4 do well in both dry and wet years compared to the closest prior art, but are especially better in wet years. Inbred corn line PHHB4 is a yellow, dent corn inbred and provides an acceptable female parental line in crosses for producing first generation F1 corn hybrids. PHHB4 is adapted to most regions of the United States but does best in Nebraska, Iowa, Illinois and Indiana.") 9:44-16:53 ("Examples – Inbred and Hybrid Performance of PHHB4")
	5,633,427 (EX1089)	**"Inbred Corn Line PHHB"** [Continuation of the '178]

Hybrid	Patent No.	Notable Disclosures
	5,347,081 (EX1076)	**"Inbred Corn Line PHK56"** 6:10-20 ("PHK56 is best adapted to the Central Corn Belt of the United States. The inbred can be used to produce hybrids from approximately 106-118 relative maturity based on the Minnesota Relative Maturity Rating System for harvest moisture of grain. PHK56 would make a good male because it is a good pollinator with good pollen yield. In hybrid combinations PHK56 provides high yields, has low grain moisture at maturity and performs under stress as well as good conditions. It also has good roots, low ear placement, and gray leaf spot tolerance.") 9:63-12:20 (examples concerning PHK56's "inbred and hybrid performance": "These results show that PHK56 hybrids offer significant advantage over commercial products that are sold for yield and other important agronomic traits.")

Hybrid	Patent No.	Notable Disclosures
3559	5,453,564 (EX1078)	**"Inbred Corn Line PHTE4"** 7:13-16 ("PHTE4 produces hybrids that are high yielding and flower early. PHTE4 hybrids have above average seedling vigor, test weight and staygreen. PHTE4 hybrids also have above average resistance to brittle stalks.") 9:60-10:62 ("In the examples that follow, the traits and characteristics of inbred corn line PHTE4 are given as a line in comparison with other inbreds and in hybrid combination.")
	5,495,069 (EX1081)	[Continuation of the '564]
	5,569,822 (EX1088)	[Continuation of the '069]

Hybrid	Patent No.	Notable Disclosures
	5,534,661 (EX1084)	**"Inbred Corn Line PHKW3"** 13:46-24:15 ("In the examples that follow, the traits and characteristics of inbred maize line PHKW3 are given as a line in comparison with other inbreds and in hybrid combination….") See, e.g., 13:52-14:6 (disclosing data indicating that claimed PHKW3 was "taller," had "higher ear placement," and had "significantly lower grain harvest moisture" as compared to either parent).
3730	5,689,036 (EX1091)	**"Hybrid Maize Plant and Seed (3730)"** 5:32-36 ("This hybrid maize plant is characterized by high yield, strong stalks, excellent early season growth and rapid dry-down after reaching maturity. It is best adapted for the North Central Region of the United States.")

Hybrid	Patent No.	Notable Disclosures
		10:38-44 ("Hybrid 3730 demonstrates an unexpected, excellent early season growth that is very rapid relative to other hybrids for its maturity. In addition, Hybrid 3730 has very good stalks and rapid dry-down after reaching maturity. Hybrid 3730 also demonstrates improved staygreen over other hybrids in its maturity.") 12:25-16:67 ("Research Comparisons" against hybrids 3723, 3733, 3714, and 3563) 17:1-25 ("Strip Test Data for Hybrid 3730 against five other hybrids: "Hybrid 3730 has a yield advantage over all of the hybrids. Hybrid 3730 has an income/acre advantage over all but one of the hybrids, 3723, which has a similar income per acre as 3730. The income per acre advantage ranged from $3.46 to $13.80. Hybrid 3730's yield and income advantage plus its advantage for other characteristics over these hybrids will make it

Hybrid	Patent No.	Notable Disclosures
		an important addition for most of the areas where these hybrids are grown.") 18:1-25 ("Comparison of Key Characteristics for Hybrid 3730: "Hybrid 3730 has good drydown and early growth when compared to the other hybrids. Hybrid 3730 has overall high yield and other good agronomic characteristics which should make it an important hybrid in its area of adaptation.")
	5,545,813 (EX1085)	**"Inbred Maize Line PHRF5"** 9:59-10:2 ("Inbred maize line PHRF5 is a yellow, dent maize inbred that is best suited as a female in crosses for producing first generation F1 maize hybrids. Inbred maize line PHRF5 is best adapted to the North Central region of the United States and can be used to produce hybrids from approximately 99 relative maturity based on the Comparative Relative Maturity Rating System for harvest moisture of grain. Inbred

Hybrid	Patent No.	Notable Disclosures
		maize line PHRF5 yields well for its maturity, has good stalks and good roots. Inbred maize line PHRF5 has good early season growth and good staygreen. Although PHRF5 has a somewhat lower resistance to Brittle Snap than other inbreds, PHRF5 demonstrates good stalk lodging resistance.") 13:5-22:59 (providing "performance examples of PHRF5," including performance of hybrids)
34R06	5,557,035 (EX1086)	[covered above]
	5,444,178 (EX1077)	[covered above]
	5,633,427 (EX1089)	[covered above]
	5,347,081 (EX1076)	[covered above]

Hybrid	Patent No.	Notable Disclosures
35N05	5,502,272 (EX1082)	**"Hybrid Corn Plant and Seed (3563)"** Abstract ("This hybrid corn plant is characterized by excellent yield potential, good test weight, and fast drydown. It performs best from Indiana/Ohio West.") 8:5-14:28 (Example 1—"Research Comparisons" between 3563 and three other Pioneer hybrids along with one DeKalb hybrid) 13:29-16:20 (Example 2—"Test Strip Data" comparison between 3563 and three other Pioneer hybrids along with one DeKalb hybrid) 15:22-47 ("Comparison of Key Characteristics for Hybrid 3563….Relative to the hybrids compared, ***3563 has higher test weight and better grain appearance***.")

Hybrid	Patent No.	Notable Disclosures
	5,463,173 (EX1079)	**"Inbred line PHR61"** 5:63-66 ("Inbred corn line PHR61 is a yellow, dent corn inbred that is best used as a female in crosses for producing first generation F1 corn hybrids. PHR61 is best adapted to the North Central Region of the United States.") 6:2-14 ("PHR61 has consistent high hybrid yields for its grain moisture maturity. PHR61 has excellent stalks, stay green, and grain quality… Inbred PHR61 provides hybrids which, although adapted to cool Northern climates, perform exceptionally well in warm growing seasons which occasionally occur in the Northern Corn Belt of the United States. 9:55-11:1 ("Inbred and Hybrid Performance of PHR61" as compared to six other Pioneer inbred lines)

Hybrid	Patent No.	Notable Disclosures
	5,347,081 (EX1076)	[covered above]
34K77	5,534,661 (EX1084)	[covered above]
35R57	5,689,034 (EX1090)	**"Inbred Maize Line PH24E"** 9:55-10:9 ("Inbred maize line PH24E is a yellow, dent maize inbred that is best suited as either a male or female in crosses for producing first generation F1 maize hybrids. Inbred maize line PH24E is best adapted to the Northcentral region of the United States and can be used to produce hybrids from approximately 106 relative maturity based on the Comparative Relative Maturity Rating System for harvest moisture of grain. As an inbred per se, maize line PH24E is a high yielding female with a resistance to barrenness. Inbred PH24E exhibits good cold test

Hybrid	Patent No.	Notable Disclosures
		results, good stalks and dark green plants. As an inbred per se, PH24E exhibits excellent resistance to barrenness which makes it a reliable seed production parent. Inbred PH24E demonstrates excellent general combining ability. When in hybrid combination, PH24E exhibits high yield for its maturity with a stability over different environments across the Northcentral Corn Belt. PH24E hybrids have excellent roots, good stalk strength and quality and short plant stature. PH24E hybrids' short plant stature and associated reduced crop residues, make them well adapted to conservation tillage cropping systems. PH24E hybrids perform well from the eastern to western edges of the Northcentral Corn Belt.") 13:1-26:30 ("Performance Examples of PH24E," including hybrid performance").

Hybrid	Patent No.	Notable Disclosures
3563	5,502,272 (EX1082)	[covered above]
	5,463,173 (EX1079)	[covered above]
	5,347,081 (EX1076)	[covered above]
3751	5,082,992 (EX1075)	**"Inbred Corn Line PHP02"** 4:66-5:1 ("Inbred corn line PHP02 is a yellow dent corn inbred that gives superior characteristics in hybrid combination and is an excellent parental line in crosses for producing first generation F1 corn hybrids.") 5:21-25 ("The inbred is adapted over a wide area of the northern Corn Belt and can be used advantageously in hybrids from approximately 95-114 RM based on the Minnesota Relative Maturity Rating System for harvest moisture of the grain.")

189. These disclosures in the patents at issue in the *J.E.M.* case identified particular reasons why the claimed varieties had specific value separate and apart from other corn varieties. In fact, during the *J.E.M.* case, the U.S. Patent Office signed a legal brief stressing that the patents at issue (including my own patent) disclosed "readily identifiable benefits to farmers." EX1030, 28. I agree with the Patent Office's characterization.

190. By contrast, the '545 Patent does not identify any such specific value or benefit to farmers.

XI. GROUNDS 5-6: THE '545 PATENT FAILS TO STAISFY SECTION 112

A. The Minimal Differences Between the '545 Patent's Specification and the Prior Art Are At Best Consistent with the Disclosures Required for PVP Certificates

191. As compared to the indisputable §102(a)(1) prior art Benson patent (disclosing an inbred sibling of the claimed variety—sharing one of the two parental lines), the only additional information the '545 Patent provides is that:

(1) the code name of the new variety is PH4CYJ (rather than PH47W4 as in Benson)

(2) the new variety was created by crossing inbred line PH1KTF (also used in Benson) with inbred line PH1VNA (as opposed to PH18FC as in Benson)

(3) the new variety has shown uniformity and stability for the traits identified in the Variety Description Information (Table 1), which are different from those in Benson's Table 1; and

(4) PO made a deposit of the new variety with a public repository under a particular ascension number.

192. In fact, Benson contains additional material that was removed from otherwise identical portions of the '545 Patent's specification. For example, Benson provides citations to several journal articles in support of its discussion of genetic marker profiles that are absent for the '545 Patent. *Compare* Benson, 15:55-61 *with* EX1001, 15:60. The same is true for articles in support of backcross conversions (*compare* Benson, 19:55-61 and 20:4-5 *with* EX1001, 19:54 and 19:63), molecule marker analyses (*compare* Benson, 23:19-31 *with* EX1001, 23:7-12), and plant transformation protocols (*compare* Benson, 23:56-24:4 *with* EX1001, 23:39-43), among others.

193. Aside from these deletions, PO added "or plant material" to its industrial applicability section three times: "Another embodiment is a method of harvesting the grain *or plant material* of the Fl plant of variety PH4CYJ and using the grain *or plant material* in a commodity. … Examples of maize grain *or plant material* as a commodity plant product include, but are not limited to, oils, meals, flour, starches, syrups, proteins, cellulose, silage, and sugars." *See,* EX1001,

36:23-27. But this is not a meaningful difference because Benson already states that "plant parts other than the grain of maize" are "use[d] in industry." Benson, 37:46-49; see also Benson, 37:50-55 ("the plant produced from the seed [and] the hybrid maize plant … can be utilized for human food, livestock feed, and as a raw material in industry"). Thus, it would be obvious from Benson, as well as from a POSA's general experience, that the plant material of the maize plant has substantial industrial applicability.

194. Finally, the '545 Patent's breeding history states that "ears were selected [from the cross] based on genetic analysis predicting disease, insect, and agronomic phenotypic performance." EX1001, 38:64-66. Here again, this would have been obvious to a POSA from Benson, as well as from general experience. *See* Benson, 16:58-63 ("Favorable genotypes and or marker profiles, optionally associated with a trait of interest, may be identified…"). Moreover, the same disclosure was already disclosed verbatim in prior art references like Longenberger. EX1007, 38:57-61.

195. Aside from the different code name (PH4CYJ in the '545 Patent versus PH47W4 in Benson, reflecting the fact that each patent concerns a different variety), the only new information the '545 Patent's specification provides to POSAs is contained in the "Breeding History" (37:60-38:3) and "Variety

Description Information" (i.e., Table 1, 38:11-39:25) sections. *See* EX1001, a redline comparison between the '545 Patent and Benson.

196. In both Benson and the '545 Patent, the "Variety Description Information" tables disclose traits that are used for purposes of demonstrating "uniformity and stability"—both requirements under the PVPA. EX1001, 15:4-7; EX1006, 14:66-15:2.

197. The table of properties is drawn from certain fields in the the form applicants must submit when seeking PVP certificates on new corn varieties. See EX1096 ("The Objective Description Form is a necessary part of an application for Plant Variety Protection (Breeder's Rights) in the United States of America."). Notably, the PVP form includes certain other fields omitted from the '545 Patent. For example, the table does not include any information related to "Disease Reaction," "Insect Reaction," "Agronomic Traits," or "Molecular Markers."

B. The Minimal Differences Between the '545 Patent's Specification and the Prior Art Do Not Adequately Describe or Enable Claims 1-20

198. The Challenged Claims all directly or indirectly concern "***inbred maize variety PH4CYJ, representative seed of the variety*** having been deposited under NCMA accession number 202212062." Claims 1, 10, and 18 include such language directly, and the other claims descend from one of these three claims. On their face, in other words, the Challenged Claims purport to cover seeds and plants

regardless of whether they are derived from the seed stock PO supplied to the depository (i.e., the NCMA). By contrast, the claims at issue in *J.E.M.* concerning inbred lines. *E.g.*, EX1083, U.S. Patent No. 5,506,367, 20:47-49 (claiming "***Inbred corn seed designated PHP38, having ATCC accession No. 75612***"); *see infra* §X.A.

199. The '545 Patent fails even to convey the inventor's understanding of "representativeness." Aside from the claims themselves, the '545 Patent refers to "representative seed" only twice—both in column 34. But, each of these disclosures includes additional language absent from the claims themselves. The specification does not disclose "representative" species in any other context.

200. The first sentence describes "maize seed derived from the inbred maize variety PH4CYJ" that "***has 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99%***... of the same polymorphisms for molecular markers as the plant or plant part of inbred maize variety PH4CYJ." EX1001, 34:22-30. A POSA would understand that the "A' omitted from preceding quote (which recites "the inbred maize variety PH4CYJ has 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99% A of the same") is a typographical error and would understand that the "A" should be omitted. The claims include no such quantitative restrictions and/or references to the claimed variety's genotype.

201. The second sentence describes "seed derived from the inbred maize variety PH4CYJ" and having "***essentially the same morphological characteristics as maize variety PH4CYJ when grown in the same environmental conditions***." EX1001, 34:35-43. Even this sentence never specifies what morphological characteristics are required; the specification instead later notes that they "can be those listed in Table 1." EX1001, 34:44-45. By contrast, PO's standard practice in the past had been for claims to refer explicitly to "all the physiological and morphological characteristics" of a claimed variety. *See also* infra paragraphs 214-215.

202. By contrast, aside from claim 10, none of the Challenged Claims references morphological characteristics and/or environmental conditions. More fundamentally, the '545 Patent never ties any particular morphological characteristics to any particular environmental conditions. While Table 1 reflects certain morphological characteristics associated with PH4CYJ, the '545 Patent never discloses the environmental conditions under which the plants corresponding to Table 1 were grown. As such, the '545 Patent's specification is essentially useless to POSAs seeking to understand and/or reproduce the claimed invention at least because a POSA attempting to compare the PH4CYJ to other varieties would have no sound basis for doing so and thus would have no sound basis for selecting the PH4CYJ and using it to breed hybrids or inbreds. For example, many of the

physical properties of a corn plant grown in North Dakota under cold and wet conditions would be very different from those of a plant grown from the exact same seed in Iowa under hot and dry conditions.

203. By contrast, the specifications of PO's earlier patents at issue in *J.E.M.* included specific information indicating where and when the disclosed data had been generated—allowing POSAs to understand the relevant environmental conditions under which the plants associated with the data had grown. *See*, *e.g.*, EX1083, U.S. Patent No. 5,506,367, 9:27-29 ("Data…is based primarily on a maximum of two reps from Johnson, Iowa grown in 1988…."). Most of the patents disclose the location where variety was grown. *See, e.g.,* EX1082, 5:38-39 ("data collected primarily at Johnston, Iowa"); EX1085, 11:46-49 ("Data… based primarily on a maximum for four reps from Johnston, Iowa grown in 1993 and 1994"); EX1084, 10:2-3 ("Most of the data in the Variety Description information was collected at Johnston, Iowa.").

204. Although the '367 Patent reports that "***[m]ost*** of the data in the Variety Description Information was collected at Johnston, Iowa," (EX1083, 6:40-41) it appears that some data was gathered for other zones or conditions of other zones were replicated because the '367 Patent reports "[a]verage across maturity zones. Zone: 0" and "Region Best Adapted: Central & Eastern Corn Belt" (EX1083, 6:55-60), meaning that data from or approximating other zones was

considered. However, conditions in Johnson, Iowa also differ greatly from year to year and from one time of year to another time of year, as do conditions in other places, to a greater or lesser degree.

1. Lack of Written Description

205. The Challenged Claims lack adequate written description because the '545 patent's specification fails to describe an invention understandable to that skilled artisan and show that the inventor actually invented the invention claimed. Nothing in the disclosure provides any basis to understand what the inventor possessed and distinguish it from materials the inventor did not purport to claim. The '545 Patent lacks a description enabling POSAs to distinguish infringing seeds or plants from non-infringing ones.

2. Lack of Enablement

206. The Challenged Claims are also unpatentable for lack of enablement because the '545 patent's specification fails to enable the full scope of the invention as defined by its claims. The Challenged Claims on their face are not limited to the deposited seed, but instead merely recite the deposited seed as "representative"—without defining any means to enable POSAs to determine whether or not other seeds, plants, plant parts, or plant cells satisfy this requirement.

207. Without an indication of the environmental conditions under which the plants reflected in Table 1 were grown, the properties reflected in that table—the only data the '545 Patent provides—offer insufficient guidance to POSAs. Without such guidance, the specification and related deposit are at best starting point, a direction for further research.

C. The Minimal Differences Between the '545 Patent's Specification and the Prior Art Stand in Contrast to PO's Earlier Plant Utility Patents the Supreme Court Considered in *J.E.M.*

208. PO's own past practices confirm the reasonableness of requiring individualized specifications—not an assembly-line, fill-in-the-blank approach—if plant breeders seek utility patent protection for new varieties rather than merely pursuing PVP certificates.

1. Unlike the '545 Patent, PO's Earlier Patents Had Highly Customized Specifications Highlighting Distinctive Properties of the Claimed Inbred Lines

209. Each of the patent families PO asserted in the *J.E.M.* case heard by the Supreme Court had a highly customized disclosure explaining what was inventive about the new variety as compared to others. *See* above, paragraphs 175-190 (discussing patents asserted in *J.E.M*).

210. For example, U.S. Patent No. 5,491,295 (EX1080)—the very first patent identified in PO's *J.E.M.* complaint (EX1074, 4) and a patent on which I am one of the inventors—concerned a hybrid corn plant "characterized by superior

yield for maturity, excellent seedling vigor, very good roots and stalks, and exceptional stay green." EX1080, 2:66-3:3. The Supreme Court itself highlighted this language (534 U.S. at 128).

211. Similarly, PO's other patent families at issue in *J.E.M.*—including those with priority dates multiple years after the February 1, 1991 application to which the '295 Patent claimed priority—each included highly differentiated disclosures. Instead of relying on a single template and an assembly line, PO at the time prepared individualized specifications crafted to highlight what was purportedly inventive about each new variety and how it augmented the state of the art.

212. Indeed, while the details across PO's other patents asserted in the *J.E.M.* case vary, all include detailed tables comparing the claimed varieties to other corn varieties and indicating to POSAs particular commercially significant benefits of the claimed varieties. *See* above, paragraphs 175-190. PO included these tables in addition to the initial "Variety Description Information" table specific to the claimed variety and mirroring the information required for PVP certificates. *See* above, paragraph 188. By contrast, PO failed to include any such comparative data or particularized analysis in the '545 Patent distinguishing the claimed PH4CYJ variety over other corn varieties.

213. In the twenty-five years that had passed between the most recent of PO's earlier patents (i.e., those at issue in the *J.E.M.* case) and the filing of the '545 Patent in July 2021, the corn variety landscape became even more crowded. *See also* above, paragraphs 189-190.

2. Unlike the '545 Patent, PO's Earlier Patents Had Narrower Claims Specifically Linked to PO's Deposits and/or "All" Disclosed Characteristics of the New Varieties

214. Despite having individualized and far more fulsome disclosures than the '545 Patent, PO's earlier patents at issue in *J.E.M.* consistently had ***narrower*** claims that did not raise §112 problems of the sort detailed in *supra* VII.B. For example, the above-noted '295 patent had three independent claims:

> Claim 1: A hybrid corn plant designated as 3394 and its parts, and ***having ATCC accession number 97224***.
>
> Claim 6: Seed produced by a hybrid corn plant designated as 3394, said hybrid corn plant ***having ATCC accession number 97224***.
>
> Claim 5: A hybrid corn plant having ***all the physiological and morphological characteristics of 3394***, ATCC accession number 97224.

EX1080, 22:35-55. Similarly, one of PO's earlier patents to an inbred line had two independent claims:

Claim 1: Inbred corn seed designated PHP38, ***having ATCC accession number 75612***.

Claim 6: An inbred corn plant having ***all the physiological and morphological characteristics of the plant of claim 2 [a corn plant produced by the seed of claim 1].***

EX1083, U.S. Patent 5,506,367, 20:47-61.

215. Unlike the Challenged Claims, none of these claims recite purportedly "representative seed." Out of all the claims in the *J.E.M.* patents, only a single patent (EX1091) includes "representative" language. Instead, claims 1 and 6 of the patent to the hybrid and claim 1 of the patent to the inbred are limited to plants or seed actually derived from the deposited line. And while claim 5 of the patent on the hybrid and claim 6 of the patent on the inbred are broader, they still require plants having "***all*** ***the physiological and morphological characteristics***" of the new variety. The patents disclose extensive information to that effect, including but not limited to the specific locations and growing seasons in which the tested samples reflected in the Variety Description Information were grown. By contrast, the '545 Patent provides less information and does not even reflect where the measured plants were grown.

XII. CONCLUSION

216. As explained above, the Challenged Claims of the ’545 Patent are rendered obvious by the combinations discussed above and the Challenged Claims are unpatentable under 35 U.S.C. § 103.

217. The Challenged Claims of the ’545 Patent lack specific utility and are therefore unpatentable under 35 U.S.C. § 101.

218. In signing this declaration, I understand that the declaration will be filed as evidence in a review proceeding before the Patent Trial and Appeal Board of the U.S. Patent and Trademark Office. I acknowledge that I may be subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will appear for cross examination within the United States during the time allotted for cross examination.

I hereby declare that all statements made herein of my own knowledge are true and that all statements 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 Section 1001 of the Title 18 of the United States Code and that such willful false statements may jeopardize the results of these proceedings.

Executed on: April 11,2024

Raymond D. Riley, Ph.D.

APPENDIX A

APPENDIX A MATERIALS CONSIDERED

Exhibit	Description
1001	U.S. Patent No. 11,696,545
1005	U.S. Patent No. 8,895,819 ("Smalley")
1006	U.S. Patent No. 10,660,288 ("Benson")
1007	U.S. Patent No. 10,681,888 ("Longenberger")
1008	Plant Variety Protection Certificate No. 201200324
1009	Plant Variety Protection Certificate No. 202000332
1010	Plant Variety Protection Certificate No. 202200416
1011	Lundmark, C. Genetically Modified Maize. BioScience 2007, 57, 996
1012	Lee, E.A.; Tracy, W.F. *Modern Maize Breeding*, in Handbook of Maize: Genetics and Genomics; Bennetzen, J.L., Hake, S., Eds.; Springer: New York, NY, USA, 2009; pp. 141–160. ISBN 978-0-387-77863-1
1013	Byerlee, D., *The Globalization of Hybrid Maize*, 1921–1970. J. Glob. Hist., 15:101–122 (2020)
1015	Andorf et al., *Technological advances in maize breeding: past, present and future*, Theor Appl Genet., 132(3):817-849 (2019)
1016	Fehr et al., Principles of Cultivar Development (1987)
1017	Wych et al., Production of Hybrid Seed, Corn and Corn Improvement, Chapter 9 (1988)
1018	Schnable et al., The B73 Maize Genome: Complexity, Diversity, and Dynamics, Science, 326:1112-1115 (2009)
1019	"A Brief History of Corn – From Domestication to 1995," Pioneer Hi-Bred International, Inc. (Dec. 19, 2022), https://www.pioneer.com/us/agronomy/domestication-of-corn.html
1020	Geiger, *Doubled Haploids in Hybrid Maize Breeding*, Maydica 54:485-99 (2009)
1021	Weber, *Today's Use of Haploids in Corn Plant Breeding* in Advances in Agronomy, Volume 123 (2014)
1030	Brief for the United States as Amicus Curiae Supporting Respondent, *J.E.M. AG Supply, Inc. v. Pioneer Hi-Bred Int'l , Inc.*, 534 U.S. 124 (2001) (No. 99-1996) (filed June 2001)
1033	Excerpts from Encyclopaedia Britannica
1034	Excerpts from Merriam-Webster's Collegiate Dictionary (11th ed. 2006)
1035	Altman, *Standard deviations and standard errors*, Brit. Med. J., 331:903 (2005)
1036	U.S. Patent No. 11,723,334
1037	U.S. Patent No. 11,712,009

1038	U.S. Patent No. 11,439,108
1039	U.S. Patent No. 11,432,496
1040	U.S. Patent No. 11,432,497
1041	U.S. Patent No. 10,827,697
1042	U.S. Patent No. 10,863,699
1043	U.S. Patent No. 10,765,076
1044	U.S. Patent No. 9,872,475
1045	U.S. Patent No. 9,699,995
1046	U.S. Patent No. 9,686,949
1047	U.S. Patent No. 9,456,566
1048	U.S. Patent No. 9,357,733
1049	U.S. Patent No. 9,161,503
1050	U.S. Patent No. 9,024,152
1051	U.S. Patent No. 9,006,540
1052	U.S. Patent No. 9,000,277
1053	U.S. Patent No. 9,000,280
1054	U.S. Patent No. 8,993,859
1055	U.S. Patent No. 8,962,949
1056	U.S. Patent No. 8,889,966
1058	U.S. Patent No. 11,666,020
1060	U.S. Patent No. 10,863,705
1062	U.S. Patent No. 10,881,064
1064	"Corn Leaf Angle Response to Plant Density," Pioneer Hi-Bred International, Inc. (Dec. 19, 2022), https://www.pioneer.com/us/agronomy/corn-leaf-angle-response-plant-density.html
1065	Fageria, "Phosphorus-Use Efficiency by Corn Genotypes," J. Plant Nutrition, 20:1267 (1997)
1066	U.S. Patent No. 7,718,856
1067	U.S. Patent No. 10,492,410
1068	U.S. Patent No. 10,492,411
1069	U.S. Patent No. 10,492,412
1070	U.S. Patent No. 10,492,413
1071	U.S. Patent No. 10,492,414
1072	U.S. Patent No. 10,011,828
1073	U.S. Patent No. 8,927,214
1074	Amended Complaint for Patent Infringement, *Pioneer Hi-Bred Int'l, Inc. v. J.E.M. AG Supply, Inc. et al*, No. C98-4016 (N.D. Iowa September 11, 1998)

1075	U.S. Patent No. 5,082,992
1076	U.S. Patent No. 5,347,081
1077	U.S. Patent No. 5,444,178
1078	U.S. Patent No. 5,453,564
1079	U.S. Patent No. 5,463,173
1080	U.S. Patent No. 5,491,295
1081	U.S. Patent No. 5,495,069
1082	U.S. Patent No. 5,502,272
1083	U.S. Patent No. 5,506,367
1084	U.S. Patent No. 5,534,661
1085	U.S. Patent No. 5,545,813
1086	U.S. Patent No. 5,557,035
1087	U.S. Patent No. 5,567,861
1088	U.S. Patent No. 5,569,822
1089	U.S. Patent No. 5,633,427
1090	U.S. Patent No. 5,689,034
1091	U.S. Patent No. 5,689,036
1092	U.S. Patent No. 5,159,133
1094	Plant Variety Protection Certificate No. 200700388
1096	USDA Agricultural Marketing Service, Objective Description of Variety—Corn (*Zea mays* L.), https://www.ams.usda.gov/sites/default/files/media/28-Corn%20ST-470-28%202015.pdf
1101	Comparison between EX1001 (’545 Patent) and EX1006 (Benson)
1106	Excerpts from Merriam-Webster’s Ninth New Collegiate Dictionary (1984)
1107	U.S. Patent No. 9,693,531
1108	U.S. Patent No. 9,642,322
1109	U.S. Patent No. 9,426,963
1110	U.S. Patent No. 8,759,636

APPENDIX B

Appendix B

	US Patent No. 11,696,545				US Patent No. 8,895,819 (Smalley)				U.S. 10,660,288 (Benson)				U.S. 10,681,888 (Longenberger)			
	Variety: PH4CYJ				Variety: PH1KTF				Variety: PH47W4				Variety: PH47K2			
			95% CI				95% CI				95% CI				95% CI	
	Value	**SE**	**Low CI**	**High CI**	**Value**	**SE**	**Low CI**	**High CI**	**Value**	**SE**	**Low CI**	**High CI**	**Value**	**SE**	**Low CI**	**High CI**
PLANT:																
Plant height (to tassel tip) (cm), mean (SE)	213.3	11.86	190.1	236.5	194.9	1.5	192.0	197.8	211.4	7.41	196.9	225.9	207.0	6.1	195.0	219.0
Ear height (to base of top ear node) (cm), mean (SE)	72.3	10.78	51.2	93.4	62.9	1.2	60.5	65.3	78.0	3.83	70.5	85.5	75.1	9.31	56.9	93.3
Length of Top Ear Internode (cm), mean (SE)	13.3	0.95	11.4	15.2	15.1	0.2	14.7	15.5	17.0	2.53	12.0	22.0	16.7	1.98	12.8	20.6
Number of Nodes Above Ground, mean (SE)	12.9	1.41	10.1	15.7	N/A				13.2	1.11	11.0	15.4	11.9	0.77	10.4	13.4
LEAF:																
Width of Ear Node Leaf (cm), mean (SE)	9.1	0.83	7.5	10.7	9.5	0.1	9.3	9.7	10.2	0.65	8.9	11.5	9.3	0.62	8.1	10.5
Length of Ear Node Leaf (cm), mean (SE)	84.3	4.89	74.7	93.9	75.5	0.5	74.4	76.6	87.0	2.29	82.5	91.5	83.9	4.7	74.7	93.1
Number of Leaves Above Top Ear, mean (SE)	6.1	0.92	4.3	7.9	6.3	0.1	6.1	6.5	7.3	0.94	5.5	9.1	5.9	0.85	4.2	7.6
Leaf Angle (degrees) (at anthesis, 2nd leaf above top ear to the stalk), mean (SE)	35.5	6.87	22.0	49.0	22.5	0.6	21.2	23.8	34.3	6.57	21.4	47.2	26.3	4.44	17.6	35.0
TASSEL:																
Number of Primary Lateral Branches, mean (SE)	2	1.3	-0.5	4.5	0.0	0.2	-0.5	0.5	0.4	0.58	-0.7	1.5	1.5	1.24	-0.9	3.9
Number of Secondary Branches, mean (SE)	0.1	0.22	-0.3	0.5	N/A				0.0	0	0.0	0.0	0.0	0	0.0	0.0
Branch Angle from Central Spike (degrees), mean (SE)	18.3	9.57	-0.5	37.1	27.5	5.7	16.3	38.7	15.0	5.35	4.5	25.5	38.9	18.73	2.2	75.6
Tassel Length (from peduncle node to tassel tip) (cm), mean (SE)	57.6	4.15	49.5	65.7	51.9	0.6	50.7	53.1	58.8	5.57	47.9	69.7	56.5	4.59	47.5	65.5
Peduncle Length (from top leaf node to lower branch) (cm), mean (SE)	27.6	4.57	18.6	36.6	23.4	0.5	22.5	24.3	25.7	5.14	15.6	35.8	21.3	3.74	14.0	28.6
Central Spike Length (cm), mean (SE)	27.2	1.69	23.9	30.5	N/A				29.2	2.58	24.1	34.3	30.9	3.26	24.5	37.3
Length of Interior Husk (cm), mean (SE)	20.2	1.11	18.0	22.4	N/A				16.9	2.7	11.6	22.2	20.2	2.84	14.6	25.8
EAR (Unhusked ear):																
Flag Leaf Length (cm) (from flag leaf collar to tassel tip), mean (SE)	43.1	4.54	34.2	52.0	N/A				33.4	3.71	26.1	40.7	36.4	4.28	28.0	44.8
EAR (Husked ear data):																
Shank Length (cm), mean (SE)	6.1	1.33	3.5	8.7	8.2	0.3	7.6	8.8	9.1	1.16	6.8	11.4	8.9	1.79	5.4	12.4
Ear Length (cm), mean (SE)	15.3	0.89	13.6	17.0	15.9	0.2	15.5	16.3	14.1	1.09	12.0	16.2	17.0	0.87	15.3	18.7
Ear Diameter at mid-point (mm), mean (SE)	40.4	1.57	37.3	43.5	40.3	0.4	39.6	41.0	41.9	1.56	38.8	45.0	36.1	2.26	31.7	40.5
Ear Weight (gm), mean (SE)	126	15.79	95.1	156.9	127.3	3.1	121.3	133.3	121.1	17.56	86.7	155.5	107.8	25.95	56.9	158.7
Number of Kernel Rows, mean (SE)	14.2	0.96	12.3	16.1	14.6	0.2	14.1	15.1	16.5	1.12	14.3	18.7	14.0	1.3	11.5	16.5
Number of Kernels Per Row, mean (SE)	27.2	2.15	23.0	31.4	N/A				27.0	4.2	18.8	35.2	25.4	4.85	15.9	34.9
KERNEL (Dried):																
Kernel Length (mm), mean (SE)	10.9	0.78	9.4	12.4	10.9	0.1	10.7	11.1	10.4	0.59	9.2	11.6	8.7	1.27	6.2	11.2
Kernel Width (mm), mean (SE)	8.3	0.79	6.8	9.8	8.6	0.1	8.4	8.8	7.2	0.74	5.7	8.7	7.5	0.68	6.2	8.8
COB:																
Cob Diameter at mid-point (mm), mean (SE)	23.7	1.2	21.3	26.1	24.4	0.2	24.0	24.8	22.5	1.25	20.1	25.0	20.3	1.37	17.6	23.0