

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*
- *with sequence listing part of description (Rule 5.2(a))*

(88) Date of publication of the international search report:

16 November 2017 (16.11.2017)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/27160

A. CLASSIFICATION OF SUBJECT MATTER

IPC - C07K 14/325; C12N 15/82; A01N 03/02 (2017.01)

CPC - A01N 37/46, 63/02; C12N 15/8286, 15/82; C07K 14/325

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

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

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US2010/0235951 A1 (VAN RIE, J et al.) September 16, 2010; paragraphs [0001], [0009], [0027], [0076], [0079]	1, 3/1, 4/1
Y	WO 2015/021139 A2 (PIONEER HI-BRED INTERNATIONAL, INC.) February 12, 2015; page 4, lines 18-26; page 11, lines 28-35; page 13, lines 9-16; page 16, lines 1016; page 71, Table 6; page 72, line 21; SEQ ID NO: 16	1, 3/1, 4/1
A	WO 2105/120276 A1 (PIONEER HI-BRED INTERNATIONAL, INC. et al.) August 13, 2015; page 15, line 9; page 148, lines 19-25	2, 3/2, 4/2
A	US 2010/0192256 A1 (ABAD, AR et al.) July 29, 2010; paragraphs [41], [0046], [0058], [0061]	2, 3/2, 4/2
P, X	US 2016/0194364 A1 (PIONEER HI-BRED INTERNATIONAL, INC.) July 7, 2016; entire document	1, 3/1, 4/1

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

06 September 2017 (06.09.2017)

Date of mailing of the international search report

02 OCT 2017

Name and mailing address of the ISA/

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/27160

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 6-30, 35-42
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

-Please see supplemental page-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-4; SEQ ID NO: 62

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/27160

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

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of a sequence listing:
 - a. ☒ forming part of the international application as filed:
 - ☒ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
 - ☐ in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
2. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
3. Additional comments:

-***-Continued from Box No. III: Observations where unity of invention is lacking-***-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Groups I+, Claims 1-5 and SEQ ID NO: 62 are directed toward a variant Cry1B polypeptide having increased insecticidal activity against corn earworm and/or fall armyworm.

The variant Cry1B polypeptide will be searched to the extent it encompasses SEQ ID NO: 62 (first exemplary variant Cry1B). Applicant is invited to elect additional variant Cry1B polypeptide(s), with specified SEQ ID NO: for each, or with specified substitution(s) at specified site(s) of a SEQ ID NO: to be searched. Additional variant Cry1B polypeptide sequence(s) will be searched upon the payment of additional fees. It is believed that claims 1 (in-part), 2 (in-part), 3 (in-part) and 4 (in-part) encompass this first named invention and thus these claims will be searched without fee to the extent that they encompass SEQ ID NO: 62 (variant Cry1B). Applicants must specify the claims that encompass any additionally elected variant Cry1B polypeptide sequence(s). Applicants must further indicate, if applicable, the claims which encompass the first named invention, if different than what was indicated above for this group. Failure to clearly identify how any paid additional invention fees are to be applied to the "+" group(s) will result in only the first claimed invention to be searched/examined. An exemplary election would be a variant Cry1B polypeptide encompassing SEQ ID NO: 63 (first exemplary elected variant Cry1B).

Group II, Claims 31-34 are directed toward chimeric Cry1B polypeptide.

No technical features are shared between the variant Cry1B polypeptide sequences of Groups I+ and, accordingly, these groups lack unity a priori.

The inventions listed as Groups I+ and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical features of Groups I+ include SEQ ID NO: 62, not present in Group II; the special technical features of Group II include a chimeric Cry1B polypeptide, wherein one, two or three of the alpha-helices in Domain I are replaced with the corresponding alpha helices of a second Cry1B polypeptide, not present in any of Groups I+.

Groups I+ and II share the technical features including: variant Cry1B polypeptides; SEQ ID NO: 1 and SEQ ID NO: 47. Groups I+ share the technical features including: a variant Cry1B polypeptide comprising an amino acid sequence; wherein the variant Cry1B polypeptide has increased insecticidal activity against corn earworm and/or fall armyworm compared to the Cry1B polypeptide of SEQ ID NO: 1.

However, these shared technical features are previously disclosed by US 2010/0192256 A1 to Abad et al. (hereinafter 'Abad') in light of evidence provided by Genbank Accession WP_033698198 (hereinafter 'WP_033698198'), and in view of WO 2015/021139 A2 to Pioneer Hi-Bred International, Inc. (hereinafter 'Pioneer').

Abad discloses variant Cry1B polypeptides (variant polypeptides having enhanced pesticidal activity relative to the naturally occurring polypeptide, including a polypeptide comprising SEQ ID NO: 2 (variant Cry1B polypeptides); paragraphs [0010], [0011], SEQ ID NO: 2, wherein SEQ ID NO: 2 is 100% identical to the sequence of WP033698198, for B. thuringiensis Cry1Bd (page 1)); SEQ ID NO: 1 (SEQ ID NO: 2 (SEQ ID NO: 1); paragraph [0010], wherein SEQ ID NO: 2 is 100% identical to Applicants' SEQ ID NO: 1); a variant Cry1B polypeptide comprising an amino acid sequence (a variant polypeptide relative to a naturally occurring polypeptide comprising SEQ ID NO: 2 (a variant Cry1B polypeptide comprising an amino acid sequence); paragraphs [0010], [0011], SEQ ID NO: 2, wherein SEQ ID NO: 2 is 100% identical to the sequence of WP033698198, for B. thuringiensis Cry1Bd (page 1)); wherein the variant Cry1B polypeptide has increased insecticidal activity (wherein the variant polypeptide relative to SEQ ID NO: 2 has enhanced insecticidal activity (wherein the variant Cry1B polypeptide has increased insecticidal activity); paragraphs [0010], [0011], SEQ ID NO: 2; wherein SEQ ID NO: 2 is 100% identical to the sequence of WP033698198, for B. thuringiensis Cry1Bd (page 1)) against corn earworm and/or fall armyworm (against corn earworm and/or fall armyworm; paragraph [0015]) compared to the Cry1B polypeptide of SEQ ID NO: 1 (compared to the Cry1B polypeptide of SEQ ID NO: 2 (SEQ ID NO: 1); paragraphs [0010], [0011], wherein SEQ ID NO: 2 is 100% identical to Applicants' SEQ ID NO: 1).

Abad does not disclose: SEQ ID NO: 47.

Pioneer discloses pesticidal polypeptides, including a polypeptide comprising SEQ ID NO: 47 (pesticidal polypeptides, including a polypeptide comprising SEQ ID NO: 2 (SEQ ID NO: 47); page 4, lines 18-26, page 15, lines 14-21; wherein SEQ ID NO: 2 is 100% identical to Applicants' SEQ ID NO: 47), including pesticidal activity to armyworms and/or earworm (including pesticidal activity to armyworms and/or earworm; page 64, line 21 - page 65, line 1).

It would have been obvious to a person of ordinary skill in the art at the time of the invention was made to have modified the disclosure of Abad to have included comparing the activity of the insecticidal polypeptides and variants thereof to an additional polypeptide having pesticidal activity against the same types of pests, such as the first polypeptide disclosed by Pioneer, in order to enable an assessment of whether the natural and/or variant polypeptides were more effective than other pesticidal polypeptides in the art.

Since none of the special technical features of the Groups I+ and II inventions is found in more than one of the inventions, and since all of the shared technical features are previously disclosed by a combination of the Abad and Pioneer references, unity of invention is lacking.