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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))*

[Continued on next page]

(54) Title: CYANOBACTERIUM TREATED MONOCOT PLANT SEEDS AND RELATED METHODS

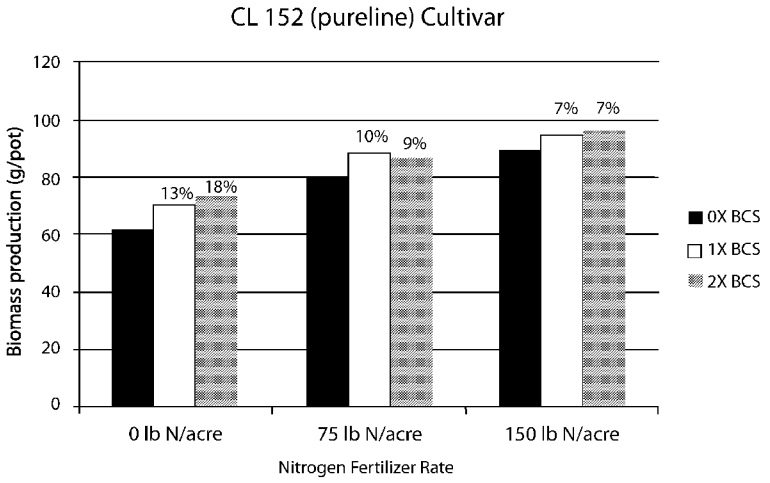


Figure 2

(57) Abstract: Monocot seeds treated with various cyanobacterium compositions, methods of making the treated seeds, and methods of using the seeds to improve monocot plant growth and yield are provided.

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24 November 2016

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C05B 17/00, C05D 1/00, C10G 1/06, C05F 11/08, A01N 25/26 (2016.01)

CPC - Y02T 50/678, Y02P 30/20, Y02W 30/47, C05B 17/00, C05D 1/00, C05F 11/08, C05F 11/02

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)
IPC(8)- C05B 17/00, C05D 1/00, C10G 1/06, C05F 11/08, A01N 25/26 (2016.01)
CPC - Y02T 50/678, Y02P 30/20, Y02W 30/47, C05B 17/00, C05D 1/00, C05F 11/08, C05F 11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - C10G 1/065, C10G 1/083, C10G 1/086, C10G 2300/1011, C10G 2400/02, C10G 2400/04, C10G 2400/08, Y02E 50/343, C12N 1/12, Y02P 20/145, A01C 1/06, A01N 61/00, A01N 63/00, A01N 63/04, A01N 25/00, A01N 2300/00

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(PGPB,USPT,USOC,EPAB,JPAB); PatBase, Google/Scholar: Monocot, rice, corn, wheat, sugarcane, lilies, orchids, grass, cyanobacteria, Aulosira, Tolypothrix, Anabaena, Nostoc, blue green algae, biofertilizer BGA, insecticide, a fungicide, a safener, carbamate... GenCore 6.4.1: SEQ ID NO: 1

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y -- A	Reddy, et al. Blue-green algal treatment and inoculation had no significant effect on rice yield in an acidic wetland soil. Philipp Agric 1986, 69:629-632; pg 630,	1, 2, 8, 9, 14, --------- (23-25)/(1,2,8, 9,14) -------- 6, 7, 12, 13, 15, (23-25)/(6,7,12,13,15)
A	Thomazeau, et al. THE CONTRIBUTION OF SUB-SAHARAN AFRICAN STRAINS TO THE PHYLOGENY OF CYANOBACTERIA: FOCUSING ON THE NOSTOCACEAE (NOSTOCALES, CYANORACTERIA). Journal of Phycology 2010, 46(3):564-579, pg 565, col 2	8, 9
X -- Y	Roger et al. Blue-Green Algae and Rice. Publisher The International Rice Research Institute. 2012 [according to the properties of the posted document] [Retrieved from the Internet 03 July 2016: <http://books.irri.org/971104028X_content.pdf>]; pg 8, last para; pg 34, 2.5.4.5; pg 51, Section 4.2; pg 53, Section 4.5; pg 78, Section 5.4; pg 83, section 5.6.2.	1, 2, 17-19, 21, 22, (23-25)/(1,2,17-19,21,22) ---------- (23-25)/(1,2,8, 9,14)
A	GenBank Submission JF925315.1. Nostoc sp. CYN73 16S ribosomal RNA gene, partial sequence. (11 March 2012) [Retrieved from the Internet 03 July 2016: <http://www.ncbi.nlm.nih.gov/nuccore/338221241/>], nucleotides 282-713, 91.6% identity to SEQ ID NO:1	6, 7, 12, 13, 15, (23-25)/(6,7,12,13,15)

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 August 2016	30 SEP 2016

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 16/26777

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 13*ter*.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 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.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:

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 16/26777

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.:
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:

********** See Supplemental Sheet to continue **********

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, 2, 6-9, 12-15, 17-19, 21, 22, (23-25) (in part), restricted to a rice seed, Nostocales cyanobacterium, 16S RNA of SEQ ID NO:1, and adjuvant, which is a carbamate insecticide.
[NOTE: Claim 16 was excluded from the first invention, because it is drawn to a non-elected subject matter, specifically, a corn seed.]

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.

********** Supplemental Sheet **********

In Continuation of Box 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.

Group I+: claims 1-25, directed to a treated monocot plant seed that has been at least partially coated with a composition comprising: (i) at least one cyanobacterium species; and (ii) an agriculturally acceptable adjuvant or excipient. The treated monocot plant seed will be searched to the extent that the monocot plant seed encompasses a rice seed, 16S RNA that has at least 95% identity to SEQ ID NO:1, cyanobacterium encompasses Nostocales, agriculturally acceptable adjuvant encompasses insecticide, the insecticide encompasses a carbamate. It is believed that claims 1, 2, 6-9, 12-19, 21, 22, (23-25) (in part) encompass this first named invention, and thus these claims will be searched without fee to the extent that they encompass a treated rice seed that has been at least partially coated with a composition comprising: (i) at least one Nostocales cyanobacterium having a 16S RNA that has at least 95% identity to SEQ ID NO:1 and (ii) an agriculturally acceptable adjuvant, which is a carbamate insecticide. Additional kind(s) of a plant seed, 16S RNA(s), cyanobacterium specie(s), and/or adjuvant will be searched upon the payment of additional fees. Applicants must specify the claims that encompass any additionally elected plant seed(s), 16S RNA(s), cyanobacterium specie(s), and/or adjuvant. 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. An exemplary election would be a wheat seed, 16S RNA that has at least 95% identity to SEQ ID NO:4, cyanobacterium encompasses Nostocales, agriculturally acceptable adjuvant encompasses insecticide, the insecticide encompasses a neonicotinoid insecticide, i.e., claims 1, 2, 6-9, 12-22, (23-25) (in part).
[NOTE: Claim 16 was excluded from the first invention, because it is drawn to a non-elected subject matter., specifically, a corn seed.]

Group II: claims 26-74, directed to a method of using a composition comprising: (i) at least one cyanobacterium species; and (ii) an agriculturally acceptable adjuvant or excipient.

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:

Special Technical Features
The special technical feature of each invention of Group I+ is a specific plant seed recited therein.

The special technical feature of some inventions of Group I+ is a specific cyanobacterium specie, and/or 16S RNA(s), and/or adjuvant and/or insecticide.

The special technical feature of some inventions of Group I+ is a cyanobacterium of a specific family within the order Nostocales (please see a paper titled "Toxopsis calypsus gen. nov., sp. nov. (Cyanobacteria, Nostocales) from cave 'Francthi', Peloponnese, Greece: a morphological and molecular evaluation" by Lamprinou, et al. (Int J Syst Evol Microbiol. 2012, 62(Pt 12):2870-7); pg 2874, col 2 to pg 2876, col 1, "the order Nostocales comprises four families (Scytonemataceae, Microchaetaceae, Rivulariaceae, Nostocaceae).

The inventions of Group I+ do not include the shared or common technical feature of a method of using a composition comprising: (i) at least one cyanobacterium species; and (ii) an agriculturally acceptable adjuvant or excipient, as required by Group II.

Common Technical Features
The inventions of Groups I+ and II share the technical feature of a treated monocot plant seed that has been at least partially coated with a composition comprising: (i) at least one cyanobacterium species; and (ii) an agriculturally acceptable adjuvant or excipient. However, this shared technical feature does not represent a contribution over prior art as being anticipated by a paper titled "Blue-green algal treatment and inoculation had no significant effect on rice yield in an acidic wetland soil" by Reddy, et al. (Philipp Agric 1986, 69:629-632) (hereinafter "Reddy").
Reddy discloses a treated monocot plant seed that has been at least partially coated with a composition comprising: (i) at least one cyanobacterium species (pg 630, "Seeds of [rice cultivar] IR58 were soaked in a dense culture of Nostoc sp. ... for 48 h and spread on a seedbed sat IRR1 for germination. Nostoc culture used for soaking was evenly spread on the surface of the seedbed"); and (ii) an agriculturally acceptable excipient (pg 630, water, as in the control, "Seeds soaked in water and grown on a seedbed where no BGA culture was applied served as control."). As said technical feature was known in the art at the time of the invention, this cannot be considered special technical feature that would otherwise unify the groups.

The inventions of Groups I+ and II therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.