

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference MONS:522WO		FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US22/79380	International filing date (<i>day/month/year</i>) 07 November 2022 (07.11.2022)	(Earliest) Priority Date (<i>day/month/year</i>) 12 November 2021 (12.11.2021)	
Applicant MONSANTO TECHNOLOGY LLC			

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 6 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed.
☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. ☒ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☒ **Certain claims were found unsearchable** (see Box No. II).

3. ☒ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☒ the text is approved as submitted by the applicant.
☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 1
☐ as suggested by the applicant.
☒ as selected by this Authority, because the applicant failed to suggest a figure.
☐ as selected by this Authority, because this figure better characterizes the invention.
- b. ☐ none of the figures is to be published with the abstract.

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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.
 - b. ☒ furnished subsequent to the international filing date for the purposes of international search (Rule 13~~ter~~.1(a)),
☒ accompanied by a statement to the effect that the sequence listing does not go beyond the disclosure in the international application as filed.
2. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this report has been established to the extent that a meaningful search could be carried out without a WIPO Standard ST.26 compliant sequence listing.
3. Additional comments:

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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.: 7-30
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.:
Groups I+, Claims 1-6, 31-44, and SEQ ID NO: 30 (TFL1 gene polynucleotide sequence), SEQ ID NO: 13 (guide RNA sequence).

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.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. C12N 15/82; A01H 1/06; A01H 5/08; C07K 14/415 (2023.01)

ADD.

CPC - INV. C12N 15/8218; A01H 1/06; A01H 5/08; C07K 14/415; C12N 15/8201; C12N 15/8241; Y02A 40/146

ADD.

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 database consulted during the international search (name of database 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.
X --- Y	US 2018/0092319 A1 (J.R. SIMPLOT COMPANY) 05 April 2018; paragraphs [0005], [0006], [0007], [0008], [0010], [0012], [0017], [0019], [0022], [0023], [0077], [0100], [0103], [0106], [0117], [0119], [0143], [0146], [0150]	1-6, 33-42, 44 --- 43
Y	US 2006/0070141 A1 (NIELSEN, KK et al.) 30 March 2006; paragraphs [0111], [0159]	43
A	(LIU, B et al.) Glycine max GmTFL1b gene for terminal flower 1b, complete cds. Genbank entry (online). National Institute of Biotechnology Information. 10 May 2010 (Retrieved on 10 April 2023). Retrieved from the Internet: [URL: https://www.ncbi.nlm.nih.gov/nucleotide/AB511820.1?report=genbank&log\$=nuclopt&blast_rank=1&RID=38WPMUAM016]; pages 1-2	31
A	US 10,517,242 B1 (SYNGENTA PARTICIPATIONS AG) 31 December 2019; column 2, lines 39-41	31-32
A	(TIAN, Z et al.) Glycine max cultivar Changshanidou Dt1 (Dt1) gene, complete cds. Genbank entry (online). National Institute of Biotechnology Information. 20 April 2010 (Retrieved on 10 April 2023). Retrieved from the Internet: [URL: https://www.ncbi.nlm.nih.gov/nucleotide/GU047141.1?report=genbank&log\$=nuclopt&blast_rank=25&RID=38W5M492016]; pages 1-2	31-32
☒ 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

"D" document cited by the applicant in the international application

"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

10 April 2023 (10.04.2023)

Date of mailing of the international search report

APR 25 2023

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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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	(NATIONAL CENTER FOR BIOTECHNOLOGY INFORMATION) PREDICTED: Sorghum bicolor probable receptor-like protein kinase At5g18500 (LOC8060368), mRNA. Genbank entry (online). National Institute of Biotechnology Information. 13 June 2017 (Retrieved on 10 April 2023). Retrieved from the Internet: [URL: https://www.ncbi.nlm.nih.gov/nucleotide/XM_002455514.2?report=genbank&log\$=nucltop&blast_rank=85&RID=38W5M492016]; pages 1-2	32

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****-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 1-6, 31-44, and SEQ ID NO: 30 (TFL1 gene polynucleotide sequence), SEQ ID NO: 13 (guide RNA sequence) are directed towards TFL1 gene and plants, and polynucleotides, guide RNAs, and methods associated therewith.

The TFL1 gene and plants, and polynucleotides, guide RNAs, and methods of Claims 1-6, 31-32 (each in-part), 33-44 are believed to encompass the first named invention of Groups I+ and are the claims that will be searched without fee to the extent that they encompass SEQ ID NO: 30 (first exemplary TFL1 gene polynucleotide sequence), SEQ ID NO: 13 (first exemplary guide RNA sequence). This first named invention of Group I+ has been selected to encompass the first species of each of the genera found in claims 31-32 based on the guidance set forth in section 10.54 of the PCT International Search and Preliminary Examination Guidelines.

Applicant is invited to elect additional TFL1 gene polynucleotide sequence(s), guide RNA sequence(s) to be searched. Additional TFL1 gene polynucleotide sequence(s), guide RNA sequence(s) will be searched upon the payment of additional fees. Applicants must specify the searchable claims that encompass any additionally elected TFL1 gene polynucleotide sequence(s), guide RNA 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. Exemplary elections would be SEQ ID NO: 31 (TFL1 gene polynucleotide sequence), SEQ ID NO: 14 (guide RNA sequence).

Groups I+ were considered to share the technical features including: a modified plant, plant seed, plant part, or plant cell, comprising a modification that reduces the expression or activity of TFL1, or a homolog thereof, as compared to the expression or activity of TFL1 or the homolog thereof in an otherwise identical plant, plant seed, plant part, or plant cell that lacks the modification; a polynucleotide comprising a sequence; a guide RNA comprising a polynucleotide sequence; a method for producing a plant comprising a modified TFL1 gene, the method comprising: a. introducing a modification into at least one target site in an endogenous TFL1 gene or a homolog thereof of a plant cell; b. identifying and selecting one or more plant cells of step a. comprising said modification in said TFL1 gene or homolog thereof; and c. regenerating at least one plant from at least one or more cells selected in step b; a method for increasing the determinacy of a plant, comprising modifying at least one allele of an endogenous promoter of a TFL1 gene, such that TFL1 protein production is reduced as compared to the production of TFL1 protein production in an otherwise identical plant that lacks the modification; these shared technical features are previously disclosed by the publication entitled "Targeted deletion of floral development genes in Arabidopsis with CRISPR/Cas9 using the RNA endonuclease Csy4 processing system" by Liu, et al. (hereinafter "Liu").

Liu discloses a modified plant, plant seed, plant part, or plant cell, comprising a modification that reduces the expression or activity of TFL1, or a homolog thereof, as compared to the expression or activity of TFL1 or the homolog thereof in an otherwise identical plant, plant seed, plant part, or plant cell that lacks the modification (Arabidopsis seeds transformed (a modified plant seed) with Cas9-sgRNA-expressing vector to induce targeted deletion in the TFL1 gene resulting in loss of function in TFL1 expression (modification that reduces the expression or activity of TFL1, as compared to the expression or activity of TFL1 in an otherwise identical plant seed that lacks the modification); abstract; page 8, 1st column, 2nd paragraph and 2nd column, 2nd and 3rd paragraphs); a polynucleotide comprising a sequence (TFL1 genomic sequence; page 2, 2nd column, 2nd paragraph); a guide RNA comprising a polynucleotide sequence (Cas9-sgRNA-expressing vector, wherein the guide RNA would intrinsically comprise a specific polynucleotide sequence; page 8, 2nd column, 3rd paragraph); a method for producing a plant comprising a modified TFL1 gene, the method comprising: a. introducing a modification into at least one target site in an endogenous TFL1 gene or a homolog thereof of a plant cell; b. identifying and selecting one or more plant cells of step a. comprising said modification in said TFL1 gene or homolog thereof; and c. regenerating at least one plant from at least one or more cells selected in step b (Arabidopsis seeds transformed (method for producing) with Cas9-sgRNA-expressing vector to induce targeted deletion in the TFL1 gene (introducing a modification into at least one target site in an endogenous TFL1 gene) resulting in loss of function in TFL1 expression, followed by germination of the seeds and harvesting (identifying and selecting one or more plant cells of step a. comprising said modification in said TFL1 gene, and regenerating at least one plant from at least one or more cells selected in step b), which would intrinsically result in a plant comprising a modified TFL1 gene; abstract; page 8, 1st column, 2nd paragraph and 2nd column, 2nd and 3rd paragraphs; page 9, 1st column, 1st paragraph); a method for increasing the determinacy of a plant, comprising modifying at least one allele of a TFL1 gene, such that TFL1 protein production is reduced as compared to the production of TFL1 protein production in an otherwise identical plant that lacks the modification (Arabidopsis seeds transformed with Cas9-sgRNA-expressing vector to induce targeted deletion in the TFL1 gene (modifying at least one allele of a TFL1 gene) resulting in loss of function in TFL1 expression (TFL1 protein production is reduced as compared to the production of TFL1 protein production in an otherwise identical plant that lacks the modification), which caused a change from indeterminate to determinate inflorescences (method for increasing the determinacy of a plant); abstract; page 8, 1st column, 2nd paragraph and 2nd column, 2nd and 3rd paragraphs). In a separate, distinct embodiment, Liu discloses modifying at least one allele of an endogenous promoter of a gene (the targeted deletion between exon 1 and exon 2 of SVP gene significantly decreased mRNA transcription, indicating that this sequence may include promoter fragments of SVP (modifying at least one allele of an endogenous promoter of a gene); page 8, 1st column, 2nd paragraph). It would have been obvious to a person of ordinary skill in the art, at the time of the invention, to have modified the method, as previously disclosed by Liu, for the integration of modifying at least one allele of an endogenous promoter of a gene based on the teachings of the alternative embodiment of Liu, as this modification would provide the capability of increasing the determinacy of a plant by modifying at least one allele of an endogenous promoter of a TFL1 gene, such that TFL1 protein production is reduced as compared to the production of TFL1 protein production in an otherwise identical plant that lacks the modification, thereby providing a plant with an improved agronomical trait, such as being less prone to stem lodging.

Since none of the special technical features of the Groups I+ inventions is found in more than one of the inventions, and since all of the shared technical features are previously disclosed by the Liu reference, unity of invention is lacking.