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Published:

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

6 November 2014

(54) Title: COMPOSITIONS AND METHODS OF USE OF ACC OXIDASE POLYNUCLEOTIDES AND POLYPEPTIDES

(57) Abstract: Transgenic compositions and methods reduce the expression of endogenous ACC oxidase genes to improve an agronomic characteristic of a crop plant, which may be maize. Yield increase and drought tolerance due to reduction in the endogenous ACC oxidase levels are observed. ACC oxidase genes are identified in maize, rice, and Arabidopsis genomes.



WO 2014/143996 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/028214

A. CLASSIFICATION OF SUBJECT MATTER
INV. C12N15/82 C12N9/02 C12Q1/68
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)
C12N
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, BIOSIS, MEDLINE, EMBL

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/066389 A1 (GALLIE DANIEL R [US] ET AL) 24 March 2005 (2005-03-24) the whole document	7-11,13,14
X	WI SOO JIN ET AL: "Antisense expression of carnation cDNA encoding ACC synthase or ACC oxidase enhances polyamine content and abiotic stress tolerance in transgenic tobacco plants", MOLECULES AND CELLS, SEOUL, KR, vol. 13, no. 2, 30 April 2002 (2002-04-30), pages 209-220, XP002338203, ISSN: 1016-8478	1,2
Y	the whole document ----- -/--	3-14,28

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 11 July 2014	Date of mailing of the international search report 05/09/2014
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Bilang, Jürg

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/028214

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	W. Y. SOBEIH: "Long-distance signals regulating stomatal conductance and leaf growth in tomato (<i>Lycopersicon esculentum</i>) plants subjected to partial root-zone drying", JOURNAL OF EXPERIMENTAL BOTANY, vol. 55, no. 407, 10 September 2004 (2004-09-10), pages 2353-2363, XP055128146, ISSN: 0022-0957, DOI: 10.1093/jxb/erh204	1,2
Y	page 2356, right-hand column page 2362, right-hand column, last paragraph	3-14,28
Y	----- YOUNG T E ET AL: "ACC Synthase Expression Regulates Leaf Performance and Drought Tolerance in Maize", THE PLANT JOURNAL, BLACKWELL SCIENTIFIC PUBLICATIONS, OXFORD, GB, vol. 40, no. 5, 1 December 2004 (2004-12-01), pages 813-825, XP002997116, ISSN: 0960-7412, DOI: 10.1111/J.1365-313X.2004.02255.X the whole document	1-14,28
Y	----- PICTON S ET AL: "ALTERED FRUIT RIPENING AND LEAF SENESCENCE IN TOMATOES EXPRESSING AN ANTISENSE ETHYLENE-FORMING ENZYME TRANSGENE", THE PLANT JOURNAL, BLACKWELL SCIENTIFIC PUBLICATIONS, OXFORD, GB, vol. 3, no. 3, 1 March 1993 (1993-03-01), pages 469-481, XP000673757, ISSN: 0960-7412 the whole document	1-14,28
A	----- JOHN I ET AL: "DELAYED LEAF SENESCENCE IN ETHYLENE-DEFICIENT ACC-OXIDASE ANTISENSE TOMATO PLANTS: MOLECULAR AND PHYSIOLOGICAL ANALYSIS", THE PLANT JOURNAL, BLACKWELL SCIENTIFIC PUBLICATIONS, OXFORD, GB, vol. 7, no. 3, 1 March 1995 (1995-03-01), pages 483-490, XP002014397, ISSN: 0960-7412, DOI: 10.1046/J.1365-313X.1995.7030483.X the whole document ----- -/--	1-14,28

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/028214

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>TUOMAINEN J ET AL: "Ozone induction of ethylene emission in tomato plants: Regulation by differential accumulation of transcripts for the biosynthetic enzymes", THE PLANT JOURNAL, BLACKWELL SCIENTIFIC PUBLICATIONS, OXFORD, GB, vol. 12, no. 5, 1 November 1997 (1997-11-01), pages 1151-1162, XP002288052, ISSN: 0960-7412, DOI: 10.1046/J.1365-313X.1997.12051151.X abstract</p> <p style="text-align: center;">-----</p>	1-14,28
A	<p>HAMILTON A J ET AL: "ANTISENSE GENE THAT INHIBITS SYNTHESIS OF THE HORMONE ETHYLENE IN TRANSGENIC PLANTS", NATURE, NATURE PUBLISHING GROUP, UNITED KINGDOM, vol. 346, 19 July 1990 (1990-07-19), pages 284-287, XP002919320, ISSN: 0028-0836, DOI: 10.1038/346284A0 the whole document</p> <p style="text-align: center;">-----</p>	1-14,28

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/028214

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 additional sheet

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 an 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.:

1-14, 28

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-14, 28

Method of improving abiotic stress tolerance in a crop plant, comprising reducing the expression of an ACC oxidase gene

1.1. claims: 7-14

Abiotic stress tolerant maize plant and part thereof

2. claims: 15-19

Method for increasing grain yield in a crop plant comprising reducing the levels of ethylene

3. claims: 20-22

A gene down-regulating construct to reduce the expression of a plurality of ACC oxidases

4. claims: 23-27

A method of down-regulating an endogenous ACC oxidase gene in maize

5. claims: 29, 30

Method of selecting a maize plant for increased drought tolerance

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/028214

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2005066389	A1	24-03-2005	US 2005066389 A1	24-03-2005
			US 2008209585 A1	28-08-2008
			US 2010281556 A1	04-11-2010
