

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
27 December 2007 (27.12.2007)

PCT

(10) International Publication Number
WO 2007/149583 A3

(51) International Patent Classification:
A01H 5/00 (2006.01) *C12N 15/82* (2006.01)

(21) International Application Number:
PCT/US2007/014690

(22) International Filing Date: 22 June 2007 (22.06.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/815,770 22 June 2006 (22.06.2006) US
60/928,565 10 May 2007 (10.05.2007) US

(71) Applicant (for all designated States except US): **THE BOARD OF TRUSTEES OPERATING MICHIGAN STATE UNIVERSITY** [US/US]; 2727 Alliance Drive, Lansing, MI 48910 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **LI, Yonghua** [CN/US]; 3035-2a Trappers Cove, Lansing, MI 48910 (US). **BEISSON, Fred** [FR/US]; 3035-2a Trappers Cove, Lansing, MI 48910 (US). **POLLARD, Mike** [US/US]; 4437 Maumee Drive, Okemos, MI 48864 (US). **OHLROGGE, John** [US/US]; 2124 Lagoon Drive, Okemos, MI 48864 (US).

(74) Agents: **GOETZ, Robert, A.** et al.; Medlen & Carroll, LLP, 101 Howard Street, Suite 350, San Francisco, CA 94105 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:
13 November 2008

(54) Title: ACYLTRANSFERASES FOR ALTERING LIPID PRODUCTION ON PLANTS

(57) Abstract: The present invention relates to compositions comprising acyltransferase nucleic acid molecules for altering lipids on the surface of plants, and related methods. In particular, the present invention provides compositions and methods for increasing the amount of free fatty acids, acylglycerols, and other lipids on the surface of a plant. In a preferred embodiment, the present invention relates to increasing activity of a GPAT acyltransferase for altering lipid on the plant surface, for increasing surface lipids, for enhancing environmental stress tolerance, increasing resistance to biotic stress, and providing novel plant lipids for commercial products. In further embodiments, the present invention relates to using an Arabidopsis thaliana GPAT acyltransferase for altering lipid compounds on the surface of a plant.



WO 2007/149583 A3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US07/14690

A. CLASSIFICATION OF SUBJECT MATTER

IPC: A01H 5/00(2006.01);C12N 15/82(2006.01)

USPC: 800/281,298

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)

U.S. : 800/281, 298

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)
WEST, STN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	YOKOI et al, Introduction of the cDNA for Arabidopsis glycerol-3-phosphate acyltransferase (GPAT) confers unsaturation of fatty acids and chilling tolerance of photosynthesis on rice. Molecular Breeding. 1998, Vol 4, pages 269-275, especially pages 270-272.	1,6,7,12-14,23-25,30,31,33,34 ----- 2-5,8-11,15-22,32
Y	US PGPub 20060094088 (PICATAGGIO et al) 04 May 2006 (04.05.2006), paragraphs [0063], [0181], [0186] and [0166] to [0177].	2-5,8-11,15-22 and 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	"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
"E" earlier application or patent published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

28 August 2008 (28.08.2008)

Date of mailing of the international search report

16 SEP 2008

Name and mailing address of the ISA/US

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

Facsimile No. (571) 273-3201

Authorized officer

Elizabeth F. McElwain

Telephone No. 571-272-1600

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US07/14690

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.: 36 and 37
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 Continuation 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 additional fees, this Authority did not invite payment of any 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.: 1-25 and 30-34

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.

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.

Groups I-VIII, claim(s) 1-25 and 30-34, to the extent the claims are drawn to a nucleic acid encoding a glycerol phosphate transferase of one of SEQ ID NO: 9, 10, 11, 12, 13, 14, 15 and 16 consecutively, wherein SEQ ID NO: 9 is the first Group.

Group IX, claim(s) 26-29, drawn to an extracellular plant lipid.

Group X, claim(s) 35, drawn to use of an acyltransferase polypeptide.

The inventions listed as Groups I-X 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: Groups I-VIII lack unity given that they are each drawn to nucleic acid sequences encoding glycerol phosphate acyltransferases, wherein nucleic acid sequences encoding said enzymes were known in the prior art, as set forth in the specification at pages 58-59. In addition, Group IX is drawn to extracellular plant lipids, which are distinct molecules that do not share a special technical feature with any of the nucleic acids of Groups I-VIII or the lipids of Group IX, wherein the acyltransferase of Group X may not be a glycerol phosphate acyltransferase (GPAT) and acyltransferases were known in the prior art, including GPATs, as set forth in the specification at pages 58-59.