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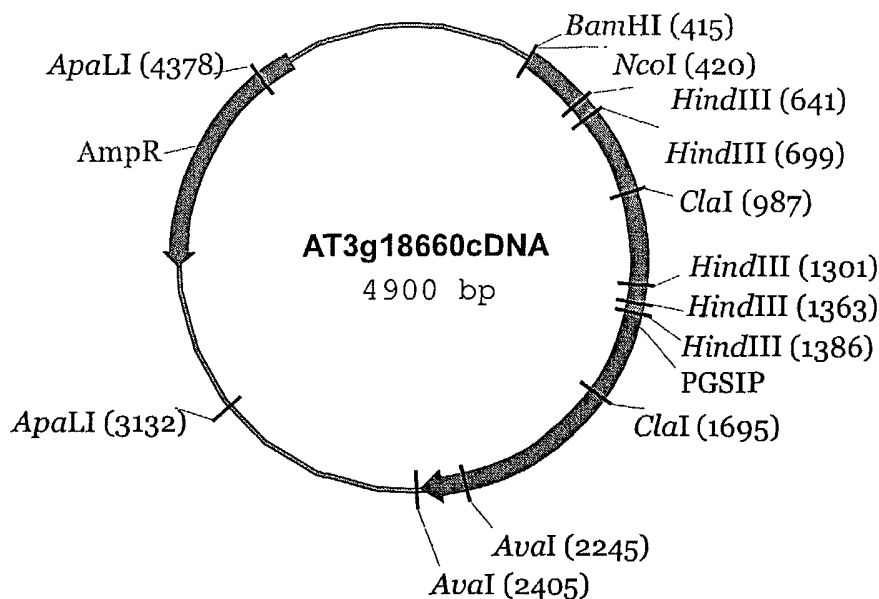
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[Continued on next page]

(54) Title: PLANT GLYCOGENIN HOMOLOGS AND USE THEREOF IN STARCH MODIFICATION



(57) Abstract: The present invention relates to a method of altering starch synthesis in a plant by modifying the starch priming activity of the plant. In particular, this is achieved by altering the expression or activity of a starch primer which is preferably encoded by the sequence of SEQ ID NO: 1 or a sequence substantially homologous thereto. Also provided are plants in which the starch priming activity has been altered, and propagating material derived from such plants.

WO 2003/014365 A3

**Declarations under Rule 4.17:**

- as to the identity of the inventor (Rule 4.17(i)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS,

MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations

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see PCT Gazette No. 37/2003 of 12 September 2003, Section II

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 02/03636

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 C12N9/10 C12N15/82 C12N5/00 C07K16/16 C08B30/00

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 7 C12N C07K C08B

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 practical, search terms used)

EPO-Internal, WPI Data, BIOSIS, GENSEQ, EMBL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE NAGENSEQ 'Online! 18 October 2000 (2000-10-18) ALEXANDROV,N.: "Arabidopsis thaliana DNA fragment SEQ ID NO:49388" Database accession no. AAC46232 XP002239796 -& DATABASE AAGENSEQ 'Online! 18 October 2000 (2000-10-18) ALEXANDROV,N.: "Arabidopsis thaliana protein fragment SEQ ID NO:49389" Database accession no. AAG39867 XP002239797 -& EP 1 033 405 A (CERES INC) 6 September 2000 (2000-09-06) paragraphs '0009!, '0010!, '0162!-'0167!, '0177!, '2286!- '2295! page 9165 --- -/--	1-3, 10-12, 17,21, 22, 26-37, 44,45

Further documents are listed in the continuation of box C.

Patent family members are listed in 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 document 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
30 July 2003	13. 08. 2003

Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer ALCONADA RODRIG., A
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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 02/03636

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE GENEMBL 'Online! 13 March 1998 (1998-03-13) FEDERSPIEL, N.A.: "Arabidopsis thaliana chromosome I BAC T14N5 genomic sequence, complete sequence" Database accession no. AC004260 XP002248861</p> <p style="text-align: center;">---</p>	<p>8-10, 16, 18-22, 26-36, 44, 45</p>
X	<p>WO 96 03513 A (MONSANTO CO) 8 February 1996 (1996-02-08) claim 27</p> <p style="text-align: center;">---</p>	46
A	<p>DATABASE GENEMBL 'Online! 27 November 1998 (1998-11-27) LIN, X. ET AL.: "Arabidopsis thaliana chromosome 2 clone T20F21 map ve016, complete sequence" Database accession no. AC006068 XP002239760</p> <p style="text-align: center;">---</p>	
A	<p>US 6 255 114 B1 (EVERARD JOHN D ET AL) 3 July 2001 (2001-07-03) examples 1,2</p> <p style="text-align: center;">-----</p>	38-46

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. Claims: 1-3, 11-13, 17 and 37 (complete) and 10, 21-36 and 38-46 (in part)

An isolated nucleic acid comprising the genomic sequence of SEQ ID NO:1 isolated from *A.thaliana* or the cDNA sequence of SEQ ID NO:2 and which encodes for the polypeptide of SEQ ID NO:3; the isolated polypeptide of SEQ ID NO:3, fusion protein, antibody that specifically bind to the polypeptide of the invention, a complex comprising said polypeptide and a starch molecule, a vector comprising the polynucleotide of SEQ ID NOs: 1 or 2; a cell comprising said vector; a genetically-engineered plant comprising the isolated nucleic acid molecule of SEQ ID NO:1 or 2; a method of altering starch synthesis in plant comprising introducing into said plant a nucleic acid sequence of SEQ ID NO:1, a plant wherein starch synthesis is altered, the modified starch obtained from said plant.

2. Claims: 4, 5 and 14 (complete) and 10, 19-36 and 38-46 (in part)

As invention 1, but related to the polynucleotide of SEQ ID NO:10 isolated from *A.thaliana* and which codes for the polypeptide of SEQ ID NO:11.

3. Claims: 6, 7 and 15 (complete) and 10, 19-36 and 38-46 (in part)

As invention 1, but related to the polynucleotide of SEQ ID NO:8 isolated from *A.thaliana* and which codes for the polypeptide of SEQ ID NO:9.

4. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the polynucleotides of SEQ ID NO:6 and 23 isolated from *A.thaliana* and which code, respectively, for the polypeptides of SEQ ID NO:7 and 24.

5. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the polynucleotide of SEQ ID NO:12 isolated from *A.thaliana* and which codes for the polypeptide of SEQ ID NO:13.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

6. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the poynucleotide of SEQ ID NO:14 isolated from A.thaliana and which codes for the polypeptide of SEQ ID NO:15.

7. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the poynucleotide of SEQ ID NO:16 isolated from barley (Hordeum vulgare) and which codes for the polypeptide of SEQ ID NO:17.

8. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the poynucleotide of SEQ ID NO:18 isolated from barley (Hordeum vulgare) and which codes for the polypeptide of SEQ ID NO:19.

9. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the poynucleotide of SEQ ID NO:20 isolated from wheat (Triticum aestivum) and which codes for the polypeptide of SEQ ID NO:21.

10. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the poynucleotide of SEQ ID NO:20 isolated from wheat (Triticum aestivum) and which codes for the polypeptides of SEQ ID NO:21 and 22.

11. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the poynucleotide of SEQ ID NO:25 isolated from rice (Oryza sativa) and which codes for the polypeptide of SEQ ID NO:26.

12. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the poynucleotide of SEQ ID NO:27 isolated from maize (Zea mays) and which codes for the polypeptide of SEQ ID NO:28.

13. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the poynucleotide of SEQ ID NO:29 isolated from maize (Zea mays) and which codes for the polypeptide of SEQ ID NO:30.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

14. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the polynucleotide of SEQ ID NO:30 isolated from maize (*Zea mays*) and which codes for the polypeptide of SEQ ID NO:31.

15. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the polynucleotide of SEQ ID NO:31 isolated from maize (*Zea mays*) and which codes for the polypeptide of SEQ ID NO:32.

16. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the polynucleotide of SEQ ID NO:33 isolated from maize (*Zea mays*) and which codes for the polypeptide of SEQ ID NO:34.

17. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the polynucleotide of SEQ ID NO:4 isolated from maize (*Zea mays*).

18. Claims: 8-10, 16, 18-36 and 38-46 (in part)

As invention 1, but related to the polynucleotide of SEQ ID NO:4 isolated from maize (*Zea mays*).

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Present claim 38 relates to a method of altering starch synthesis in a plant comprising introducing in said plant a nucleic acid sequence defined by reference to a desirable characteristic or property, namely, that it is a starch primer gene. The claims relates to methods which make use of all genes having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and disclosure within the meaning of Article 5 PCT for only a very limited number of such products. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Independent of the above reasoning, the claims also lack clarity (Article 6 PCT). An attempt is made to define the product by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those parts of the claims which appear to be clear, supported and disclosed, namely those parts relating to the method which uses the polynucleotides of SEQ ID NO :2, 6 or 23 or the polypeptides encoded thereby (SEQ ID NO: 3, 7 or 24, respectively), as disclosed on examples 16 and 20.

Present claim 38(iii) relates to method of altering starch synthesis in a plant which comprises introducing into said plant an agent, wherien said agent is defined by reference to a desirable characteristic or property, namely, that it is able of altering the expression of starch primer gene or of a nucleotide sequence that hybridises to it. The claim covers methods which make use of any agent having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and disclosure within the meaning of Article 5 PCT for only a very limited number of such agents. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Independent of the above reasoning, the claims also lack clarity (Article 6 PCT). An attempt is made to define the agent by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those parts of the claims which appear to be clear, supported and disclosed, namely the use of antisense poynucleotides, ribozymes or RNAi specific for the mRNA encoded by the polynucleotide of SEQ ID NO: 2, 6 or 23 (as disclosed on pages 39-44 of the description).

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

international application No.
PCT/GB 02/03636

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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:
see FURTHER INFORMATION sheet PCT/ISA/210

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 II Observations where unity of invention is lacking (Continuation of Item 2 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 fee, this Authority did not invite payment of any additional fee.

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.:
1-3, 11-13, 17 and 37 (complete) and 8-10, 16, 18-36 and 38-46 (in part)

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.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 02/03636

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
WO 9603513	A	08-02-1996	AU 691325 B2	14-05-1998
			AU 3143795 A	22-02-1996
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