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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM,

[Continued on next page]

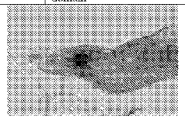
(54) Title: METHODS AND COMPOSITIONS FOR PLANT PEST CONTROL

FIG. 1

No.	Seq Id No	Internal No.	DNA Seq
1	1	hgg1c.pk001.e18	CAAAAGCTCGGCACTCCGACGTGGACGAGATCATACATTTGCGCA ACCGGCTTACATGCGTGACCCGTTGCGTGCCGACTTTCTCGCGGGC TCCAAACTGAAGGAGGTGAAGAAGACGGACTACAACCAGTGCAA GTCCATGCTGCTCGACCTGTTCGACGGCACGCGCGTGATTTGGTG GGCGAAACGCGGGACCGAAGCGGACGCAAGCGGTTGATCTCCTGC TTTCAACTGTACCGACAAAGCAGAGCCGCGGCAAATTTCGGCATG TTCGCTGTCCATCCCTTTTTCCAAGCGTCCGGACTTGGCAAGCGAT TGTTGACTGTTGCTGAACGCTATGCCGTATTGTGTGGGGCAGTGA CGAGATGCATTTGGATGTTGGCGGGAGTTTGGCCGAATTAAAGTT GGGCATGGGACGACTGCAGAGATACTACAAGCGGCGCGGGTTCCT ATCAACCGGCATTCTTCGCCCCTTCAATGGGGCTGTGGCGCGCTTC ATCACGGTAGACCGAAACGATCTGTGGATTGAGCTGATGGTCAAG GACATACGTGGAGCATTGGATGACATCGGCGGAGATCCAGAGAAA CGGATGAAAAGAGTGAACAGTCGGGGGAGATTGGCCAGAGAAGC AGACAAAGACGACGGCGGCAGAGATCCACAAAAAGGATGGAGA GAGTGCGAAGCTTTGGGAGATTAACCATAGAAGCAGACAGGGAC GACATCGGCAGAGACGCGCAAAAAAGGATGGAGAGAGTGCGCAG TTTAGGGAGATTGGCAAGAGAAGCAGACAAATCGGATGAGAGTA AAGGCAAAGATGGGGAGGAAAAGAAAAAGACAACACAGGCAGA GGGGGAAGAGAGTAAAGGCAAAGATGGAGAGGAAAAGAAAAAG ACAACACAGGCAGAGGGGGAAGAGAGAATTAAGCCTTTGGCTGA TTGAAGAAGCATTCAAACAGTTGTGTCTCCTCGAAAAATACAGAC TCTGAAGCTTCAATACAGTAAATACAGTATGCTTGTCCGGAATAA TTTAATGAATCATCGTTTTTTTATTAAAAATTTTCAAATCGTT GCCAGTTGGCGTTTCGTCGTAGTTATACTGTAGAAAGATTGGCAAA AATAAATGTTTCTGGCTTAA

No.	Seq Id No	Internal No.	Amino Acid Seq
1	143	hgg1c.pk001.e18	KSSALRRGRDHTFAQPAYMKDPLRADLLAGSKLKEVKKTDYNQ CKSMLLDLFDGTRVTLVGITTRDRSGRKRLISCFQLYRQSRAAAYF GMFAVTPFTQASGLGKRLLTVATRYARTVWGSDFMHILDVGGSE AELKLGMGRLQRVYKRRGHLSTGILRPENGAVARFTVDRNDLWI ELMVKLDRGALDDIGGDPEKRMKRVNSRGRLAREADKDDGGRD PQKRMFRVRSFGRLTIEADRDDIGRDAQKRMFRVRSLGRLARFA DKSDFSKGKDGFFKKKTTQAFGFFSKGKDGFFKKKTTQAFGFF RIKPLAD

No.	Seq Id No	Internal No.	Homology	Predicted Subcellular Location
1	1	hgg1c.pk001.e18	GCN5-like N-acetyltransferases from Streptomyces; contains GNAT acetyltransferase domain	Nuclear



(57) Abstract: The present invention comprises methods and compositions for controlling nematode parasitism in host plant. The present invention comprises novel polynucleotides and polypeptides encoded by such polynucleotides comprising one or more nucleic acid sequences disclosed herein having a nucleotide sequence comprising any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof, or a polypeptide sequence comprising any one of SEQ ID NOs: 143-160, a fragment or variant thereof.

WO 2014/165227 A3

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, 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, IR, IS, JP, KE, KG, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

— *with sequence listing part of description (Rule 5.2(a))*

(88) Date of publication of the international search report:
24 December 2014

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US14/24865

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - C12N 15/82 (2014.01)
USPC - 800/298
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)
IPC(8): A01H 1/00, 5/00; C12N 15/09, 15/82 (2014.01)
USPC: 800/278, 279, 288, 295, 298, 317, 320; CPC: C07K 14/43563; C12N 15/8218, 15/8285

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)
MicroPatent (US-Granted, US-Applications, EP-A, EP-B, WO, JP, DE-G, DE-A, DE-T, DE-U, GB-A, FR-A); ProQuest; IP.com; Google; Google Scholar; 'nucleic acid construct,' 'polypeptide, 'plant cell,' 'isolated polynucleotide,' silence, nematode

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 2010/0281572 A1 (HUSSEY, RS et al.) November 4, 2010; abstract; paragraphs [0017] [0024], [0033], [0044], [0047], [0056], [0057], [0086], [0088], [0091], [0093], [0094], [0101], [0103], [0109], [0122], [0138], [0140], [0145], [0172], [0189], [0190], [0208], [0210]; column 27, Table 2	1-9, 11/1-11/3, 11/7-11/9, 12-17, 19-39, 41, 43-51 ----- 10, 11/10, 18, 40/39/30-40/39/35, 42/30-42/35
Y	US 2007/0074311 A1 (GRUIS, DB et al.) March 29, 2007; abstract; paragraphs [0033], [0034], [0039], [0040], [0056]; Claim 3	10, 11/10, 18, 40/39/30-40/39/35, 42/30-42/35
A	US 2012/0151629 A1 (MCCAIG, BC et al.) June 14, 2014; abstract	1-51

☐ 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
19 September 2014 (19.09.2014)	09 OCT 2014

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. 571-273-3201	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US14/24865

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:

-***-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.:

-***-Please See Supplemental Page-***-

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.

-***-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 1-51 are directed toward a polynucleotide construct, comprising, a nucleotide sequence selected from the group consisting of: (a) a nucleotide sequence comprising any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof; a polypeptide encoded by said nucleic acid sequence; a plant cell comprising said nucleic acid construct, wherein the nucleic acid construct encodes a silencing element having nematocidal activity against a nematode plant pest; and a method for controlling a nematode plant pest, comprising, feeding to a nematode plant pest a composition comprising a silencing element.

The isolated polynucleotide construct comprising a nucleotide sequence, a polypeptide encoded by said nucleic acid sequence; and a plant cell comprising said nucleic acid construct will be searched to the extent that the polynucleotide encompasses SEQ ID NO: 1 (artificial DNA nucleic acid sequence). It is believed that Claims 1 (in-part), 2 (in-part), 3 (in-part), 4 (in-part), 5 (in-part), 6 (in-part), 7 (in-part), 8 (in-part), 9 (in-part), 11 (in-part), 12 (in-part), 13 (in-part), 14 (in-part), 15 (in-part), 16 (in-part), 17 (in-part), 18 (in-part), 19 (in-part), 20 (in-part), 21 (in-part), 22 (in-part), 23 (in-part), 24 (in-part), 25 (in-part), 26 (in-part), 27 (in-part), 28 (in-part), 29 (in-part), 30 (in-part), 31 (in-part), 32 (in-part), 33 (in-part), 34 (in-part), 35 (in-part), 36 (in-part), 37 (in-part), 38 (in-part), 39 (in-part), 40 (in-part), 41 (in-part), 42 (in-part), 43 (in-part), 44 (in-part), 45 (in-part), 46 (in-part), 47 (in-part), 48 (in-part), 49 (in-part), 50 (in-part) and 51 (in-part) encompass this first named invention and thus these claims will be searched without fee to the extent that they encompass SEQ ID NO: 1 (artificial DNA nucleic acid sequence). Applicants must specify the claims that encompass any additionally elected sequences. 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. An Exemplary Election would be: SEQ ID NO: 2 (artificial DNA nucleic acid sequence).

No technical features are shared between SEQ ID NOs: 1-142 or 161 and, accordingly, these sequences lack unity a priori.

Groups I+ share the technical features including a nucleic acid construct, comprising, a nucleotide sequence selected from the group consisting of: (a) a nucleotide sequence comprising any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof; (b) a nucleotide sequence comprising at least 90% sequence identity to any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof, wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; (c) a nucleotide sequence comprising at least 19 consecutive nucleotides of any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof, wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; (d) a nucleotide sequence that hybridizes under stringent conditions to the full length complement of the nucleotide sequence of a), wherein said stringent conditions comprise hybridization in 50% formamide, 1 M NaCl, 1% SDS at 37 degrees C, and a wash in 0.1X SSC at 60 degrees C to 65 degrees C, wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; and, (e) a nucleotide sequence encoding a polypeptide sequence comprising any one of SEQ ID NOs: 143-160 or a fragment or variant thereof; a polypeptide encoded by a nucleic acid sequence of a nucleic acid construct, comprising a sequence selected from the group consisting of: (a) a polypeptide sequence comprising any one of SEQ ID NOs: 143-160 or a fragment or variant thereof; (b) a polypeptide sequence comprising at least 90% sequence identity to any one of SEQ ID NOs: 143-160 or a fragment or variant thereof; (c) a polypeptide sequence of any one of SEQ ID NOs: 143-160 or a fragment or variant thereof; wherein the polypeptide has nematocidal activity against a nematode plant pest; and (d) a polypeptide encoded by a polynucleotide sequence comprising any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof; a plant cell, comprising, at least one heterologous nucleic acid construct, wherein the heterologous nucleic acid construct comprises (a) a nucleotide sequence comprising any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof, wherein the nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; (b) a nucleotide sequence comprising at least 90% sequence identity to any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof, wherein the nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; (c) a nucleotide sequence comprising at least 19 consecutive nucleotides of any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof, wherein the nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; or (d) a nucleotide sequence encoding a polypeptide sequence comprising any one of SEQ ID NOs: 143-160 or a fragment or variant thereof, wherein the nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; wherein the silencing element, when ingested by a nematode plant pest, reduces the level of at least one target sequence in the nematode plant pest and thereby controls the nematode plant pest; a method for controlling a nematode plant pest, ... Continued on Next Supplemental Page ...

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-***-Continued from Previous Supplemental Page:

... Continued from Previous Supplemental Page ... comprising, feeding to a nematode plant pest a composition comprising a silencing element, wherein said silencing element, when ingested by said nematode plant pest, reduces the level of a target nematode plant pest sequence and thereby controls the nematode plant pest, wherein said target nematode plant pest sequence comprise a nucleotide sequence comprising at least 90% sequence identity to any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof; and an isolated polynucleotide, comprising, a nucleotide sequence selected from the group consisting of: (a) a nucleotide sequence comprising any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof; (b) a nucleotide sequence comprising at least 90% sequence identity to any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof, wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; (c) a nucleotide sequence comprising at least 19 consecutive nucleotides of any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a complement thereof, wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; (d) a nucleotide sequence that hybridizes under stringent conditions to the full length complement of the nucleotide sequence of a), wherein said stringent conditions comprise hybridization in 50% formamide, 1 M Na Cl, 1% SDS at 37 degrees C, and a wash in 0.1X SSC at 60 degrees C to 65 degrees C, wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; and, (e) a nucleotide sequence encoding a polypeptide sequence comprising any one of SEQ ID NOs: 143-160 or a fragment or variant thereof.

However, these shared technical features are previously disclosed by US 2010/0281572 A1 to Hussey, et al. (hereinafter 'Hussey') in view of the publication entitled 'GenBank Accession CK350712: hggfha28D04 Gland Cell LD PCR cDNA Library Heterodera Glycines cDNA, mRNA Sequence' by Maier, et al. (hereinafter 'Maier'). Hussey discloses a nucleic acid construct (a nucleic acid construct; paragraph [0017]), comprising a nucleotide sequence (comprising a nucleotide sequence; paragraph [0044]), wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest (wherein the plant expresses inhibitory RNA that downregulates nematode parasitism genes (wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; paragraph [0018]); a polypeptide encoded by a nucleic acid sequence of a nucleic acid construct, comprising a sequence (a polypeptide encoded by a nucleic acid sequence of a nucleic acid construct, comprising a sequence; paragraph [0019]); a plant cell, comprising, at least one heterologous nucleic acid construct (a plant cell, comprising, at least one heterologous nucleic acid construct; paragraph [0024]), wherein the heterologous nucleic acid construct comprises (a) a nucleotide sequence (wherein the heterologous nucleic acid construct comprises (a) a nucleotide sequence; paragraph [0044]), wherein the nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest (wherein the nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; paragraph [0018]); wherein the silencing element, when ingested by a nematode plant pest, reduces the level of at least one target sequence in the nematode plant pest and thereby controls the nematode plant pest (wherein the construct produces inhibitory RNA that down regulates the expression of a nematode parasitism gene transcript (wherein the silencing element, when ingested by a nematode plant pest, reduces the level of at least one target sequence in the nematode plant pest, and thereby controls the nematode plant pest; paragraph [0018]); a method for controlling a nematode plant pest (a method for reducing, preventing or treating nematode disease in plants (a method for controlling a nematode pest; paragraph [0089]), comprising, feeding to a nematode plant pest (feeding to a nematode plant pest; paragraph [0089]) a composition comprising a silencing element (a transgenic plant cell comprising inhibitory RNA (a composition comprising a silencing element); paragraph [0092]), wherein said silencing element, when ingested by said nematode plant pest, reduces the level of a target nematode plant pest sequence and thereby controls the nematode plant pest (wherein said silencing element, when ingested by said nematode plant pest, reduces the level of a target nematode plant pest sequence, and thereby controls the nematode plant pest; paragraphs [0018], [0092]), wherein said target nematode plant pest sequence comprise a nucleotide sequence (wherein said target nematode plant pest sequence comprises a parasitism gene (wherein said target nematode plant pest sequence comprise a nucleotide sequence); paragraph [0092]); and an isolated polynucleotide (isolated polynucleotide; paragraph [0053]), comprising a nucleotide sequence (comprising a nucleotide sequence; paragraph [0044]), wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest (wherein the construct produces inhibitory RNA that down-regulates the expression of a nematode parasitism gene transcript (wherein said nucleotide sequence encodes a silencing element having nematocidal activity against a nematode plant pest; paragraphs [0018], [0092]).

Hussey does not disclose a nucleotide sequence selected from the group consisting of: (a) a nucleotide sequence comprising any one of SEQ ID NOs: 1-142 or 161, a fragment or variant thereof, or a protein encoded by said nucleotide sequences.

Further, Maier discloses a nucleotide sequence consisting of: (a) a nucleotide sequence comprising a fragment of SEQ ID NO: 1 (mRNA sequence (a nucleotide sequence comprising a fragment of SEQ ID NO: 1); page 1; bases 1-260 are 100% identical to bases 1-260 of SEQ ID NO: 1), wherein the sequence encodes a polypeptide identified as a nematode parasitism gene (wherein the sequence encodes a polypeptide identified as a nematode parasitism gene; page 1).

It would have been obvious to a person of ordinary skill in the art, at the time of the invention, to have modified the previous disclosure of Hussey, for integrating the use of fragments of genes and/or sequences from other known parasitism genes, including the genes previously disclosed by Maier, for implementing silencing constructs for additional strains of nematodes, or to protect against particular nematode strains which were pests for particular plant species.

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 a combination of the Hussey and Maier references, unity of invention is lacking.