

Title

**Summary of the Literature Review for GHB119 cotton
October 1, 2020 – September 30, 2021**

Final ReportData or guideline requirement

Explanatory note on literature searching
conducted in the context of GMO applications for (renewed) market authorization
and annual post-market environmental monitoring reports on GMOs authorised in the EU market.
EFSA supporting publications 2019:EN-1614

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November 9, 2021

Principal author

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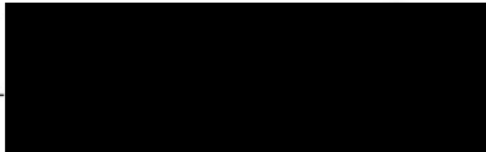
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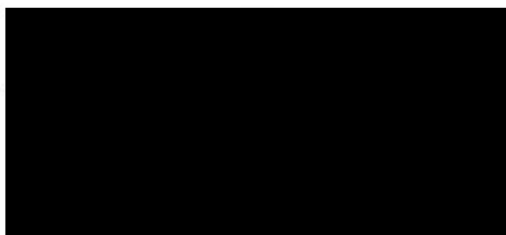


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SIGNATURE PAGE

Principal author:



Date

2021-11-09

STUDY PERSONNEL

Electronic database search	[REDACTED]
Agency website search	GRM
Manual search (reference list from review articles)	[REDACTED]
Stage 1 assessment	[REDACTED] [REDACTED]
Stage 2 assessment	<u>Food and feed safety</u> [REDACTED] [REDACTED] <u>Molecular characterization</u> [REDACTED] [REDACTED] <u>Environmental safety</u> [REDACTED] [REDACTED]
Report	[REDACTED] [REDACTED] [REDACTED]

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SUMMARY

The GHB119 cotton event expresses the *Bacillus thuringiensis* subsp. *dakota* Cry2Ae insecticidal protein that is effective in controlling lepidopteran larvae such as cotton bollworm, tobacco budworm, and fall armyworm. GHB119 cotton also expresses the herbicide tolerant phosphinothricin acetyl transferase (PAT/*bar*) as a selectable marker which confers tolerance to glufosinate-ammonium herbicides. The OECD identifier is BCS-GHØØ5-8.

A scoping review was performed for the GHB119 cotton and its newly expressed proteins, Cry2Ae and PAT/*bar*. The objective of this scoping review was to determine if there were studies about the molecular characterization of GHB119 cotton, its effect on food and feed safety or environmental safety, that might require in-depth examination. A set of broad literature searches was performed using several bibliographic databases covering scientific literature from October 1, 2020 to September 30, 2021. Additional sources of information, such as web pages of food safety, agriculture, and biotechnology-related authorities were searched for the same time window, along with the bibliographies of relevant reviews. The references identified were evaluated for potential relevance to the scoping review questions according to pre-defined criteria.

These literature searches identified a total of 277 unique publications, which were subject to rapid assessment to exclude obviously irrelevant publications. A total of 11 publications were progressed for detailed assessment and were determined to be not relevant after detailed review.

No new publications were found that contained new data on the molecular characterization of the GHB119 cotton and its newly expressed proteins, Cry2Ae and PAT/*bar*. Similarly, no new publications were found that suggested any potential adverse effects of GHB119 cotton on human health, animal health, or the environment. No issues or topics were identified that would trigger or warrant more specific question formulation or indicate that a systematic review would be of value.

1. INTRODUCTION

The GHB119 cotton event expresses the *Bacillus thuringiensis* subsp. *dakota* Cry2Ae insecticidal protein that is effective in controlling lepidopteran larvae such as cotton bollworm, tobacco budworm, and fall armyworm. GHB119 cotton also expresses the herbicide tolerant phosphinothricin acetyl transferase (PAT/*bar*) as a selectable marker which confers tolerance to glufosinate-ammonium herbicides. The OECD identifier is BCS-GHØØ5-8.

The objective of the literature searches described here was to determine if there were studies published between October 1, 2020 and September 30, 2021 that mention the molecular characterization of the GHB119 cotton, and/or any adverse effect of GHB119 cotton in food, feed or the environment. In that context, a broad and inclusive literature search was performed, and the articles retrieved were reviewed in a comprehensive and transparent manner. This was intended as a scoping review. The literature review was performed as recommended in the European Food Safety Authority (EFSA) explanatory note on literature searching conducted in the context of Genetically Modified Organisms (GMO)¹ applications and post-market environmental monitoring activities (2019).

The literature searches were performed for the GHB119 cotton and its newly expressed proteins, Cry2Ae and PAT/*bar*. The search terms also included relevant synonyms, and intended traits, plant species and general GMO terms.

2. OVERALL METHODS

2.1. Objective of the scoping review

The objective of the scoping review was to survey the evidence base for the GHB119 cotton and its newly expressed proteins, Cry2Ae and PAT/*bar*, in order to identify any specific issues related to food or feed safety, molecular characterization or environmental safety that might require in-depth examination.

2.2. Review questions

Review questions were formulated to conform to PE(I)CO structure (Population, Exposure (Intervention), Comparators, Outcome) if possible, and to address data requirements. They were modeled after the review question examples provided in the EFSA 2019 explanatory note¹.

Question 1: Were any studies published during the reporting period that describe adverse effects on human or animal health or the environment of the GHB119 cotton and its newly expressed proteins Cry2Ae and PAT/*bar*?

Key elements:

Population: Human health; animal health; environmental safety

Exposure (Intervention): GHB119 cotton, derived food/feed products, newly expressed proteins in GHB119 cotton

Comparators: When applicable, comparable populations or subjects exposed to appropriate controls (e.g., vehicle only, innocuous control protein, non-GM comparator) or conventional counterpart used for comparative analysis of plant material

Outcome: Adverse effects

Question 2: Were any studies published during the reporting period that focus on molecular characterization of the GHB119 cotton and its newly expressed proteins Cry2Ae and PAT/*bar* in cotton?

Key elements:

Population: GHB119 cotton and newly expressed proteins in GHB119 cotton

Outcome: Molecular characterization (which would indicate the information/data requirement for molecular characteristics)

2.3. Criteria for relevance

Criteria for establishing the relevance of retrieved publications were defined prior to conduct of the search. These criteria were modeled after those given in the EFSA 2019 explanatory note¹ and are described in [Table 1](#).

Table 1: Eligibility/inclusion criteria to establish the relevance of retrieved publications

Concepts	Criteria	Comment
Key elements of review questions with PECO structure		
Population	The publication addresses human and animal health, and/or the environment (including biodiversity, ecosystem services, service providing units, and endangered species) as general protection goals	From the publications that address the GMO under consideration, those that address protection goals relevant to the risk assessment of the GMO are eligible
Exposure (Intervention)	The publication addresses the GMO, derived food/feed products, and/or the intended trait(s) (e.g., newly expressed proteins(s)) that are identical or like those under regulatory review	This enables the selection of publications that address the GMO, derived food/feed products, and/or the intended trait(s) under consideration
Comparator	If the publication reports a comparative study that uses plant material as test material, eligible publications must report a non-GM variety as comparator	In those cases where the publication addresses the GMO under consideration, reports a comparative analysis study and uses plant material as test material, eligible publications also need to include an appropriate non-GM line as comparator
Outcome	The publication addresses effects/impacts on human and animal health, and/or the environment	Publications that address the GMO under consideration also need to address effects/impacts on entities of concern, and potential determinants of exposure that place these entities at risk, in order to be relevant to the risk assessment of the GMO
Additional concepts		

Concepts	Criteria	Comment
Information/data requirements	The publication reports information pertaining to one or more information/data requirement(s) outlined in Appendix A for the GMO and derived food/feed products under consideration, including the intended trait(s)	Publications that potentially contribute to the knowledge informing the risk assessment of the GMO under consideration, and thus the risk hypotheses addressed, taking account of both hazard and exposure, can be considered relevant according to this eligibility/inclusion criterion. Publications addressing other issues such as benefits, socio-economics, ethics, crop protection, detection methods, efficacy, public perception and risk communication can be excluded, as they are not necessarily relevant to the risk assessment of GMOs
Plant species	The publication addresses the same plant species as the GMO under consideration	This eligibility/inclusion criterion permits the exclusion of publications on GMOs that contain the same intended trait(s) as the GMO under consideration, but which are introduced in another plant species
Scope of GMO application	The publication addresses pathways and levels of exposure to the GMO, derived food/feed products, and the intended trait(s) that are relevant for the intended uses of the GMO and derived food/feed products under regulatory review	From the publications that address the GMO under consideration, those that consider pathways and levels of exposure relevant to the scope of the GMO application (i.e., import and processing for food/feed uses, cultivation) are eligible
Target pests/organisms	The publication addresses target pests/organisms that are established in the EU	This permits the exclusion of publications that address interactions between the GMO and target pests/organisms that do not occur in the EU

Concepts	Criteria	Comment
Stacked events obtained by conventional crosses/ subcombinations	The publication addresses the higher stacked event and/or a subcombination or subcombinations of the single events of the higher stacked event, independently of its/their origin	This permits the selection of publications on the higher stacked event and/or subcombinations of the single events of the higher stacked event that are in the scope of the GMO application(s), independently of their origin. This permits the exclusion of publications on the single events of the higher stacked event, because the risk assessment of GMO applications for stacked events covers only the products in the scope of the GMO application – i.e., the higher stacked event and subcombinations of the singles involved, independently of their origin
Molecular stacks	The publication addresses: the molecular stack; all newly expressed proteins in the molecular stack; and/or one or several of the newly expressed proteins in the molecular stack that has/have not been previously risk assessed by EFSA and/or its GMO Panel and for which no safe use has been determined yet by EFSA and/or its GMO Panel	This permits the exclusion of publications that address one or several (not all) of the newly expressed proteins in the molecular stack that has/have been previously risk assessed by EFSA and/or its GMO Panel and for which the safe use has been determined by EFSA and/or its GMO Panel
Previously risk assessed publications	The publication has not been previously risk assessed by EFSA and/or its GMO Panel and is not cited/referenced in an EFSA/GMO Panel output	This permits the exclusion of publications that have been previously risk assessed by EFSA and/or its GMO Panel and cited/referenced in an EFSA/GMO Panel output
Access	Full-text document is accessible	If potentially relevant full-text documents cannot be obtained, they should be listed in a table with a description of the (unsuccessful) methods that have been used to try to obtain a copy

Concepts	Criteria	Comment
Reporting format	The publication presents original/primary data, or it is a risk assessment from a relevant key organisation (such as regulatory agencies and risk assessment bodies involved in the risk assessment of GMOs)	This permits the exclusion of publications that do not present original/primary data (e.g., editorials, position papers), and the inclusion of relevant risk assessments performed and reported by relevant key organisations. Reviews should only be included if they present data that are not available from a primary research study
Reporting format	A study in a publication should only be presented once, but if it is presented in more than one publication, all publications should be listed and grouped	Duplicate publications should be excluded at the screening stage. Only one copy of a study is required even if it is reported in different publications, and identified in more than one database

Table adapted from EFSA, 2019: Explanatory note on literature searching conducted in the context of GMO applications for (renewed) market authorisation and annual post-market environmental monitoring reports on GMOs authorised in the EU market.

2.4. Reference publication

One publication that is related to GHB119 cotton was previously identified and was used to test and validate the search strategy:

- Wu A-J; Chapman K; Sathischandra S; Massengill J; Araujo R; Soria M; Bugas M; Bishop Z; Haas C; Holliday B; Cisneros K; Lor J; Canez C; New S; Mackie S; Ghoshal D; Privalle L; Hunst P; Pallett K (2019). GHB614 x T304-40 x GHB119 x COT102 Cotton: Protein Expression Analyses of Field-Grown Samples. *Journal of Agriculture and Food Chemistry* 67(1):275-281

This article was selected as reference publication because even though it is not directly relevant for the GHB119 event, it mentions the event (GHB119), one of the newly expressed proteins (PAT/bar, phosphinothricin acetyl transferase), the intended traits (insect control, herbicide tolerance) and the crop (cotton). Since this article was published outside of the timeframe of this report, the search profile was tested without applying the time filters used in the final profile (UP>=20201001 and UP<=20210930).

3. SEARCH METHODS AND OUTCOMES

The search strategies used here followed the 2019 EFSA explanatory note on literature searching conducted in the context of GMO applications and post-market environmental monitoring activities¹. The search strategies were designed to be broad and sensitive enough to capture any relevant publications, if available.

An information specialist with background in plant biotechnology selected the databases, identified relevant search terms, developed search profiles, designed search strategies, and conducted the searches.

3.1. Time window and date of the literature search

The database searches were performed on October 13, 2021. Only documents updated between October 1, 2020 and September 30, 2021, were considered in the search. The dates of most recent database updates are provided in [Table 3](#).

3.2. Databases used in the literature search

All searches were performed in the host STN (Scientific and Technical Information Network), an online database service operated jointly by CAS and FIZ Karlsruhe. STN provides access to a broad range of databases from the most renowned database producers worldwide.

The searches described here were performed in five databases: three multidisciplinary/large databases (Biosis, Medline and CA-Plus) and two subject-specific databases focused on agriculture-related topics (Agricola and CABA).

See [Appendix 1](#) for detailed database descriptions.

3.3. Search strategy

The search profile was designed to cover event name, newly expressed proteins, and intended traits. The reference publication ([Section 2.4](#)) was identified by the search profile confirming the validity of the applied search strategy. Since the 'newly expressed proteins' profiles and the 'intended trait' profiles produced too many results when used on their own, they were combined with additional profiles: the 'newly expressed proteins' profiles were combined with a 'plant species' profile while the 'intended trait' profiles were combined with a 'general GMO' profile as well as with the 'plant species' profile. See [Table 2](#) for a detailed search profile.

Table 2: Search profile for database search

Set	Search string	Concepts
1	GHB119 or GHB(w)119 or BCS-GH005-8 or BCS(w)GH005(w)8 or BCSGH005(w)8 or BCS-GH005-8 or BCS-(w)GH005(w)8 or BCSGH005(w)8 or BCS-GH005-8 or BCS-(w)GH005(w)8 or BCSGH005(w)8	Event name
2	s ((bar or pat) (2a) (gene# or protein# or enzyme#)) or ppt(2w)acetyltransferase or ppt(2w)acetyl(w)transferase or pt(w)n(2w)acetyltransferase or pt(w)n(2w)acetyl(w)transferase or phosphinothricin(w)n(w)acetyltransferase or phosphinothricin(2w)acetyltransferase or phosphinothricin(2w)acetyl(w)transferase or phosphinothricinacetyl(w)transferase	Newly expressed protein 1
3	cry2ae# or cry(w)2(w)ae# or cry(w)2ae# or cry2(w)ae# or cry2(w)a(w)e# or cry(w)2(w)a(w)e# or cry2a(w)e# or cryIIae# or cry(w)II(w)ae# or cry(w)IIae# or cryII(w)ae# or cryII(w)a(w)e# or cry(w)II(w)a(w)e# or cryIIa(w)e# or cryIIae# or cry(w)ll(w)ae# or cry(w)llae# or cryll(w)ae# or cryll(w)a(w)e# or cry(w)ll(w)a(w)e# or crylla(w)e#	Newly expressed protein 2
4	(herbicid? or bialaphos or basta or glufosinate or phosphinothricin or liberty? Or Insect# OR pest# OR Lepidoptera# OR Noctuidae OR Crambidae OR borer# OR	Intended traits

	cornborer# OR stalkborer# OR earworm# OR ear(w)worm# OR armyworm# OR army(w)worm# OR cutworm# OR cut(w)worm# OR Ostrinia OR O(w)nubilalis OR Sesamia OR S(w)nonagrioides OR Diatraea OR D(w)grandiosella OR D(w)crambidoides OR Helicoverpa OR H(w)zea OR Spodoptera OR S(w)frugiperda OR Papaipema OR P(w)nebris OR Elasmopalpus OR E(w)lignosellus OR D(w)saccharalis OR Striacosta OR S(w)albicosta OR Agrotis OR A(w)ipsilon OR S(w)cretica OR Mythimna OR M(w)unipuncta OR ECB OR MCB OR SWCB OR SCSB OR CEW OR FAW OR SCB OR WBC) (5a) (resist? OR protect? OR toleran?)	
5	cotton# OR gossypium OR G(w)hirsutum OR g(w)barbadense	Plant species
6	GMO OR GMOs OR LMO OR LMOs OR GM OR GE OR transgen? OR (genetic?(3a)(modif? OR transform? OR manipulat? OR improv? OR engineer?))	GMO general
7	2 AND 5	Newly expressed protein 1 AND Plant species
8	4 AND 5 AND 6	Intended trait AND Plant species AND GMO general
9	1 OR 3 OR 7 OR 8	Event name OR (Newly expressed protein 1 AND plant species) OR Newly expressed protein 2 OR (Intended traits AND Plant species AND GMO general)

All searches were performed in the Basic Index (BI) field, which includes the following subject headings/field names:

- **Agricola:** title (TI), controlled term (CT), supplementary term (ST), abstract (AB), named person (NA), corporate name (CO), note (NTE), geographic term, CABA and other fields (GT)
- **Biosis:** title (TI), abstract (AB), biosystematic codes (BC), chemical name (CN), controlled term (CT), gene name (GEN), geographic term (GT), organism (ORGN) and supplementary term (ST); as well as CAS Registry Numbers (RN)
- **CA-Plus:** title (TI), supplementary term (ST), index term (IT) and abstract (AB); as well as CAS Registry Numbers
- **CABA:** title (TI), controlled term (CT), supplementary term (ST), broader term (BT), abstract (AB), organism name (ORGN) and geographic term (GT); as well as CAS Registry Numbers
- **Medline:** title (TI), chemical name (CN), gene name (GEN), controlled term (excluding MeSH numbers) (CT), supplementary term (ST), named person (NA), other source (OS), and abstract (AB), as well as CAS Registry Numbers and GenBank Numbers

Relevant controlled terms ([Table 3](#)) were not searched separately because they are included in the Basic Index and were captured by the free-text searches.

Table 3: Relevant controlled terms (CT) and index terms (IT) in each database

Database	Event	New proteins	Intended traits	Plant species	GM plants
Agricola	None	None	"HERBICIDE RESISTANCE" No terms for insect resistance	"GOSSYPIMUM BARBADENSE" "GOSSYPIMUM HIRSUTUM"	"TRANSGENIC PLANTS"
Biosis	None	None	No terms for herbicide or insect resistance	"GOSSYPIMUM BARBADENSE" "GOSSYPIMUM HIRSUTUM"	None
CABA	None	None	"HERBICIDE RESISTANCE" No terms for insect resistance	"GOSSYPIMUM BARBADENSE"/CT "GOSSYPIMUM HIRSUTUM"/CT	"TRANSGENIC PLANTS"
CAS	None	None	"HERBICIDE RESISTANCE" No terms for insect resistance	GOSSYPIMUM/CT	"GENETICALLY MODIFIED PLANTS"
Medline	None	None	"HERBICIDE RESISTANCE" No terms for insect resistance	"GOSSYPIMUM BARBADENSE" "GOSSYPIMUM HIRSUTUM"	"PLANTS, GENETICALLY MODIFIED"

The search results were limited to documents updated between October 1, 2020 and September 30, 2021 (UP>=20201001 and UP<=20210930), and to non-patent documents (not P/DT). To ensure that documents with indexing errors where two document types (DTs) (one eligible and one ineligible) were attached to a single record were not missed, documents with both 'journal' and 'patent' as document type were also kept. These putative documents would be identified with (P/DT AND J/DT) in CABA and CAPLUS.

[Table 4](#) summarizes the number of results obtained from each of the databases searched.

See [Appendix 2](#) for a complete search history.

Table 4: Overview of the selected databases and summary of search results from each database

Database	AGRICOLA	BIOSIS	CAB Abstracts	CAPLUS	MEDLINE
Database Provider	STN International	STN International	STN International	STN International	STN International
Coverage	1970-present	1926-present	1973-present	1907-present	1946-present

Database	AGRICOLA	BIOSIS	CAB Abstracts	CAPLUS	MEDLINE
Date of search	13 Oct 2021	13 Oct 2021	13 Oct 2021	13 Oct 2021	13 Oct 2021
Datespan of the search	1 Oct 2020 – 30 Sept 2021	1 Oct 2020 – 30 Sept 2021	1 Oct 2020 – 30 Sept 2021	1 Oct 2020 – 30 Sept 2021	1 Oct 2020 – 30 Sept 2021
Latest database update	11 Oct 2021	6 Oct 2021	5 Oct 2021	11 Oct 2021	12 Oct 2021
Number of records retrieved	37	82	107	62	69
Number of records after duplicate removal	32	71	81	24	69
Number of relevant records after rapid assessment	3	3	1	3	1

4. INTERNET and MANUAL SEARCHES

4.1. Internet Searches of food safety, agriculture, and biotechnology-related authority webpages

A search of the web pages of food safety, agriculture, and biotechnology-related authorities was conducted. Search results were manually examined for relevant records that were either published during the time period under consideration (date span of search: October 1, 2020 to September 30, 2021) or refer to relevant records published during this time frame. Relevance of results were determined based on the criteria listed in [Table 1](#) and they were summarized in [Table 5](#). All web pages searched were justified by their recommendation in the EFSA 2019 explanatory note¹. Of the 13 key organisations cited in the EFSA 2019 explanatory note¹, Environment and Climate Change Canada and Intersecretarial Commission on Biosafety of GMOs (CIBIOGEM) were excluded, since they are not involved in the risk assessment of GM plants. Therefore, the internet search was limited to 11 key organisations relevant for GBH119 cotton. Search terms consisted of GHB119 cotton, BCS-GHØØ5-8, Cry2Ae, PAT/*bar*, or phosphinothricin acetyltransferase (all searched singly, with no search limits applied).

Table 5: Results of search of food safety, agriculture, and biotechnology-related authority websites

Source Site Name	Website URL	Date of Most Recent Site Update	Date of Search	No. of Relevant Records
US Environmental Protection Agency (EPA)	https://www.epa.gov/	Oct 22, 2021	Oct 22, 2021	0

Source Site Name	Website URL	Date of Most Recent Site Update	Date of Search	No. of Relevant Records
US Department of Agriculture (USDA)	https://www.usda.gov/	Oct 22, 2021	Oct 22, 2021	0
US Food and Drug Administration (FDA)	https://www.fda.gov/	Oct 22, 2021	Oct 22, 2021	0
Health Canada	https://www.canada.ca/en/health-canada.html	Sep 2021	Oct 21, 2021	0
Canadian Food Inspection Agency (CFIA)	https://www.canada.ca/en/food-inspection-agency.html	Sep 2021	Oct 21, 2021	0
Food Standards Australia New Zealand (FSANZ)	http://www.foodstandards.gov.au/Pages/default.aspx	Oct 10, 2021	Oct 10, 2021	0
Office of the Gene Technology Regulator (OGTR) Australia	http://www.ogtr.gov.au/	Oct 10, 2021	Oct 10, 2021	0
National Technical Commission on Biosafety (CTNBio) Brazil	http://ctnbio.mcti.gov.br/en	Oct 2021	Oct 13-15, 2021	0
National Advisory Commission on Agricultural Biotechnology (CONABIA) Argentina	https://www.argentina.gob.ar/agroindustria/bioeconomia/biotecnologia	Oct 1, 2021	Oct 18, 2021	0
Genetic Engineering Approval Committee (GEAC) India	http://moef.gov.in/	Oct 2021	Oct 14, 2021	0
Ministry of Agriculture, Forestry and Fisheries (MAFF) Japan	http://www.maff.go.jp/	Oct 14, 2021	Oct 14, 2021	0

4.2. Manual searches of reference lists of recent review articles

Recent review articles as sources of reference lists to search for potentially relevant studies were identified via searches of PubMed.gov for general terms such as “GMO” or “GM crops” in the titles and abstracts. The search of PubMed.gov was also restricted to recent reviews published between October 1, 2020 and September 30, 2021. The resulting number of relevant studies found within the bibliographies of these review articles is given in [Table 6](#).

Table 6: Documents for which reference lists were scanned for relevant studies

No	Author(s) and Year	Title	Source	Number of relevant bibliographic references retrieved
1	Golnar AJ, Ruell E, Lloyd AL, Pepin KM. 2021	Embracing Dynamic Models for Gene Drive Management.	Trends Biotechnol. 2021 Mar;39(3):211-214. doi: 10.1016/j.tibtech.2020.08.011. Epub 2020 Sep 30. PMID: 33010965.	0
2	Gupta S, Kumar A, Patel R, Kumar V. 2021	Genetically modified crop regulations: scope and opportunity using the CRISPR-Cas9 genome editing approach.	Mol Biol Rep. 2021 May;48(5):4851-4863. doi: 10.1007/s11033-021-06477-9. Epub 2021 Jun 10. PMID: 34114124.	0
3	Hadrup N, Frederiksen M, Wedebye EB, Nikolov NG, Carøe TK, Sørli JB, Frydendall KB, Liguori B, Sejbaek CS, Wolkoff P, Flachs EM, Schlünssen V, Meyer HW, Clausen PA, Hougaard KS. 2021	Asthma-inducing potential of 28 substances in spray cleaning products-Assessed by quantitative structure activity relationship (QSAR) testing and literature review.	J Appl Toxicol. 2021 Jul 11. doi:10.1002/jat.4215. Epub ahead of print. PMID: 34247391.	0
4	Kumar V, Guleria P. 2020	Application of DNA-Nanosensor for Environmental Monitoring: Recent Advances and Perspectives.	Curr Pollut Rep. 2020 Dec 12:1-21. doi: 10.1007/s40726-020-00165-1. Epub ahead of print. PMID: 33344145; PMCID: PMC7732738.	0
5	Hameed A, Mehmood MA, Shahid M, Fatma S, Khan A, Ali S. 2020	Prospects for potato genome editing to engineer resistance against viruses and cold-induced sweetening.	GM Crops Food. 2020 Oct 1;11(4):185-205. doi: 10.1080/21645698.2019.1631115. Epub 2019 Jul 6. PMID: 31280681; PMCID: PMC7518746.	0
6	Leska A, Nowak A, Nowak I, Górczyńska A. 2021	Effects of Insecticides and microbiological Contaminants on <i>Apis mellifera</i> .	Health. Molecules. 2021 Aug 22;26(16):5080. doi: 10.3390/molecules26165080. PMID: 34443668; PMCID: PMC8398688	0

No	Author(s) and Year	Title	Source	Number of relevant bibliographic references retrieved
7	Madzak C. 2021	<i>Yarrowia lipolytica</i> Strains and Their Biotechnological Applications: How Natural Biodiversity and Metabolic Engineering Could Contribute to Cell Factories Improvement.	J Fungi (Basel). 2021 Jul 10;7(7):548. doi: 10.3390/jof7070548. PMID: 34356927; PMCID: PMC8307478.	0
8	Menz J, Modrzejewski D, Hartung F, Wilhelm R, Sprink T. 2020	Genome Edited Crops Touch the Market: A View on the Global Development and Regulatory Environment.	Front Plant Sci. 2020 Oct 9;11:586027. doi: 10.3389/fpls.2020.586027. PMID:33163013; PMCID: PMC7581933.	0
9	Mushtaq M, Ahmad Dar A, Skalicky M, Tyagi A, Bhagat N, Basu U, Bhat BA, Zaid A, Ali S, Dar TU, Rai GK, Wani SH, Habib-Ur-Rahman M, Hejnak V, Vachova P, Brestic M, Çiğ A, Çiğ F, Erman M, El Sabagh A. 2021	CRISPR-Based Genome Editing Tools: Insights into Technological Breakthroughs and Future Challenges.	Genes (Basel). 2021 May 24;12(6):797. doi: 10.3390/genes12060797. PMID: 34073848; PMCID: PMC8225059.	0
10	Okoli AS, Blix T, Myhr AI, Xu W, Xu X. 2021	Sustainable use of CRISPR/Cas in fish aquaculture: the biosafety perspective.	Transgenic Res. 2021 Jul 25. doi:10.1007/s11248-021-00274-7. Epub ahead of print. PMID: 34304349.	0
11	Teferra TF. 2021	Should we still worry about the safety of GMO foods? Why and why not? A review.	Food Sci Nutr. 2021 Jul 27;9(9):5324-5331. doi: 10.1002/fsn3.2499. PMID: 34532037; PMCID: PMC8441473.	0
12	Turnbull C, Lillemo M, Hvoslef-Eide TAK. 2021	Global Regulation of Genetically Modified Crops Amid the Gene Edited Crop Boom - A Review:	Front Plant Sci. 2021 Feb 24;12:630396. doi: 10.3389/fpls.2021.630396. PMID: 33719302; PMCID: PMC7943453	0

No	Author(s) and Year	Title	Source	Number of relevant bibliographic references retrieved
13	Woźniak E, Tyczewska A, Twardowski T. 2021	A Shift Towards Biotechnology: Social Opinion in the EU.	Trends Biotechnol. 2021 Mar;39(3):214-218. doi: 10.1016/j.tibtech.2020.08.001. Epub 2020 Sep 4. PMID: 32896439.	0
14	Zhang Y, Restall J, Crisp P, Godwin I, Liu G. 2021	Current status and prospects of plant genome editing in Australia.	In Vitro Cell Dev Biol Plant. 2021 May 24:1-10. doi: 10.1007/s11627-021-10188-y. Epub ahead of print. PMID: 34054265; PMCID: PMC8143062.	0

5. RESULTS OF THE STUDY IDENTIFICATION AND SELECTION PROCESS

The database searches ([Section 3](#)) identified a total of 357 references, which were reduced to 277 after removal of duplicates ([Table 4](#)). No additional studies were identified in the manual searches ([Section 4](#)).

5.1. Screening of titles and abstracts to exclude obviously irrelevant references (Stage 1)

All references identified in the database searches described in [Section 3](#) were assessed for relevance based on information in their title and abstract by two reviewers independently. If opinions of relevance differed, the discrepancies were discussed between the reviewers and if a disagreement persisted, the publication under the discussion was transferred to Stage 2 for detailed evaluation by the experts. In this search, both evaluators were in 100 % agreement.

Clearly irrelevant records were tagged as “Not Relevant”. These included:

- Duplicated entries
- Secondary literature (reviews), other than assessments from regulatory agencies
- Articles on non-relevant topics like detection methods, socio-economic implications of GM crops, GM policy, agronomical performance, other herbicide resistant GM crops, other insect resistant GM crops, unrelated topics, etc.

Publications which appeared to be relevant and those of unclear relevance were tagged as “Relevant” and progressed to Stage 2 (detailed assessment; see [Section 5.2](#)).

The number of publications excluded after rapid assessment for relevance is presented in [Table 7](#) documenting the selection process.

5.2. Detailed assessment of eligible references (Stage 2)

Publications tagged as “Relevant” in Stage 1 were assessed in detail independently by two scientific experts in each of three corresponding areas (i.e., Molecular Biology, Food and Feed Safety, Environmental Safety), based on the full text of the publications. If opinions of relevance differed between reviewers within each area, the initial reviewers discussed the discrepancy as necessary and consulted additional reviewers to resolve the discrepancy if needed.

In the relevance assessment of the literature review for the GHB119 cotton, reviewers agreed in 100% of the Stage 2 evaluations.

[Table 7](#) gives an overview of the reference selection process and results of the detailed assessment.

Table 7: Results of the publication selection process

Total number of publications retrieved after all searches of the scientific literature (excluding duplicates)	277
Number of publications excluded from the search results after rapid assessment for relevance (Stage 1)	266
Total number of full-text documents assessed in detail	11
Number of publications excluded from further consideration after detailed assessment for relevance (Stage 2)	11
Total number of unobtainable/unclear publications	0
Total number of relevant publications	0

[Table 8](#) lists the publications determined to be relevant along with their potential impact on the safety assessment based on detailed evaluation. Publications that were clearly not relevant after a detailed assessment are listed in [Table 9](#). [Table 10](#) lists the publications for which full-text documents were unobtainable for detailed assessment or for which relevance was unclear after detailed assessment.

Table 8: Report of all relevant publications retrieved after detailed assessment of full-text documents for relevance: ordered by category of information/data requirement(s)

Main category of information/data requirement	Study Author(s). Year	Title
Molecular Characterization	No studies in this category	
Food & Feed Safety	No studies in this category	
Environmental Safety	No studies in this category	

Table 9: Report of publications excluded from the risk assessment after detailed assessment of full-text documents

Study (Author(s) and year)	Title	Source	Reason(s) for exclusion based on eligibility/inclusion criteria listed in Table 1
Ali, Qasim Salisu, Ibrahim Bala Shahid, Ahmad Ali Liaqat, Ayesha Rao, Abdul Qayyum. 2020	90-day subchronic toxicity study of transgenic cotton expressing Cry1Ac, Cry2A and CP4-EPSPS proteins in Sprague-Dawley rats.	Food and chemical toxicology: an international journal published for the British Industrial Biological Research Association (Dec 2020), Volume 146, pp. 111783 ISSN: 0278-6915 Source Note: December 2020 v. 146	GM cotton variety (VH289) expressing Cry1Ac, Cry2A and CP4-EPSPS proteins was used in a 90-day rat study. No adverse effects were observed. The study is not relevant for GHB119 (Cry 2Ae, PAT/ <i>bar</i>) event.

Study (Author(s) and year)	Title	Source	Reason(s) for exclusion based on eligibility/inclusion criteria listed in Table 1
Bourgou, Larbougou Kargougou, Ester Sawadogo, Mahamadou Fok, Michel. 2020	Bt cotton seed purity in Burkina Faso: status and lessons learnt	Journal of Cotton Research (2020), 3(1), 30 CODEN: JCROHB; ISSN: 2523-3254	The authors discuss the purity level of GM (Bollgard II, Monsanto) and non-GM seeds used to grow cotton crops in Burkina Faso, Africa, in 2015. The study is not related to the ERA of GHB119 cotton.
Bourgou, Larbougou. Fok, Michel. 2021	Seed production scheme and purity under GMO use: the case of Bt-cotton in Burkina Faso. Original Title: Systeme semencier et purete des semences dans un contexte d'utilisation d'OGM : le cas du coton Bt au Burkina Faso.	Cahiers Agricultures, (MAY 21 2021) Vol. 30, pp. Article No.: 25. https://www.cahiersagricultures.fr/ . ISSN: 1166-7699. E-ISSN: 1777-5949.	The authors assessed the purity level of GM (Bollgard II, Monsanto) and non-GM seeds used to grow cotton crops in Burkina Faso, Africa, in 2015. The study is not related to the ERA of GHB119 cotton.
Carriere, Yves. DeGain, Ben. Unnithan, Gopalan C. Harpold, Virginia S. Li, Xianchun. Tabashnik, Bruce E. 2019	Seasonal Declines in Cry1Ac and Cry2Ab Concentration in Maturing Cotton Favor Faster Evolution of Resistance to Pyramided Bt Cotton in <i>Helicoverpa zea</i> (Lepidoptera: Noctuidae)	Journal of economic entomology (6 Oct 2019), Volume 112, Number 6, pp. 2907-2914, 8 p. ISSN: 0022-0493; 0022-0493 Source Note: 20191006, v. 112, no. 6	The authors compared the performance of <i>Helicoverpa zea</i> larvae from a strain selected for resistance to Cry1Ac in the laboratory, its field-derived parent strain that was not exposed to Bt toxins in the laboratory, and their F1 progeny on young and old non-Bt cotton and cotton producing Cry1Ac and Cry2Ab. The Bt cotton variety DP 164 B2RF was used (event MON88913 x MON15985). The study is not related to the ERA of GHB119 cotton.

Study (Author(s) and year)	Title	Source	Reason(s) for exclusion based on eligibility/inclusion criteria listed in Table 1
Fast, Brandon J; Shan, Guomin; Herman, Rod A; Gampala, Satyalinga Srinivas. 2020	Transgene expression in sprayed and non-sprayed herbicide-tolerant genetically engineered crops is equivalent.	Regulatory toxicology and pharmacology: RTP, (2020 Mar) Vol. 111, pp. 104572. Electronic Publication Date: 26 Dec 2019 Journal code: 8214983. E-ISSN: 1096-0295. L-ISSN: 0273-2300.	The GHB119 cotton event was not included in this study.
Hernandez-Teran, Alejandra Wegier, Ana Benitez, Mariana Lira, Rafael Sosa Fuentes, Tania Gabriela Escalante, Ana E. 2019	In vitro performance in cotton plants with different genetic backgrounds: the case of <i>Gossypium hirsutum</i> in Mexico, and its implications for germplasm conservation.	PeerJ, (JUN 10 2019) Vol. 7, pp. Article No.: e7017. https://peerj.com/ . ISSN: 2167-8359. E-ISSN: 2167-8359.	The authors evaluated and compared in vitro performance of wild and domesticated cotton populations in Mexico and its relationship with transgenes (Cry1Ab/Ac, Cry2Ab and CP4EPSPS). The study is not related to the ERA of GHB119 cotton.
Pan, Xiaoping. 2019	Determining pollen-mediated gene flow in transgenic cotton	Methods in Molecular Biology (New York, NY, United States) (2019), 1902(Transgenic Cotton), 309-321 CODEN: MMBIED; ISSN: 1940-6029	The author used transgenic IR and HT cotton as two examples to present a field practice method for determining transgene flow in cotton. The study does not present primary data and is not related to the ERA of GHB119 cotton.

Study (Author(s) and year)	Title	Source	Reason(s) for exclusion based on eligibility/inclusion criteria listed in Table 1
Saeed Ahmad, Saghir Ahmad Zia, Z. U. Shahid, M. R. Tipu, A. L. Wajid Nazeer, Abdul Jabbar, Ghayour Ahmad, Sadiq, M. A. Muhammad Shahid. Muhammad Akram. Saleem, M. A. 2020	Insecticidal effects on pollinator's population and pollen mediated gene flow from transgenic to non-transgenic cotton genotypes.	Pure and Applied Biology (2020), Volume 9, Number 4, pp. 2182-2189, 15 refs. ISSN: 2304-2478 DOI: https://doi.org/10.19045/bsp.ab.2020.90233 Published by: International Society of Pure and Applied Biology, Quetta	The authors evaluated pesticide risks on pollinators and the ultimate effect of pollinators on cotton refuge crop in Pakistan. The GM cotton used was the hybrid MNH-886 [FH - 207 × MNH- 770) × Bollgard] that express Cry1Ac. The study is not related to the ERA of GHB119 cotton.
Salisu, Ibrahim Bala Shahid, Ahmad Ali Yaqoob, Amina Rao, Abdul Qayyum Husnain, Tayyab. 2019	Effect of dietary supplementation of recombinant Cry and Cp4 epsps proteins on haematological indices of growing rabbits	Journal of Animal Physiology and Animal Nutrition (2019), 103(1), 305-316 CODEN: JAPNEF; ISSN: 0931-2439	GM cotton Cry1Ac, Cry2A and Cp4epsps genes variety (VH-289) was used in a 180-days feeding study where haematological parameters of growing rabbits were evaluated. No adverse effects were observed. The study is not relevant for GHB119 (Cry 2Ae, PAT/bar) event.
Singh, Monika Randhawa, Gurinderjit Bhoge, Rajesh K. Singh, Sushmita Kak, Anjali Sangwan, Omender. 2020	Monitoring Adventitious Presence of Transgenes in Cotton Collections from Genebank and Experimental Plots: Ensuring GM -Free Conservation and Cultivation of Genetic Resources	Agricultural research (Dec 2020), Volume 9, Number 4, pp. 469-476, 8 p. ISSN: 2249-720X Source Note: 202012, v. 9, no. 4	The authors used PCR for checking adventitious presence of transgenes in a set of 100 accessions of ex situ cotton collection being conserved in the National Genebank of India. Adventitious presence of transgenes was also monitored in 50 samples collected from experimental plots, growing adjacent to Bt cotton, using molecular markers for specific GM cotton (MON 15985). The study is not related to the ERA of GHB119 cotton.

Study (Author(s) and year)	Title	Source	Reason(s) for exclusion based on eligibility/inclusion criteria listed in Table 1
Yan, Shuo. Yu, Jian. Han, Min. Michaud, J. P. Guo, Li-Lei. Li, Zhen. Zeng, Bo. Zhang, Qing-Wen. Liu, Xiao-Xia. 2020	Intercrops can mitigate pollen-mediated gene flow from transgenic cotton while simultaneously reducing pest densities.	Science of the Total Environment, (APR 1 2020) Vol. 711, pp. Article No.: 134855. https://www.sciencedirect.com/journal/science-of-the-total-environment . CODEN: STENDL. ISSN: 0048-9697. E-ISSN: 1879-1026.	The authors aimed to determine the potential for PGF (pollen mediated gene flow) from GM cotton to susceptible plants in typical Chinese agricultural settings, and the degree to which it might vary as a function of different intercrops. The GM cotton used was Zhongmiansuo79. The study is not related to the ERA of GHB119 cotton.

Table 10: Report of unobtainable/unclear publications

Study (Author(s) and year)	Title	Source	Description of (unsuccessful) methods used to try and obtain a copy of the publication
No publications in this category.			

6. NARRATIVE SYNTHESIS/SUMMARY OF RELEVANT STUDIES

A total of 11 publications were selected during Stage 1 evaluation (rapid assessment based on title and abstract). After Stage 2 evaluation (detailed review based on full text), it was determined that no publications were relevant for the safety assessment of the GHB119 cotton and its newly expressed proteins Cry2Ae and PAT/*bar*.

7. CONCLUSION

The literature searches performed for the GHB119 cotton and its newly expressed proteins, Cry2Ae and PAT/*bar*, for the period from October 1, 2020 to September 30, 2021, identified a total of 277 unique publications (after duplicate removal). A total of 11 publications were progressed for detailed assessment after excluding 266 obviously irrelevant publications during Stage 1 evaluation (rapid assessment based on title and abstract).

The 11 publications that progressed to the detailed assessment were evaluated in detail, based on full text, for potential relevance, following the pre-established criteria listed in [Table 1](#). No new publications were found that contained new data on the molecular characterization of the GHB119 cotton and its newly expressed proteins, Cry2Ae and PAT/*bar*. Similarly, no new publications were found that suggested any potential adverse effects of GHB119 cotton on human health, animal health, or the environment. No issues or topics were identified that would trigger or warrant more specific question formulation or indicate that a systematic review would be of value.

8. REFERENCES

No.	Author(s), title, source, edition, year, pages
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- | | |
|----|---|
| 1. | Devos Y, Guajardo IM, Alvarez F and Glanville J. Explanatory note on literature searching conducted in the context of GMO applications for (renewed) market authorisation and annual post-market environmental monitoring reports on GMOs authorised in the EU market. EFSA supporting publications 2019:EN-1614. 62 pages. doi:10.2903/sp.efsa.2019.EN-1614. |
|----|---|

9. APPENDICES

Appendix 1 Database descriptions

Host	File	Description
STN	AGRICOLA	<p>Agriculture Online Access is a bibliographic database containing selected worldwide literature of agriculture and related fields. AGRICOLA is the locator and bibliographic access and control system of the National Agricultural Library (NAL) collections and also includes records from other cooperating institutions. Coverage of the database includes agricultural economics and rural sociology, agricultural production, animal sciences, chemistry, entomology, food and human nutrition, forestry, natural resources, pesticides, plant science, soils and fertilizers, and water resources. Also covered are related areas such as biology and biotechnology, botany, ecology, and natural history.</p> <p>The database draws on bibliographies, serial articles, book chapters, monographs, computer files, serials, maps, audiovisuals, and reports. Bibliographic information, abstracts, geographic terms, controlled terms, and supplementary terms are searchable.</p>
STN	BIOSIS	<p>BIOSIS Previews® is the largest and most comprehensive life science database in the world. Amongst others subject coverage includes Agriculture, Biochemistry, Biophysics, Botany, Environmental Biology, Physiology, Toxicology.</p> <p>Sources include periodicals, journals, conference proceedings, reviews, reports, patents, and short communications. Nearly 6,000 life source journals, 1,500 international meetings as well as review articles, books, and monographs are reviewed for inclusion.</p> <p>Bibliographic information, indexing terms, abstracts, and CAS Registry Numbers are all searchable.</p>
STN	CABA/CAB	<p>The CAB Abstracts database covers worldwide literature from all areas of agriculture and related sciences including Agriculture, Agricultural chemicals, Animal sciences and production, Crop protection, Crop sciences and production, Environment, Soils and fertilizers.</p> <p>Sources for CABA include journals, books, reports, published theses, conference proceedings, and patents.</p> <p>Bibliographic information, indexing terms, abstracts, and CAS Registry Numbers are searchable.</p>
STN	CAS-CA/CAPLUS	<p>The Chemical Abstracts (CA) database covers all areas of Biochemistry, Chemistry and Chemical engineering, and related sciences.</p> <p>Sources include over 8,000 journals, patents from 38 national patent offices and two international patent organizations, technical reports, books, conference proceedings, and dissertations. Electronic only journals and Web preprints are also covered.</p> <p>Bibliographic terms, indexing terms, roles, CAS Registry Numbers, International Patent Classification, and abstracts are searchable.</p>

Host	File	Description
STN	MEDLINE	<p>MEDLINE contains information on every area of medicine. The MEDLINE database corresponds to Index Medicus, Index to Dental Literature, and International Nursing Index; OLDMEDLINE, with data from NLM's from the Cumulated Index Medicus (1960-1965) and Current List of Medical Literature (1958-1959); and, since August 2001, IN-PROCESS records, the latest documents before they have been completely indexed for inclusion on MEDLINE.</p> <p>Sources include journals and chapters in books or symposia. Bibliographic information, indexing terms, abstracts, chemical names, and CAS Registry Numbers are all searchable.</p> <p>Online thesauri are available for the Medical Subject Headings (/MN), Controlled Terms (/CT) and Chemical Name (/CN) fields.</p>

Appendix 2 Search history

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FILE 'MEDLINE' ENTERED AT 11:15:02 ON 13 OCT 2021
L1      4 SEA GHB119 OR GHB(W)119 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR
        BCSGH005(W)8 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR BCSGH005(W)8

L2      1462 SEA ((BAR OR PAT) (2A) (GENE# OR PROTEIN# OR ENZYME#)) OR
        PPT(2W)ACETYLTRANSFERASE OR PPT(2W)ACETYL(W)TRANSFERASE OR
        PT(W)N(2W)ACETYLTRANSFERASE OR PT(W)N(2W)ACETYL(W)TRANSFERASE
L3      203 SEA PHOSPHINOTHRICIN(W)N(W)ACETYLTRANSFERASE OR PHOSPHINOTHRICI
        N(2W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYL(W)TRANSFER
        ASE OR PHOSPHINOTHRICINACETYL(W)TRANSFERASE
L4      1536 SEA (L2 OR L3)
L5      13 SEA CRY2AE# OR CRY(W)2(W)AE# OR CRY(W)2AE# OR CRY2(W)AE# OR
        CRY2(W)A(W)E# OR CRY(W)2(W)A(W)E# OR CRY2A(W)E#
L6      0 SEA CRYIIAE# OR CRY(W)II(W)AE# OR CRY(W)IIAE# OR CRYII(W)AE#
        OR CRYII(W)A(W)E# OR CRY(W)II(W)A(W)E# OR CRYIIA(W)E#
L7      0 SEA CRYLLAE# OR CRY(W)LL(W)AE# OR CRY(W)LLAE# OR CRYLL(W)AE#
        OR CRYLL(W)A(W)E# OR CRY(W)LL(W)A(W)E# OR CRYLLA(W)E#
L8      13 SEA (L5 OR L6 OR L7)
L9      30358 SEA HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR PHOSPHINO
        THRICIN OR LIBERTY?
L10     208215 SEA INSECT# OR PEST# OR LEPIDOPTERA# OR NOCTUIDAE OR CRAMBIDAE
        OR BORER# OR CORNBORER# OR STALKBORER# OR EARWORM# OR EAR(W)WOR
        M# OR ARMYWORM# OR ARMY(W)WORM# OR CUTWORM# OR CUT(W)WORM# OR
        OSTRINIA OR O(W)NUBILALIS OR SESAMIA OR S(W)NONAGRIODES
L11     14036 SEA DIATRAEA OR D(W)GRANDIOSELLA OR D(W)CRAMBIDOIDES OR
        HELICOVERPA OR H(W)ZEA OR SPODOPTERA OR S(W)FRUGIPERDA OR
        PAPAIPEMA OR P(W)NEBRIS OR ELASMOPALPUS OR E(W)LIGNOSELLUS OR
        D(W)SACCHARALIS OR STRIACOSTA OR S(W)ALBICOSTA
L12     22824 SEA AGROTIS OR A(W)IPSILON OR S(W)CRETICA OR MYTHIMNA OR
        M(W)UNIPUNCTA OR ECB OR MCB OR SWCB OR SCSB OR CEW OR FAW OR
        SCB OR WBC
L13     2409224 SEA (RESIST? OR PROTECT? OR TOLERAN?)
L14     11555 SEA ((L9 OR L10 OR L11 OR L12)) (5A)L13
L15     26894 SEA COTTON# OR GOSSYPIMUM OR G(W)HIRSUTUM OR G(W)BARBADENSE
L16     3822741 SEA GMO OR GMOS OR LMO OR LMOS OR GM OR GE OR TRANSGEN? OR
        (GENETIC?(3A) (MODIF? OR TRANSFORM? OR MANIPULAT? OR IMPROV? OR
        ENGINEER?))
L17     14 SEA L4 AND L15
L18     653 SEA L14 AND L15 AND L16
L19     665 SEA L1 OR L8 OR L17 OR L18
L20     123 SEA L19 AND PY>=2019
L21     69 SEA L20 AND UP>=20201001 AND UP<=20210930

FILE 'BIOSIS' ENTERED AT 11:15:48 ON 13 OCT 2021
L22     2 SEA GHB119 OR GHB(W)119 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR
        BCSGH005(W)8 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR BCSGH005(W)8

L23     2837 SEA ((BAR OR PAT) (2A) (GENE# OR PROTEIN# OR ENZYME#)) OR
        PPT(2W)ACETYLTRANSFERASE OR PPT(2W)ACETYL(W)TRANSFERASE OR
        PT(W)N(2W)ACETYLTRANSFERASE OR PT(W)N(2W)ACETYL(W)TRANSFERASE
L24     332 SEA PHOSPHINOTHRICIN(W)N(W)ACETYLTRANSFERASE OR PHOSPHINOTHRICI
        N(2W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYL(W)TRANSFER
        ASE OR PHOSPHINOTHRICINACETYL(W)TRANSFERASE
L25     2939 SEA (L23 OR L24)
L26     17 SEA CRY2AE# OR CRY(W)2(W)AE# OR CRY(W)2AE# OR CRY2(W)AE# OR
        CRY2(W)A(W)E# OR CRY(W)2(W)A(W)E# OR CRY2A(W)E#
L27     0 SEA CRYIIAE# OR CRY(W)II(W)AE# OR CRY(W)IIAE# OR CRYII(W)AE#
        OR CRYII(W)A(W)E# OR CRY(W)II(W)A(W)E# OR CRYIIA(W)E#
L28     0 SEA CRYLLAE# OR CRY(W)LL(W)AE# OR CRY(W)LLAE# OR CRYLL(W)AE#
        OR CRYLL(W)A(W)E# OR CRY(W)LL(W)A(W)E# OR CRYLLA(W)E#
L29     17 SEA (L26 OR L27 OR L28)
L30     88589 SEA HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR PHOSPHINO

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THRICIN OR LIBERTY?

L31 1424729 SEA INSECT# OR PEST# OR LEPIDOPTERA# OR NOCTUIDAE OR CRAMBIDAE
OR BORER# OR CORNBORER# OR STALKBORER# OR EARWORM# OR EAR(W)WORM#
OR ARMYWORM# OR ARMY(W)WORM# OR CUTWORM# OR CUT(W)WORM# OR
OSTRINIA OR O(W)NUBILALIS OR SESAMIA OR S(W)NONAGRIOIDES

L32 27327 SEA DIATRAEA OR D(W)GRANDIOSELLA OR D(W)CRAMBIDOIDES OR
HELICOVERPA OR H(W)ZEA OR SPODOPTERA OR S(W)FRUGIPERDA OR
PAPAPEMA OR P(W)NEBRIS OR ELASMOPALPUS OR E(W)LIGNOSELLUS OR
D(W)SACCHARALIS OR STRIACOSTA OR S(W)ALBICOSTA

L33 32862 SEA AGROTIS OR A(W)IPSILON OR S(W)CRETICA OR MYTHIMNA OR
M(W)UNIPUNCTA OR ECB OR MCB OR SWCB OR SCSB OR CEW OR FAW OR
SCB OR WBC

L34 2411544 SEA (RESIST? OR PROTECT? OR TOLERAN?)

L35 34015 SEA ((L30 OR L31 OR L32 OR L33)) (5A)L34

L36 75276 SEA COTTON# OR GOSSYPIMUM OR G(W)HIRSUTUM OR G(W)BARBADENSE

L37 465984 SEA GMO OR GMOS OR LMO OR LMOS OR GM OR GE OR TRANSGEN? OR
(GENETIC?(3A) (MODIF? OR TRANSFORM? OR MANIPULAT? OR IMPROV? OR
ENGINEER?))

L38 44 SEA L25 AND L36

L39 964 SEA L35 AND L36 AND L37

L40 1006 SEA L22 OR L29 OR L38 OR L39

L41 123 SEA L40 AND PY>=2019

L42 82 SEA L41 AND UP>=20201001 AND UP<=20210930

FILE 'AGRICOLA' ENTERED AT 11:16:52 ON 13 OCT 2021

L43 2 SEA GHB119 OR GHB(W)119 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR
BCSGH005(W)8 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR BCSGH005(W)8

L44 779 SEA ((BAR OR PAT) (2A) (GENE# OR PROTEIN# OR ENZYME#)) OR
PPT(2W)ACETYLTRANSFERASE OR PPT(2W)ACETYL(W)TRANSFERASE OR
PT(W)N(2W)ACETYLTRANSFERASE OR PT(W)N(2W)ACETYL(W)TRANSFERASE

L45 252 SEA PHOSPHINOTHRICIN(W)N(W)ACETYLTRANSFERASE OR PHOSPHINOTHRICI
N(2W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYL(W)TRANSFER
ASE OR PHOSPHINOTHRICINACETYL(W)TRANSFERASE

L46 858 SEA (L44 OR L45)

L47 9 SEA CRY2AE# OR CRY(W)2(W)AE# OR CRY(W)2AE# OR CRY2(W)AE# OR
CRY2(W)A(W)E# OR CRY(W)2(W)A(W)E# OR CRY2A(W)E#

L48 0 SEA CRYIIAE# OR CRY(W)II(W)AE# OR CRY(W)IIAE# OR CRYII(W)AE#
OR CRYII(W)A(W)E# OR CRY(W)II(W)A(W)E# OR CRYIIA(W)E#

L49 0 SEA CRYLLAE# OR CRY(W)LL(W)AE# OR CRY(W)LLAE# OR CRYLL(W)AE#
OR CRYLL(W)A(W)E# OR CRY(W)LL(W)A(W)E# OR CRYLLA(W)E#

L50 9 SEA (L47 OR L48 OR L49)

L51 57412 SEA HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR PHOSPHINO
THRICIN OR LIBERTY?

L52 337276 SEA INSECT# OR PEST# OR LEPIDOPTERA# OR NOCTUIDAE OR CRAMBIDAE
OR BORER# OR CORNBORER# OR STALKBORER# OR EARWORM# OR EAR(W)WORM#
OR ARMYWORM# OR ARMY(W)WORM# OR CUTWORM# OR CUT(W)WORM# OR
OSTRINIA OR O(W)NUBILALIS OR SESAMIA OR S(W)NONAGRIOIDES

L53 14234 SEA DIATRAEA OR D(W)GRANDIOSELLA OR D(W)CRAMBIDOIDES OR
HELICOVERPA OR H(W)ZEA OR SPODOPTERA OR S(W)FRUGIPERDA OR
PAPAPEMA OR P(W)NEBRIS OR ELASMOPALPUS OR E(W)LIGNOSELLUS OR
D(W)SACCHARALIS OR STRIACOSTA OR S(W)ALBICOSTA

L54 4888 SEA AGROTIS OR A(W)IPSILON OR S(W)CRETICA OR MYTHIMNA OR
M(W)UNIPUNCTA OR ECB OR MCB OR SWCB OR SCSB OR CEW OR FAW OR
SCB OR WBC

L55 622092 SEA (RESIST? OR PROTECT? OR TOLERAN?)

L56 29680 SEA ((L51 OR L52 OR L53 OR L54)) (5A)L55

L57 64263 SEA COTTON# OR GOSSYPIMUM OR G(W)HIRSUTUM OR G(W)BARBADENSE

L58 103308 SEA GMO OR GMOS OR LMO OR LMOS OR GM OR GE OR TRANSGEN? OR
(GENETIC?(3A) (MODIF? OR TRANSFORM? OR MANIPULAT? OR IMPROV? OR
ENGINEER?))

L59 21 SEA L46 AND L57

L60 751 SEA L56 AND L57 AND L58

L61 767 SEA L43 OR L50 OR L59 OR L60
L62 57 SEA L61 AND PY>=2019
L63 37 SEA L62 AND UP>=20201001 AND UP<=20210930

FILE 'CABA' ENTERED AT 11:17:43 ON 13 OCT 2021

L64 6 SEA GHB119 OR GHB(W)119 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR BCSGH005(W)8 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR BCSGH005(W)8

L65 1540 SEA ((BAR OR PAT) (2A) (GENE# OR PROTEIN# OR ENZYME#)) OR PPT(2W)ACETYLTRANSFERASE OR PPT(2W)ACETYL(W)TRANSFERASE OR PT(W)N(2W)ACETYLTRANSFERASE OR PT(W)N(2W)ACETYL(W)TRANSFERASE

L66 378 SEA PHOSPHINOTHRICIN(W)N(W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYL(W)TRANSFERASE OR PHOSPHINOTHRICINACETYL(W)TRANSFERASE

L67 1641 SEA (L65 OR L66)

L68 15 SEA CRY2AE# OR CRY(W)2(W)AE# OR CRY(W)2AE# OR CRY2(W)AE# OR CRY2(W)A(W)E# OR CRY(W)2(W)A(W)E# OR CRY2A(W)E#

L69 0 SEA CRYIIAE# OR CRY(W)II(W)AE# OR CRY(W)IIAE# OR CRYII(W)AE# OR CRYII(W)A(W)E# OR CRY(W)II(W)A(W)E# OR CRYIIA(W)E#

L70 0 SEA CRYLLAE# OR CRY(W)LL(W)AE# OR CRY(W)LLAE# OR CRYLL(W)AE# OR CRYLL(W)A(W)E# OR CRY(W)LL(W)A(W)E# OR CRYLLA(W)E#

L71 15 SEA (L68 OR L69 OR L70)

L72 152909 SEA HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR PHOSPHINOTHRICIN OR LIBERTY?

L73 923687 SEA INSECT# OR PEST# OR LEPIDOPTERA# OR NOCTUIDAE OR CRAMBIDAE OR BORER# OR CORNBORER# OR STALKBORER# OR EARWORM# OR EAR(W)WORM# OR ARMYWORM# OR ARMY(W)WORM# OR CUTWORM# OR CUT(W)WORM# OR OSTRINIA OR O(W)NUBILALIS OR SESAMIA OR S(W)NONAGRIOIDES

L74 32661 SEA DIATRAEA OR D(W)GRANDIOSELLA OR D(W)CRAMBIDOIDES OR HELICOVERPA OR H(W)ZEA OR SPODOPTERA OR S(W)FRUGIPERDA OR PAPAPEMA OR P(W)NEBRIS OR ELASMOPALPUS OR E(W)LIGNOSELLUS OR D(W)SACCHARALIS OR STRIACOSTA OR S(W)ALBICOSTA

L75 13266 SEA AGROTIS OR A(W)IPSILON OR S(W)CRETICA OR MYTHIMNA OR M(W)UNIPUNCTA OR ECB OR MCB OR SWCB OR SCSB OR CEW OR FAW OR SCB OR WBC

L76 1307757 SEA (RESIST? OR PROTECT? OR TOLERAN?)

L77 86416 SEA ((L72 OR L73 OR L74 OR L75)) (5A)L76

L78 96175 SEA COTTON# OR GOSSYPIMUM OR G(W)HIRSUTUM OR G(W)BARBADENSE

L79 184643 SEA GMO OR GMOS OR LMO OR LMOS OR GM OR GE OR TRANSGEN? OR (GENETIC?(3A) (MODIF? OR TRANSFORM? OR MANIPULAT? OR IMPROV? OR ENGINEER?))

L80 33 SEA L67 AND L78

L81 2233 SEA L77 AND L78 AND L79

L82 2253 SEA L64 OR L71 OR L80 OR L81

L83 190 SEA L82 AND PY>=2019

L84 107 SEA L83 AND UP>=20201001 AND UP<=20210930

L85 107 SEA L84 NOT P/DT

L86 0 SEA L84 AND (P/DT AND J/DT)

L87 107 SEA L85 OR L86

FILE 'HCAPLUS' ENTERED AT 11:18:31 ON 13 OCT 2021

L88 7 SEA GHB119 OR GHB(W)119 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR BCSGH005(W)8 OR BCS-GH005-8 OR BCS-(W)GH005(W)8 OR BCSGH005(W)8

L89 5210 SEA ((BAR OR PAT) (2A) (GENE# OR PROTEIN# OR ENZYME#)) OR PPT(2W)ACETYLTRANSFERASE OR PPT(2W)ACETYL(W)TRANSFERASE OR PT(W)N(2W)ACETYLTRANSFERASE OR PT(W)N(2W)ACETYL(W)TRANSFERASE

L90 783 SEA PHOSPHINOTHRICIN(W)N(W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYL(W)TRANSFERASE OR PHOSPHINOTHRICINACETYL(W)TRANSFERASE

L91 5510 SEA (L89 OR L90)

L92 41 SEA CRY2AE# OR CRY(W)2(W)AE# OR CRY(W)2AE# OR CRY2(W)AE# OR CRY2(W)A(W)E# OR CRY(W)2(W)A(W)E# OR CRY2A(W)E#

L93 4 SEA CRYIIAE# OR CRY(W)II(W)AE# OR CRY(W)IIAE# OR CRYII(W)AE#
OR CRYII(W)A(W)E# OR CRY(W)II(W)A(W)E# OR CRYIIA(W)E#
L94 0 SEA CRYLLAE# OR CRY(W)LL(W)AE# OR CRY(W)LLAE# OR CRYLL(W)AE#
OR CRYLL(W)A(W)E# OR CRY(W)LL(W)A(W)E# OR CRYLLA(W)E#
L95 42 SEA (L92 OR L93 OR L94)
L96 155322 SEA HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR PHOSPHINO
THRINICIN OR LIBERTY?
L97 309948 SEA INSECT# OR PEST# OR LEPIDOPTERA# OR NOCTUIDAE OR CRAMBIDAE
OR BORER# OR CORNBORER# OR STALKBORER# OR EARWORM# OR EAR(W)WORM#
OR ARMYWORM# OR ARMY(W)WORM# OR CUTWORM# OR CUT(W)WORM# OR
OSTRINIA OR O(W)NUBILALIS OR SESAMIA OR S(W)NONAGRIOIDES
L98 23060 SEA DIATRAEA OR D(W)GRANDIOSELLA OR D(W)CRAMBIDOIDES OR
HELICOVERPA OR H(W)ZEA OR SPODOPTERA OR S(W)FRUGIPERDA OR
PAPAIPEMA OR P(W)NEBRIS OR ELASMOPALPUS OR E(W)LIGNOSELLUS OR
D(W)SACCHARALIS OR STRIACOSTA OR S(W)ALBICOSTA
L99 24178 SEA AGROTIS OR A(W)IPSILON OR S(W)CRETICA OR MYTHIMNA OR
M(W)UNIPUNCTA OR ECB OR MCB OR SWCB OR SCSB OR CEW OR FAW OR
SCB OR WBC
L100 5859570 SEA (RESIST? OR PROTECT? OR TOLERAN?)
L101 55750 SEA ((L96 OR L97 OR L98 OR L99)) (5A)L100
L102 266203 SEA COTTON# OR GOSSYPIMUM OR G(W)HIRSUTUM OR G(W)BARBADENSE
L103 692822 SEA GMO OR GMOS OR LMO OR LMOS OR GM OR GE OR TRANSGEN? OR
(GENETIC?(3A) (MODIF? OR TRANSFORM? OR MANIPULAT? OR IMPROV? OR
ENGINEER?))
L104 204 SEA L91 AND L102
L105 2420 SEA L101 AND L102 AND L103
L106 2538 SEA L88 OR L95 OR L104 OR L105
L107 657 SEA L106 AND PY>=2019
L108 120 SEA L107 AND UP>=20201001 AND UP<=20210930
L109 62 SEA L108 NOT P/DT
L110 0 SEA L108 AND (P/DT AND J/DT)
L111 62 SEA L109 OR L110

FILE 'MEDLINE, BIOSIS, AGRICOLA, CABA, HCAPLUS' ENTERED AT 11:19:24 ON 13
OCT 2021

L112 277 DUP REM L21 L42 L63 L87 L111 (80 DUPLICATES REMOVED)
ANSWERS '1-69' FROM FILE MEDLINE
ANSWERS '70-140' FROM FILE BIOSIS
ANSWERS '141-172' FROM FILE AGRICOLA
ANSWERS '173-253' FROM FILE CABA
ANSWERS '254-277' FROM FILE HCAPLUS