

Title

**Summary of the Literature Review for GHB614 x LLCotton25 cotton  
October 1, 2020 – September 30, 2021**

**Final Report**Data 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

Completion date

November 9, 2021

Principal author

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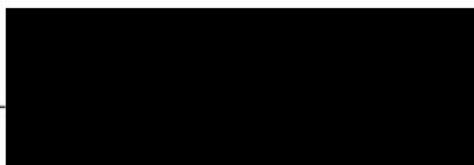
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Report No: 21-RSCT0461  
Summary of the Literature Review for GHB614 x LLCotton25 Cotton  
October 1, 2020 – September 30, 2021  
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**SIGNATURE PAGE**

Principal author:



Date

2021-11-09

**STUDY PERSONNEL**

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

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## SUMMARY

BASF has used conventional breeding techniques to develop the stacked trait cotton product GHB614 x LLCotton25 (GlyTol x LL25 cotton; GT x LL cotton) which confers tolerance to glyphosate and glufosinate-ammonium herbicides. The OECD identifier is BCS-GHØØ2-5 x ACS-GHØØ1-3.

A scoping review was performed for the GHB614 x LLCotton25 cotton and its newly expressed proteins, 2mEPSPS and PAT/*bar*. The objective of this scoping review was to determine if there were studies about the molecular characterization of GHB614 x LLCotton25 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 50 unique publications, which were subject to rapid assessment to exclude obviously irrelevant publications. A total of seven 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 GHB614 x LLCotton25 cotton and its newly expressed proteins, 2mEPSPS and PAT/*bar*. Similarly, no new publications were found that suggested any potential adverse effects of GHB614 x LLCotton25 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

BASF has used conventional breeding techniques to develop the stacked trait cotton product GHB614 x LLCotton25 (GlyTol x LL25 cotton; GT x LL cotton) which confers tolerance to glyphosate and glufosinate-ammonium herbicides. The OECD identifier is BCS-GHØØ2-5 x ACS-GHØØ1-3.

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 GHB614 x LLCotton25 cotton, and/or any adverse effect of GHB614 x LLCotton25 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)<sup>1</sup> applications and post-market environmental monitoring activities (2019).

The literature searches were performed for the GHB614 x LLCotton25 cotton and its newly expressed proteins, 2mEPSPS and PAT/*bar*. The search terms also included relevant synonyms, trade name 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 GHB614 x LLCotton25 cotton and its newly expressed proteins, 2mEPSPS 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 note<sup>1</sup>.

**Question 1:** Were any studies published during the reporting period that describe adverse effects on human or animal health or the environment of the GHB614 x LLCotton25 cotton and its newly expressed proteins 2mEPSPS and PAT/*bar*?

**Key elements:**

**Population:** Human health; animal health; environmental safety

**Exposure:** GHB614 x LLCotton25 cotton, derived food/feed products, newly expressed proteins in GHB614 x LLCotton25 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 GHB614 x LLCotton25 cotton and its newly expressed proteins 2mEPSPS and PAT/*bar* in cotton?

**Key elements:**

Population: GHB614 x LLCotton25 cotton and newly expressed proteins in GHB614 x LLCotton25 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 note<sup>1</sup> 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 GHB614 x LLCotton25 cotton was previously identified and was used to test and validate the search strategy:

- Naegeli, H.; Birch, A. N.; Casacuberta, J.; Schrijver, A. de; Gralak, M. A.; Guerche, P.; Jones, H.; Manachini, B.; Messean, A.; Nielsen, E. E.; Nogue, F.; Robaglia, C.; Rostoks, N.; Sweet, J.; Tebbe, C.; Visioli, F.; Wal, J. M.; Broll, H.; Gennaro, A.; Neri, F. M.; Paraskevopoulos, K.; de Schrijver, A. (2018). Assessment of genetically modified cotton GHB614 .times. LLCotton25 .times. MON 15985 for food and feed uses, under Regulation (EC) No 1829/2003 (application EFSA-GMO-NL-2011-94). EFSA Journal 16(4): e05213 p.

This article was selected as reference publications because even though it is not indirectly relevant to the GHB614 x LLCotton25 event, it mentions the event names (LLCotton25 and GHB614), the newly expressed proteins (PAT/bar and 2mEPSPS) and the crop (cotton). Since this article was published outside the search period 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 activities<sup>1</sup>. 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 19, 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 stack's event names, trade names, newly expressed proteins and intended traits. Since the 'intended traits' profiles produced too many results when used on their own, they were combined with additional profiles: a 'plant species' profile and a 'general GMO' profile. The reference publication ([Section 2.4](#)) was identified by the search profiles confirming the validity of the applied search strategy. See [Table 2](#) for a detailed search profile.

**Table 2: Search profile for database search**

Set	Search string	Concepts
1	LLcotton25 or LLcotton(w)25 or LL(w)cotton25 or LL(w)cotton(w)25 or ACS-GH001-3 or ACS(w)GH001(w)3 or ACSGH001(w)3 or ACS-GH001-3 or ACS(w)GH001(w)3 or ACSGH001(w)3 or ACS-GH001-3 or ACS(w)GH001(w)3 or ACSGH001(w)3	Event name 1
2	GHB614 OR GHB(W)614 OR BCS-GH002-5 OR BCSGH002-5 OR BCS(W)GH002(W)5 OR BCSGH002(W)5 OR BCS-GH002-5 OR BCS(W)GH002(W)5 OR BCSGH002(W)5 or BCS-GH002-5 or BCS(w)GH002(w)5 or BCSGH002-5	Event name 2
3	GHB614xLLcotton25 or GHB614(w)time#(w)LLcotton25 or LLcotton25xGHB614 or LLcotton25(w)time#(w)GHB614	Event name stack
4	(1 and 2) or 3	Event name all
5	GLYTOL? OR GLYTOLTM? OR GLYTOLRTM? OR GLY(w)TOL? OR GLY(w)TOLTM? OR GLY(w)TOLRTM?	Trade name 1
6	libertylink or libertylinktm or libertylinkrtm or liberty(w)link or liberty(w)linktm or liberty(w)linkrtm or LL or LLTM or LLRTM	Trade name 2
7	5 and 6	Trade name all
8	(2MEPSPS or 2(w)MEPSPS or 2M(w)EPSPS or 2(w)M(w)EPSPS) or (EPSPS OR EPSP(W)SYNTHASE OR (ENOL(W)PYRUVYLSHIKIMATE OR ENOL(W)PYRUVYL(W)SHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR ENOLPYRUVOYLSHIKIMATE or ENOYLPYRUVOYLSHIKIMATE OR	Newly expressed protein 1

	ENOLPYRUVYLSHIKIMIC) (4W) (PHOSPHATE OR PHOSPHORIC) (2W) (SYNTHASE OR SYNTHETASE) or (ENOLPYRUVYL OR ENOLPYRUYL OR ENOLPYRUVOYL) (W) (PHOSPHOSHIKIMATE OR PHOSPHOSHIKIMIC or ENOLPYRUVYLSHIKIMATEPHOSPHATE) (2W) (SYNTHASE OR SYNTHETASE) or (ENOL(W)PYRUVOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR ENOLPYRUVYLSHIKIMIC OR ENOL(W) (PYRUVYL OR PYRUVOYL) (W) SHIKIMATE) (3W) PHOSPHATE (W) (SYNTHASE OR SYNTHETASE) or (PHOSPHOSHIKIMATE (2W) CARBOXYVINYLTRANSFERASE OR PHOSPHOSHIKIMATE (2W) CARBOXYVINYL (W) TRANSFERASE OR ENOLPYRUVOYL (W) SHIKIMIC (3W) PHOSPHOSYNTHASE)) (s) ((DOUBL# or DOBL#) (W) (MUTANT# OR MUTAT?) OR 2M))	
9	((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 2
10	8 and 9	Newly expressed protein all
11	s (herbicide? or GL!PHOSATE# or GL!FOSATE# OR G360 or g(w)360 or roundup? or round(w)up?) (5a) (resist? or toleran? or protect?)	Intended trait 1
12	s (herbicide? or bialaphos or basta or glufosinate or gluphosinate or phosphinothricin or liberty?) (5a) (resist? OR protect? OR toleran?)	Intended trait 2
13	11 and 12	Intended trait all
14	cotton# or gossypium or G(w)hirsutum or g(w)barbadense	Plant species
15	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
16	13 and 14 and 15	Intended trait all AND Plant species AND GMO general
17	4 or 7 or 10 or 16	Event name all OR Trade name all OR Newly expressed protein all or (Intended trait all 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
<b>Agricola</b>	None	None	"HERBICIDE RESISTANCE" No terms for insect resistance	"GOSSYPIUM BARBADENSE" "GOSSYPIUM HIRSUTUM"	"TRANSGENIC PLANTS"
<b>Biosis</b>	None	None	No terms for herbicide or insect resistance	"GOSSYPIUM BARBADENSE" "GOSSYPIUM HIRSUTUM"	None
<b>CABA</b>	None	None	"HERBICIDE RESISTANCE" No terms for insect resistance	"GOSSYPIUM BARBADENSE"/CT "GOSSYPIUM HIRSUTUM"/CT	"TRANSGENIC PLANTS"
<b>CAS</b>	None	None	"HERBICIDE RESISTANCE" No terms for insect resistance	GOSSYPIUM/CT	"GENETICALLY MODIFIED PLANTS"
<b>Medline</b>	None	None	"HERBICIDE RESISTANCE" No terms for insect resistance	"GOSSYPIUM BARBADENSE" "GOSSYPIUM 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				
Coverage	1970-present	1926-present	1973-present	1907-present	1946-present
Date of search	19 Oct 2021				
Datespan of the search	1 Oct 2020 – 30 Sept 2021				
Latest database update	11 Oct 2021	13 Oct 2021	5 Oct 2021	18 Oct 2021	18 Oct 2021
Number of records retrieved	5	14	24	9	5
Number of records after duplicate removal	5	12	21	7	5
Number of relevant records after rapid assessment	1	1	0	2	3

#### 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 note<sup>1</sup>. Of the 13 key organisations cited in the EFSA 2019 explanatory note<sup>1</sup>, 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. The US-EPA website was excluded, since the GHB614 x LLCotton25 cotton does not contain an insect-resistant trait. The USDA, FDA, CFIA, Health Canada, FSANZ and MAFF websites were excluded, since these agencies do not regulate GM stacked products obtained by conventional breeding techniques. Therefore, the internet search was limited to four key organisations relevant for GHB614 x LLCotton25 cotton. Search terms consisted of GHB614 x LLCotton25, or GT x LL cotton or BCS-GHØØ2-5 x ACS-GHØØ1-3 or 2mEPSPS or 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
Office of the Gene Technology Regulator (OGTR) Australia	<a href="http://www.ogtr.gov.au/">http://www.ogtr.gov.au/</a>	Oct 10, 2021	Oct 10, 2021	0
National Technical Commission on Biosafety (CTNBio) Brazil	<a href="http://ctnbio.mcti.gov.br/en">http://ctnbio.mcti.gov.br/en</a>	Oct 2021	Oct 13-15, 2021	0
National Advisory Commission on Agricultural Biotechnology (CONABIA) Argentina	<a href="https://www.argentina.gob.ar/agroindustria/bioeconomia/biotechnologia">https://www.argentina.gob.ar/agroindustria/bioeconomia/biotechnologia</a>	Oct 1, 2021	Oct 18, 2021	0
Genetic Engineering Approval Committee (GEAC) India	<a href="http://moef.gov.in/">http://moef.gov.in/</a>	Oct 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, Wedeby EB, Nikolov NG,	Asthma-inducing potential of 28 substances in spray cleaning products-Assessed by quantitative structure activity relationship	J Appl Toxicol. 2021 Jul 11. doi:10.1002/jat.4215. Epub ahead of print. PMID: 34247391.	0

No	Author(s) and Year	Title	Source	Number of relevant bibliographic references retrieved
	Carøe TK, Sørli JB, Frydendall KB, Liguori B, Sejbaek CS, Wolkoff P, Flachs EM, Schlünssen V, Meyer HW, Clausen PA, Hougaard KS. 2021	(QSAR) testing and literature review.		
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
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,	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

No	Author(s) and Year	Title	Source	Number of relevant bibliographic references retrieved
	Basu U, Bhat BA, Zaid A, Ali S, Dar TU, Rai GK, Wani SH, Habib-Ur-Rahman M, Hejnak V, Vachova P, Brestic M, Çığ A, Çığ F, Erman M, El Sabagh A. 2021			
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
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 57 references, which were reduced to 50 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 GHB614 x LLCotton25 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)	50
Number of publications excluded from the search results after rapid assessment for relevance (Stage 1)	43
Total number of full-text documents assessed in detail	7
Number of publications excluded from further consideration after detailed assessment for relevance (Stage 2)	7
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 <a href="#">Table 1</a>
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 GHB614 x LLCotton25 cotton stacked product was not included in this study.

Study (Author(s) and year)	Title	Source	Reason(s) for exclusion based on eligibility/inclusion criteria listed in <a href="#">Table 1</a>
Hernandez-Teran, Alejandra. Wegier, Ana. Benitez, Mariana. Lira, Rafael. Sosa Fuentes, Tania Gabriela. Escalante, Ana E. 2019	<i>In vitro</i> 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. <a href="https://peerj.com/">https://peerj.com/</a> . ISSN: 2167-8359. E-ISSN: 2167- 8359.	The authors evaluated and compared <i>in vitro</i> performance of wild and domesticated cotton populations in Mexico and its relationship with transgenes (Cry1Ab/Ac, Cry2Ab and CP4EPSPS).  The study was not related to the ERA of GHB614 x LLCotton25 cotton stacked product.
Naegeli, H. Bresson. J. L. Dalmay, T. Dewhurst, I. C. Epstein, M. M. Firbank, L. G. Guerche, P. Hejatko, J. Moreno, F. J. Mullins, E. Nogue, F. Rostoks, N. Serrano, J. J. S. Savoini, G. Veromann, E. Veronesi, F. Alvarez, F. Ardizzone, M. Raffaello, T. 2021	Assessment of genetically modified cotton GHB614 for renewal authorisation under regulation (EC) No 1829/2003 (application EFSA-GMO -RX-018).	EFSA Journal (2021), Volume 19, Number 7, 10 refs. ISSN: 1831-4732 DOI: <a href="https://doi.org/10.2903/j.efs">https://doi.org/10.2903/j.efs</a> a.2021.6671 Published by: Wiley, Oxford	The assessment was done for GHB614 cotton and not for the GHB614 x LLCotton25 cotton stacked product.

Study (Author(s) and year)	Title	Source	Reason(s) for exclusion based on eligibility/inclusion criteria listed in <a href="#">Table 1</a>
<p>Naegeli Hanspeter. Bresson Jean Louis. Dalmay Tamas. Dewhurst Ian Crawford. Epstein Michelle M. Firbank Leslie George. Guerche Philippe. Hejatko Jan. Moreno Francisco Javier. Mullins Ewen. Nogue Fabien. Rostoks Nils. Sanchez Serrano Jose Juan. Savoini Giovanni. Veromann Eve. Veronesi Fabio. Ardizzone Michele. De Sanctis Giacomo. Fernandez Antonio. Federici Silvia. Gennaro Andrea. Gomez Ruiz Jose Angel. Lanzoni Anna. Neri Franco Maria. Paraskevopoulos Konstantinos. Raffaello Tommaso.</p> <p>2021</p>	<p>Assessment of genetically modified cotton GHB811 for food and feed uses, under Regulation (EC) No 1829/2003 (application EFSA-GMO -ES-2018-154).</p>	<p>EFSA journal. European Food Safety Authority, (2021 Aug) Vol. 19, No. 8, pp. e06781. Electronic Publication Date: 16 Aug 2021 Journal code: 101642076. E-ISSN: 1831-4732. L-ISSN: 1831-4732. Report No.: PMC-PMC8365404.</p>	<p>The assessment was done for GHB811 cotton and not for the GHB614 x LLCotton25 cotton stacked product.</p>
<p>Pan, Xiaoping.</p> <p>2019</p>	<p>Determining pollen-mediated gene flow in transgenic cotton.</p>	<p>Methods in Molecular Biology (New York, NY, United States) (2019 ), 1902(Transgenic Cotton), 309-321 CODEN: MMBIED; ISSN: 1940-6029</p>	<p>The author used transgenic IR and HT cotton as two examples to present a field practice method for determining transgene flow in cotton.</p> <p>The study does not present primary data and is not related to the ERA of GHB614 x LLCotton25 cotton.</p>

Study (Author(s) and year)	Title	Source	Reason(s) for exclusion based on eligibility/inclusion criteria listed in <a href="#">Table 1</a>
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 (2020), Volume 9, Number 4, pp. 469-476, 25 refs. ISSN: 2249-720X DOI: 10.1007/s40003-019-00449-z Published by: Spriner (India) Private Limited, New Delhi	The authors used PCR for checking adventitious presence of transgenes in a set of 100 accessions of <i>ex situ</i> 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 was not related to the ERA of GHB614 x LLCotton25 cotton stacked product.
Torres, Amada Reyes-Perez, Juan Jose Marquez-Hernandez, Cando Estrada-Arellano, Josue Esparza-Rivera, Juan Ramon Preciado-Rangel, Pablo Murillo-Amador, Bernardo. 2019	Potential transference of CP4 5-enolpiruvil shikimato-3-phosphate synthase to weed species from genetically modified <i>Gossypium hirsutum</i> in Northern Mexico.	Notulae Botanicae Horti Agrobotanici Cluj-Napoca (2019 ), 47(2), 294-299 CODEN: NBHABI; ISSN: 0255-965X URL: <a href="http://www.notulaeobotanicae.ro/index.php/nbha/index">http://www.notulaeobotanicae.ro/index.php/nbha/index</a>	The objective of the study was to quantify and identify weed species associated to genetically modified cotton (Bollgard II) fields and to detect the presence of glyphosate-insensitive EPSP synthases (CP4 EPSPS) in these species.  The study is not related to the ERA of GHB614 x LLCotton25 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 seven 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 GHB614 x LLCotton25 cotton and its newly expressed proteins 2mEPSPS and PAT/*bar*.

## 7. CONCLUSION

The literature searches performed for the GHB614 x LLCotton25 cotton and its newly expressed proteins, 2mEPSPS and PAT/*bar*, for the period from October 1, 2020 to September 30, 2021, identified a total of 50 unique publications (after duplicate removal). A total of seven publications were progressed for detailed assessment after excluding 43 obviously irrelevant publications during Stage 1 evaluation (rapid assessment based on title and abstract).

The seven publications that progressed to the detailed assessment (Stage2) 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 GHB614 x LLCotton25 cotton and its newly expressed proteins, 2mEPSPS and PAT/*bar*. Similarly, no new publications were found that suggested any potential adverse effects of GHB614 x LLCotton25 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
-----	--

- |    |   |
|----|---|
| 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>

<b>Host</b>	<b>File</b>	<b>Description</b>
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**

```
FILE 'MEDLINE' ENTERED AT 09:23:41 ON 19 OCT 2021
L1      3 SEA LLCOTTON25 OR LLCOTTON(W)25 OR LL(W)COTTON25 OR LL(W)COTTON
        (W)25 OR ACS-GH001-3 OR ACS(W)GH001(W)3 OR ACSGH001(W)3 OR
        ACS-GH001-3 OR ACS(W)GH001(W)3 OR ACSGH001(W)3
L2      4 SEA GHB614 OR GHB(W)614 OR BCS-GH002-5 OR BCSGH002-5 OR
        BCS(W)GH002(W)5 OR BCSGH002(W)5 OR BCS-GH002-5 OR BCS(W)GH002(W)
        )5 OR BCSGH002(W)5
L3      1 SEA GHB614XLLCOTTON25 OR GHB614(W)TIME#(W)LLCOTTON25 OR
        LLCOTTON25XGHB614 OR LLCOTTON25(W)TIME#(W)GHB614
L4      1 SEA (L1 AND L2) OR L3
L5      2 SEA GLYTOL? OR GLYTOLTM? OR GLYTOLRTM? OR GLY(W)TOL? OR
        GLY(W)TOLTM? OR GLY(W)TOLRTM?
L6      13859 SEA LIBERTYLINK OR LIBERTYLINKTM OR LIBERTYLINKRTM OR LIBERTY(W)
        )LINK OR LIBERTY(W)LINKTM OR LIBERTY(W)LINKRTM OR LL OR LLTM
        OR LLRTM
L7      0 SEA L5 AND L6
L8      14 SEA 2MEPSPS OR 2(W)MEPSPS OR 2M(W)EPSPS OR 2(W)M(W)EPSPS
L9      4218 SEA EPSPS OR EPSP(W)SYNTHASE OR (ENOL(W)PYRUVYLSHIKIMATE OR
        ENOL(W)PYRUVYL(W)SHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR ENOLPYRUV
        OYLSHIKAMATE OR ENOYLPYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMIC) (
        4W) (PHOSPHATE OR PHOSPHORIC) (2W) (SYNTHASE OR SYNTHETASE)
L10     0 SEA (ENOLPYRUVYL OR ENOLPYRUYL OR ENOLPYRUVYOYL) (W) (PHOSPHOSHIKI
        MATE OR PHOSPHOSHIKIMIC OR ENOLPYRUVYLSHIKIMATEPHOSPHATE) (2W) (S
        YNTHASE OR SYNTHETASE)
L11     382 SEA (ENOL(W)PYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR
        ENOLPYRUVYLSHIKIMIC OR ENOL(W) (PYRUVYL OR PYRUVYOYL) (W) SHIKIMATE
        ) (3W) PHOSPHATE (W) (SYNTHASE OR SYNTHETASE)
L12     482 SEA (PHOSPHOSHIKIMATE (2W) CARBOXYVINYLTRANSFERASE OR PHOSPHOSHIK
        IMATE (2W) CARBOXYVINYL (W) TRANSFERASE OR ENOLPYRUVYOYL (W) SHIKIMIC (
        3W) PHOSPHOSYNTHASE)
L13     24435 SEA ((DOUBL# OR DOBL#) (W) (MUTANT# OR MUTAT?) OR 2M)
L14     20 SEA L8 OR ((L9 OR L10 OR L11 OR L12)) (S) L13)
L15     1464 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
L16     203 SEA PHOSPHINOTHRICIN(W)N(W)ACETYLTRANSFERASE OR PHOSPHINOTHRICI
        N(2W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYL(W)TRANSFER
        ASE OR PHOSPHINOTHRICINACETYL(W)TRANSFERASE
L17     1538 SEA L15 OR L16
L18     8 SEA L14 AND L17
L19     3527 SEA (HERBICID? OR GL!PHOSATE# OR GL!FOSATE# OR G360 OR G(W)360
        OR ROUNDUP? OR ROUND(W)UP?) (5A) (RESIST? OR TOLERAN? OR
        PROTECT?)
L20     3354 SEA (HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR
        GLUPHOSINATE OR PHOSPHINOTHRICIN OR LIBERTY?) (5A) (RESIST? OR
        PROTECT? OR TOLERAN?)
L21     3085 SEA L19 AND L20
L22     26920 SEA COTTON# OR GOSSYPIUM OR G(W)HIRSUTUM OR G(W)BARBADENSE
L23     3826556 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?))
L24     108 SEA L21 AND L22 AND L23
L25     117 SEA L4 OR L7 OR L18 OR L24
L26     13 SEA L25 AND PY>=2019
L27     5 SEA L26 AND UP>=20201001 AND UP<=20210930

FILE 'BIOSIS' ENTERED AT 09:24:33 ON 19 OCT 2021
L28     4 SEA LLCOTTON25 OR LLCOTTON(W)25 OR LL(W)COTTON25 OR LL(W)COTTON
        (W)25 OR ACS-GH001-3 OR ACS(W)GH001(W)3 OR ACSGH001(W)3 OR
        ACS-GH001-3 OR ACS(W)GH001(W)3 OR ACSGH001(W)3
L29     4 SEA GHB614 OR GHB(W)614 OR BCS-GH002-5 OR BCSGH002-5 OR
```

BCS(W)GH002(W)5 OR BCSGH002(W)5 OR BCS-GH002-5 OR BCS(W)GH002(W)  
)5 OR BCSGH002(W)5  
L30 0 SEA GHB614XLLCOTTON25 OR GHB614(W)TIME#(W)LLCOTTON25 OR  
LLCOTTON25XGHB614 OR LLCOTTON25(W)TIME#(W)GHB614  
L31 1 SEA (L28 AND L29) OR L30  
L32 6 SEA GLYTOL? OR GLYTOLTM? OR GLYTOLRTM? OR GLY(W)TOL? OR  
GLY(W)TOLTM? OR GLY(W)TOLRTM?  
L33 14763 SEA LIBERTYLINK OR LIBERTYLINKTM OR LIBERTYLINKRTM OR LIBERTY(W)  
)LINK OR LIBERTY(W)LINKTM OR LIBERTY(W)LINKRTM OR LL OR LLTM  
OR LLRTM  
L34 2 SEA L32 AND L33  
L35 12 SEA 2MEPSPS OR 2(W)MEPSPS OR 2M(W)EPSPS OR 2(W)M(W)EPSPS  
L36 5036 SEA EPSPS OR EPSP(W)SYNTHASE OR (ENOL(W)PYRUVYLSHIKIMATE OR  
ENOL(W)PYRUVYL(W)SHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR ENOLPYRUV  
OYLSHIKAMATE OR ENOYLPYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMIC) (4  
W) (PHOSPHATE OR PHOSPHORIC) (2W) (SYNTHASE OR SYNTHETASE)  
L37 0 SEA (ENOLPYRUVYL OR ENOLPYRUYL OR ENOLPYRUVOYL) (W) (PHOSPHOSHIKI  
MATE OR PHOSPHOSHIKIMIC OR ENOLPYRUVYLSHIKIMATEPHOSPHATE) (2W) (S  
YNTHASE OR SYNTHETASE)  
L38 720 SEA (ENOL(W)PYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR  
ENOLPYRUVYLSHIKIMIC OR ENOL(W) (PYRUVYL OR PYRUVOYL) (W) SHIKIMATE  
) (3W) PHOSPHATE (W) (SYNTHASE OR SYNTHETASE)  
L39 27 SEA (PHOSPHOSHIKIMATE (2W) CARBOXYVINYLTRANSFERASE OR PHOSPHOSHIK  
IMATE (2W) CARBOXYVINYL (W) TRANSFERASE OR ENOLPYRUVOYL (W) SHIKIMIC (3  
W) PHOSPHOSYNTHASE)  
L40 26892 SEA ((DOUBL# OR DOBL#) (W) (MUTANT# OR MUTAT?) OR 2M)  
L41 19 SEA L35 OR ((L36 OR L37 OR L38 OR L39)) (S) L40  
L42 2839 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  
L43 332 SEA PHOSPHINOTHRICIN (W) N (W) ACETYLTRANSFERASE OR PHOSPHINOTHRICI  
N (2W) ACETYLTRANSFERASE OR PHOSPHINOTHRICIN (2W) ACETYL (W) TRANSFER  
ASE OR PHOSPHINOTHRICINACETYL (W) TRANSFERASE  
L44 2941 SEA L42 OR L43  
L45 8 SEA L41 AND L44  
L46 11065 SEA (HERBICID? OR GL!PHOSATE# OR GL!FOSATE# OR G360 OR G(W)360  
OR ROUNDUP? OR ROUND(W)UP?) (5A) (RESIST? OR TOLERAN? OR  
PROTECT?)  
L47 9910 SEA (HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR  
GLUPHOSINATE OR PHOSPHINOTHRICIN OR LIBERTY?) (5A) (RESIST? OR  
PROTECT? OR TOLERAN?)  
L48 9500 SEA L46 AND L47  
L49 75314 SEA COTTON# OR GOSSYPIUM OR G(W)HIRSUTUM OR G(W)BARBADENSE  
L50 466382 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?))  
L51 246 SEA L48 AND L49 AND L50  
L52 257 SEA L31 OR L34 OR L45 OR L51  
L53 23 SEA L52 AND PY>=2019  
L54 14 SEA L53 AND UP>=20201001 AND UP<=20210930

FILE 'AGRICOLA' ENTERED AT 09:25:21 ON 19 OCT 2021

L55 2 SEA LLCOTTON25 OR LLCOTTON(W)25 OR LL(W)COTTON25 OR LL(W)COTTON  
(W)25 OR ACS-GH001-3 OR ACS(W)GH001(W)3 OR ACSGH001(W)3 OR  
ACS-GH001-3 OR ACS(W)GH001(W)3 OR ACSGH001(W)3  
L56 2 SEA GHB614 OR GHB(W)614 OR BCS-GH002-5 OR BCSGH002-5 OR  
BCS(W)GH002(W)5 OR BCSGH002(W)5 OR BCS-GH002-5 OR BCS(W)GH002(W)  
)5 OR BCSGH002(W)5  
L57 0 SEA GHB614XLLCOTTON25 OR GHB614(W)TIME#(W)LLCOTTON25 OR  
LLCOTTON25XGHB614 OR LLCOTTON25(W)TIME#(W)GHB614  
L58 0 SEA (L55 AND L56) OR L57  
L59 3 SEA GLYTOL? OR GLYTOLTM? OR GLYTOLRTM? OR GLY(W)TOL? OR  
GLY(W)TOLTM? OR GLY(W)TOLRTM?

L60 3247 SEA LIBERTYLINK OR LIBERTYLINKTM OR LIBERTYLINKRTM OR LIBERTY(W)  
)LINK OR LIBERTY(W)LINKTM OR LIBERTY(W)LINKRTM OR LL OR LLTM  
OR LLRTM

L61 2 SEA L59 AND L60

L62 4 SEA 2MEPSPS OR 2(W)MEPSPS OR 2M(W)EPSPS OR 2(W)M(W)EPSPS

L63 653 SEA EPSPS OR EPSP(W)SYNTHASE OR (ENOL(W)PYRUVYLSHIKIMATE OR  
ENOL(W)PYRUVYL(W)SHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR ENOLPYRUV  
OYLSHIKAMATE OR ENOYLPYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMIC) (  
4W) (PHOSPHATE OR PHOSPHORIC) (2W) (SYNTHASE OR SYNTHETASE)

L64 0 SEA (ENOLPYRUVYL OR ENOLPYRUYL OR ENOLPYRUVOYL) (W) (PHOSPHOSHIKI  
MATE OR PHOSPHOSHIKIMIC OR ENOLPYRUVYLSHIKIMATEPHOSPHATE) (2W) (S  
YNTHASE OR SYNTHETASE)

L65 307 SEA (ENOL(W)PYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR  
ENOLPYRUVYLSHIKIMIC OR ENOL(W) (PYRUVYL OR PYRUVOYL) (W)SHIKIMATE  
) (3W)PHOSPHATE(W) (SYNTHASE OR SYNTHETASE)

L66 238 SEA (PHOSPHOSHIKIMATE(2W)CARBOXYVINYLTRANSFERASE OR PHOSPHOSHIK  
IMATE(2W)CARBOXYVINYL(W)TRANSFERASE OR ENOLPYRUVOYL(W)SHIKIMIC(  
3W)PHOSPHOSYNTHASE)

L67 6578 SEA ((DOUBL# OR DOBL#) (W) (MUTANT# OR MUTAT?) OR 2M)

L68 9 SEA L62 OR ((L63 OR L64 OR L65 OR L66)) (S)L67)

L69 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

L70 252 SEA PHOSPHINOTHRICIN(W)N(W)ACETYLTRANSFERASE OR PHOSPHINOTHRICI  
N(2W)ACETYLTRANSFERASE OR PHOSPHINOTHRICIN(2W)ACETYL(W)TRANSFER  
ASE OR PHOSPHINOTHRICINACETYL(W)TRANSFERASE

L71 858 SEA L69 OR L70

L72 4 SEA L68 AND L71

L73 8637 SEA (HERBICID? OR GL!PHOSATE# OR GL!FOSATE# OR G360 OR G(W)360  
OR ROUNDUP? OR ROUND(W)UP?) (5A) (RESIST? OR TOLERAN? OR  
PROTECT?)

L74 8217 SEA (HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR  
GLUPHOSINATE OR PHOSPHINOTHRICIN OR LIBERTY?) (5A) (RESIST? OR  
PROTECT? OR TOLERAN?)

L75 8042 SEA L73 AND L74

L76 64263 SEA COTTON# OR GOSSYPIUM OR G(W)HIRSUTUM OR G(W)BARBADENSE

L77 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?))

L78 224 SEA L75 AND L76 AND L77

L79 229 SEA L58 OR L61 OR L72 OR L78

L80 8 SEA L79 AND PY>=2019

L81 5 SEA L80 AND UP>=20201001 AND UP<=20210930

FILE 'CABA' ENTERED AT 09:26:14 ON 19 OCT 2021

L82 5 SEA LLCOTTON25 OR LLCOTTON(W)25 OR LL(W)COTTON25 OR LL(W)COTTON  
(W)25 OR ACS-GH001-3 OR ACS(W)GH001(W)3 OR ACSGH001(W)3 OR  
ACS-GH001-3 OR ACS(W)GH001(W)3 OR ACSGH001(W)3

L83 7 SEA GHB614 OR GHB(W)614 OR BCS-GH002-5 OR BCSGH002-5 OR  
BCS(W)GH002(W)5 OR BCSGH002(W)5 OR BCS-GH002-5 OR BCS(W)GH002(W)  
)5 OR BCSGH002(W)5

L84 2 SEA GHB614XLLCOTTON25 OR GHB614(W)TIME#(W)LLCOTTON25 OR  
LLCOTTON25XGHB614 OR LLCOTTON25(W)TIME#(W)GHB614

L85 2 SEA (L82 AND L83) OR L84

L86 5 SEA GLYTOL? OR GLYTOLTM? OR GLYTOLRTM? OR GLY(W)TOL? OR  
GLY(W)TOLTM? OR GLY(W)TOLRTM?

L87 5355 SEA LIBERTYLINK OR LIBERTYLINKTM OR LIBERTYLINKRTM OR LIBERTY(W)  
)LINK OR LIBERTY(W)LINKTM OR LIBERTY(W)LINKRTM OR LL OR LLTM  
OR LLRTM

L88 4 SEA L86 AND L87

L89 14 SEA 2MEPSPS OR 2(W)MEPSPS OR 2M(W)EPSPS OR 2(W)M(W)EPSPS

L90 1117 SEA EPSPS OR EPSP(W)SYNTHASE OR (ENOL(W)PYRUVYLSHIKIMATE OR  
ENOL(W)PYRUVYL(W)SHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR ENOLPYRUV

OYLSHIKAMATE OR ENOYLPYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMIC) (4W) (PHOSPHATE OR PHOSPHORIC) (2W) (SYNTHASE OR SYNTHETASE)

L91 0 SEA (ENOLPYRUVYL OR ENOLPYRUYL OR ENOLPYRUVOYL) (W) (PHOSPHOSHIKIMATE OR PHOSPHOSHIKIMIC OR ENOLPYRUVYLSHIKIMATEPHOSPHATE) (2W) (SYNTHASE OR SYNTHETASE)

L92 429 SEA (ENOL(W)PYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR ENOLPYRUVYLSHIKIMIC OR ENOL(W) (PYRUVYL OR PYRUVOYL) (W) SHIKIMATE) (3W) PHOSPHATE (W) (SYNTHASE OR SYNTHETASE)

L93 172 SEA (PHOSPHOSHIKIMATE (2W) CARBOXYVINYLTRANSFERASE OR PHOSPHOSHIKIMATE (2W) CARBOXYVINYL (W) TRANSFERASE OR ENOLPYRUVOYL (W) SHIKIMIC (3W) PHOSPHOSYNTHASE)

L94 7304 SEA ((DOUBL# OR DOBL#) (W) (MUTANT# OR MUTAT?) OR 2M)

L95 21 SEA L89 OR ((L90 OR L91 OR L92 OR L93)) (S) L94)

L96 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

L97 378 SEA PHOSPHINOTHRICIN (W) N (W) ACETYLTRANSFERASE OR PHOSPHINOTHRICIN (2W) ACETYLTRANSFERASE OR PHOSPHINOTHRICIN (2W) ACETYL (W) TRANSFERASE OR PHOSPHINOTHRICINACETYL (W) TRANSFERASE

L98 1641 SEA L96 OR L97

L99 8 SEA L95 AND L98

L100 19059 SEA (HERBICID? OR GL!PHOSATE# OR GL!FOSATE# OR G360 OR G(W)360 OR ROUNDUP? OR ROUND(W)UP?) (5A) (RESIST? OR TOLERAN? OR PROTECT?)

L101 18325 SEA (HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR GLUPHOSINATE OR PHOSPHINOTHRICIN OR LIBERTY?) (5A) (RESIST? OR PROTECT? OR TOLERAN?)

L102 17930 SEA L100 AND L101

L103 96175 SEA COTTON# OR GOSSYPIUM OR G(W)HIRSUTUM OR G(W)BARBADENSE

L104 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?))

L105 492 SEA L102 AND L103 AND L104

L106 502 SEA L85 OR L88 OR L99 OR L105

L107 32 SEA L106 AND PY>=2019

L108 24 SEA L107 AND UP>=20201001 AND UP<=20210930

L109 24 SEA L108 NOT P/DT

L110 0 SEA L108 AND (P/DT AND J/DT)

L111 24 SEA L109 OR L110

FILE 'HCAPLUS' ENTERED AT 09:27:05 ON 19 OCT 2021

L112 9 SEA LLCOTTON25 OR LLCOTTON (W) 25 OR LL (W) COTTON25 OR LL (W) COTTON (W) 25 OR ACS-GH001-3 OR ACS (W) GH001 (W) 3 OR ACSGH001 (W) 3 OR ACS-GH001-3 OR ACS (W) GH001 (W) 3 OR ACSGH001 (W) 3

L113 7 SEA GHB614 OR GHB (W) 614 OR BCS-GH002-5 OR BCSGH002-5 OR BCS (W) GH002 (W) 5 OR BCSGH002 (W) 5 OR BCS-GH002-5 OR BCS (W) GH002 (W) 5 OR BCSGH002 (W) 5

L114 1 SEA GHB614XLLCOTTON25 OR GHB614 (W) TIME# (W) LLCOTTON25 OR LLCOTTON25XGHB614 OR LLCOTTON25 (W) TIME# (W) GHB614

L115 4 SEA (L112 AND L113) OR L114

L116 8 SEA GLYTOL? OR GLYTOLTM? OR GLYTOLRTM? OR GLY (W) TOL? OR GLY (W) TOLTM? OR GLY (W) TOLRTM?

L117 19984 SEA LIBERTYLINK OR LIBERTYLINKTM OR LIBERTYLINKRTM OR LIBERTY (W) LINK OR LIBERTY (W) LINKTM OR LIBERTY (W) LINKRTM OR LL OR LLTM OR LLRTM

L118 3 SEA L116 AND L117

L119 28 SEA 2MEPSPS OR 2 (W) MEPSPS OR 2M (W) EPSPS OR 2 (W) M (W) EPSPS

L120 4391 SEA EPSPS OR EPSP (W) SYNTHASE OR (ENOL (W) PYRUVYLSHIKIMATE OR ENOL (W) PYRUVYL (W) SHIKIMATE OR ENOLPYRUVYLSHIKIMATE OR ENOLPYRUVYOYLSHIKAMATE OR ENOYLPYRUVYOYLSHIKIMATE OR ENOLPYRUVYLSHIKIMIC) (4W) (PHOSPHATE OR PHOSPHORIC) (2W) (SYNTHASE OR SYNTHETASE)

L121 9 SEA (ENOLPYRUVYL OR ENOLPYRUYL OR ENOLPYRUVOYL) (W) (PHOSPHOSHIKIMATE OR PHOSPHOSHIKIMIC OR ENOLPYRUVYLSHIKIMATEPHOSPHATE) (2W) (S

YNTHASE OR SYNTHETASE)  
L122 1076 SEA (ENOL(W) PYRUVOYL SHIKIMATE OR ENOLPYRUVYL SHIKIMATE OR  
ENOLPYRUVYL SHIKIMIC OR ENOL(W) (PYRUVYL OR PYRUVOYL) (W) SHIKIMATE  
) (3W) PHOSPHATE (W) (SYNTHASE OR SYNTHETASE)  
L123 83 SEA (PHOSPHOSHIKIMATE (2W) CARBOXYVINYLTRANSFERASE OR PHOSPHOSHIK  
IMATE (2W) CARBOXYVINYL (W) TRANSFERASE OR ENOLPYRUVOYL (W) SHIKIMIC (3  
W) PHOSPHOSYNTHASE)  
L124 74655 SEA ((DOUBL# OR DOBL#) (W) (MUTANT# OR MUTAT?) OR 2M)  
L125 40 SEA L119 OR ((L120 OR L121 OR L122 OR L123)) (S) L124)  
L126 5215 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  
L127 783 SEA PHOSPHINOTHRICIN (W) N (W) ACETYLTRANSFERASE OR PHOSPHINOTHRICI  
N (2W) ACETYLTRANSFERASE OR PHOSPHINOTHRICIN (2W) ACETYL (W) TRANSFER  
ASE OR PHOSPHINOTHRICIN ACETYL (W) TRANSFERASE  
L128 5515 SEA L126 OR L127  
L129 19 SEA L125 AND L128  
L130 29065 SEA (HERBICID? OR GL!PHOSATE# OR GL!FOSATE# OR G360 OR G(W) 360  
OR ROUNDUP? OR ROUND(W)UP?) (5A) (RESIST? OR TOLERAN? OR  
PROTECT?)  
L131 28005 SEA (HERBICID? OR BIALAPHOS OR BASTA OR GLUFOSINATE OR  
GLUPHOSINATE OR PHOSPHINOTHRICIN OR LIBERTY?) (5A) (RESIST? OR  
PROTECT? OR TOLERAN?)  
L132 27429 SEA L130 AND L131  
L133 266372 SEA COTTON# OR GOSSYPIUM OR G(W) HIRSUTUM OR G(W) BARBADENSE  
L134 693186 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?))  
L135 1296 SEA L132 AND L133 AND L134  
L136 1316 SEA L115 OR L118 OR L129 OR L135  
L137 428 SEA L136 AND PY>=2019  
L138 47 SEA L137 AND UP>=20201001 AND UP<=20210930  
L139 9 SEA L138 NOT P/DT  
L140 0 SEA L138 AND (P/DT AND J/DT)  
L141 9 SEA L139 OR L140

FILE 'MEDLINE, BIOSIS, AGRICOLA, CABA, HCAPLUS' ENTERED AT 09:28:01 ON 19  
OCT 2021

L142 50 DUP REM L27 L54 L81 L111 L141 (7 DUPLICATES REMOVED)  
ANSWERS '1-5' FROM FILE MEDLINE  
ANSWERS '6-17' FROM FILE BIOSIS  
ANSWERS '18-22' FROM FILE AGRICOLA  
ANSWERS '23-43' FROM FILE CABA  
ANSWERS '44-50' FROM FILE HCAPLUS