

RISK ASSESSMENT REPORT
OF THE GENETIC MODIFICATION
ADVISORY COMMITTEE (GMAC)
FOR
AN APPLICATION FOR APPROVAL FOR RELEASE
OF PRODUCTS OF DAS21023 COTTON FOR
SUPPLY OR OFFER TO SUPPLY

NBB REF NO: JBK(S) 600-2/1/36

APPLICANT: CORTEVA AGRISCIENCE
(MALAYSIA) SDN.BHD.

DATE: 8 APRIL 2026

I - Summary of Assessment Process

On 25 February 2026 the Genetic Modification Advisory Committee (GMAC), received from the Department of Biosafety an application for the approval for importation for release [sale/placing on the market for direct use as food, feed and for processing (FFP)] of a product of a Living Modified Organism DAS21023 cotton. The application was filed by Corteva Agriscience (Malaysia) Sdn. Bhd. (hereafter referred to as “the applicant”). After an initial review, GMAC requested for additional information from the applicant. Please refer to **Lampiran IB** for details of the additional information provided by the applicant.

A public consultation for this application was conducted from 22 May 2025 to 20 June 2025 via advertisements in the local newspapers, e-mail announcements and social media. Comments were received from Malaysian Palm Oil Board (MPOB), Consumer Association of Penang (CAP) and Malaysia Food Security and Sovereignty Forum (FKMM). GMAC took into consideration comments that were relevant to the risk assessment including molecular characterization and safety assessment of the proteins, accidental release of the LMO to the environment. Please refer to **Lampiran IVD** for comments received from public consultation.

GMAC had two (2) meetings pertaining to this application and prepared the Risk Assessment Report and Risk Assessment Matrix along with its recommended decision, for consideration by the National Biosafety Board.

II - Background of Application

This application is for approval to import and release products of a Living Modified Organism DAS21023 cotton. The aim of the import and release is to supply or offer to supply for sale/placing on the market for direct use as food, feed and for processing (FFP). According to the Biosafety Clearing House (BCH) and FAO GM Foods Platform, DAS21023 cotton has been approved in a number of countries for cultivation as well as for food, feed and for processing. DAS21023 cotton is approved in Columbia, Mexico, Japan, United States of America (US) and Canada and may be imported, stored and processed for use in food, animal feed and industrial products. The type of expected use of the products derived from DAS21023 cotton in Malaysia will be the same as the expected usage for products derived from conventional cotton. Potential users of products derived from DAS21023 cotton such as grains are feed millers, food processors and other industrial use.

Cottonseed is processed into four major byproducts: oil, meal, hulls and linters. The primary human foods from cottonseed are highly processed refined, bleached and deodorized (RBD) oil and linters. Cottonseed oil is traded as premium quality oil that is used in a variety of food uses, including frying, salad and cooking oil, mayonnaise, salad dressing, shortening, margarine and packing oil. Linters, which are also highly processed and are nearly pure cellulose, are used as a fiber supplement, casings for processed meats, binder for solids in the pharmaceutical industry and to improve viscosity in products such as toothpaste, ice cream and salad dressings. Cottonseed and cottonseed meal is primarily sold as feed for livestock, of which the major value

is as a protein concentrate. The presence of gossypol and cyclopropenoid fatty acids in cottonseed does not prevent use in ruminant diets, but does limit the cottonseed quantity utilized as a protein supplement in these diets, such as beef cattle, dairy cows and sheep. Most other farm animals (monogastric animals) are not fed cottonseed meal to any appreciable level. The hull is used as roughage for livestock. Gin byproducts are also used as a source of roughage for livestock feeds. There is no difference in the use of products of DAS21023 cotton compared to those of conventional cotton already in the market.

Information about DAS21023 cotton

Cotton 21023 was produced by a transformation with *Agrobacterium tumefaciens* with the plasmid pMYC3006, followed by conventional breeding. The pMYC3006 plasmid contains a T-DNA insert that includes two expression cassettes, one for a *cry1Ac* gene and one for a *pat* gene. The *cry1Ac* gene (synpro) was synthesized based on the peptide structure of the Cry1Ac protein. The synthetic protoxin Cry1Ac (synpro) is a crystalline insecticidal protein (ICP; also known as delta endotoxin) whose core toxin was originally identified in *Bacillus thuringiensis kurstaki*, strain HD73. The *cry1Ac* gene is directed by the promoter of Ubiquitin 1 (Ubi Zm1) of *Zea mays* (Christiansen, 1992). The *cry1Ac* gene is terminated by the bidirectional polyadenylation signal ORF25 poly A, from *A. tumefaciens* strain LBA4404 pTi15955.

In addition to *cry1Ac* gene, the transformation vector pMYC3006 contains the selection marker, *pat* gene. The *pat* gene encodes the phosphinothricin acetyltransferase (PAT) of *Streptomyces viridochromogenes*. The *pat* gene was synthesized, based on the amino acid sequence of *Streptomyces viridochromogenes*, to allow optimization of the use of the plant codon for its expression in plants (Van Wert, 1994; OECD, 1999). The *pat* gene encodes phosphinothricin acetyl transferase (PAT) which provides tolerance to glufosinate-based herbicides. PAT was used as a selectable marker during transformation.

The *pat* gene is under the direction of the synthetic promoter (4OCS) Δ mas 2'. This chimeric promoter contains the promoter of mannopina synthase derived from *Agrobacterium tumefaciens* strain LBA4404 plasmid pTi15955 and four (4) copies of the octopine synthase intensifier (OCS) of *A. tumefaciens* that induces the plasmid pTiAch5. Pat transcription is terminated by the ORF25 polyA bidirectional terminator. The *pat* gene and regulatory elements were transformed into cotton, resulting in PAT protein expression and conferring tolerance to chemically synthesized phosphinothricin products such as glufosinate-ammonium.

III - Risk Assessment and Risk Management Plan

GMAC evaluated the application with reference to the following documents:

- (i) CODEX Guideline for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Plants.
- (ii) Roadmap for Risk Assessment of Living Modified Organisms, (according to Annex III of the Cartagena Protocol on Biosafety produced by the Ad Hoc Technical

Expert Group (AHTEG) on Risk Assessment and Risk Management of the Convention on Biological Diversity).

- (iii) The risk assessment and risk management plan submitted by the applicant.

GMAC also referred to the following recommendations within the AHTEG guidelines:

- (i) That the risk assessment exercise be specific to the details of this particular application
- (ii) That the risk assessment exercise be specific to the receiving environment in question, and
- (iii) That any risk identified be compared against that posed by the unmodified organism.

In conducting the risk assessment, GMAC identified potential hazards, and then added a value/rank for the likelihood of each hazard as well as its consequences. The likelihood of each hazard occurring was evaluated qualitatively on a scale of 1 to 4, with 1 for 'highly unlikely', and 4 for 'highly likely'. The consequences of each hazard, if it were to occur, were then evaluated on a scale of 1 to 4, with 1 for 'marginal' and 4 to denote a 'major consequence'. A value was finally assigned for the overall risk from the identified potential hazard. The general formula: Overall Risk = Likelihood x Consequence was employed. GMAC also proposed risk management strategies for potential hazards, where appropriate. This methodology of assessment follows the procedure of Risk Assessment in Annex III of the Cartagena Protocol on Biosafety.

The potential hazards were identified in three main areas:

- (i) **Effects on human health**
Relevant scientific publications on the genetic modifications were reviewed for potential human health risks and issues pertaining to acute toxicity of novel protein / altering / interference of metabolic pathways, potential allergenicity of the novel protein, potential transfer of antibiotic resistance genes in digestive tract, pathogenic potential of donor microorganisms, nutritional equivalence and anti-nutritional properties.
- (ii) **Effects on animal health**
Relevant scientific publications on the genetic modifications were reviewed for potential animal health risks and issues pertaining to allergenicity, toxicity, anti-nutritional properties, survivability and animal product contamination.
- (iii) **Effects on the environment**
Relevant scientific publications on the genetic modifications were reviewed for potential environmental risks and issues pertaining to accidental release of seeds, unintentional release and planting, potential of transgenes being transferred to bacteria (soil bacteria, bacterial flora of animal gut), increased fitness, weediness and invasiveness, accumulation of the protein in the environment via feces from

animals fed with the GM plant/grain and cross pollination leading to transfer of transgenes.

Based on the above, a final list of 18 potential hazards was identified. Most of these hazards were rated as having an Overall Risk of 1 or “negligible” (please refer to the **Lampiran IIB/Risk Matrix** for details).

GMAC also took caution and discussed a few of the hazards that required further evaluation and data acquisition. Some of these risks are expected to be managed effectively with the risk management strategies proposed (please refer to section IV of this document).

Some of the potential hazards are highlighted below along with the appropriate management strategies:

a) Accidental release of viable seeds

Seeds may be accidentally released during transportation. The loss of imported seed is most likely to occur near ports or along roads from ports to manufacturing sites (Roberts *et al.*, 2014). Most of the spilled seed are unlikely to survive for long outside intentional cultivation. The numbers of plants that germinate and establish (reach maturity) is limited by 1) seeds not encountering conditions favorable for germination; 2) mowing or cleaning up (when practiced); 3) poor competitive ability with native vegetation (OECD, 2000). Although, in the rare cases where an occasional seed produces a plant, this plant would not persist in the environment (Crawley *et al.*, 2001). These areas are often managed (e.g. mowing, cleaning) which would further limit plant survival. DAS21023 cotton lacks plausible hypotheses under which it would cause fundamental changes to factors, such as competitive ability, that limit cotton pest or weed potential. Therefore, DAS21023 cotton is unlikely to make cotton more likely to germinate and establish upon accidental release via spillage. In addition, cotton requires specific agronomic conditions for successful growth and reproduction and is not highly competitive outside cultivated environments (OECD, 2008; Eastick & Hearnden, 2006). In addition, the storage temperature and humidity from harvest to receipt at a port in Malaysia would likely negatively impact the germinability of seeds. Any spillage shall be collected and cleaned up immediately. Transportation of the consignment must be in secured and closed conditions.

b) Seeds with added fitness, weediness or become invasive

The only meaningful difference between DAS21023 cotton and conventional cotton is the insect protection trait that is conferred by the Cry1Ac protein. In addition, DAS21023 cotton expresses the PAT protein which provides tolerance to the herbicide glufosinate and was used as a selectable marker during development. DAS21023 cotton is agronomically equivalent to conventional cotton and therefore does not exhibit increased fitness due to the genetic modification. The highly domesticated nature of cotton implies that fundamental changes to

limiting characteristics, including competitive ability, would be required for it to become more fit (more likely to persist). Insect resistant traits do not increase fitness in environments. It is unlikely that DAS21023 cotton will germinate and establish upon accidental spillage and have increased fitness potential. Therefore, the likelihood that DAS21023 makes cotton more likely to germinate and establish is negligible upon accidental spillage. Any spillage shall be collected and cleaned up immediately. Transportation of the consignment must be in secured and closed conditions.

c) Weediness/ Invasive of seeds

Cotton seeds are not considered to be able to survive in the environment over long periods of time because they lack dormancy and are not able to germinate under diverse climatic conditions. Cotton is highly domesticated and its weediness/invasiveness is effectively limited by multiple characteristics, including poor seed dispersal mechanisms and poor competitive ability. Fundamental changes to such limiting characteristics, including competitive ability, would be required for it to become invasive or weedy and the genetic modification of DAS21023 does not confer a selective advantage for survival in wild habitats. Extensive characterization of DAS21023 cotton demonstrated that the only meaningful difference between DAS21023 cotton and conventional cotton is the insect protection trait that is conferred by the Cry1Ac protein. Therefore, DAS21023 cotton has no increase in weediness potential beyond that of conventional cotton and the insect protection trait does not contribute to increased ability to survive or become invasive in natural habitats. For both conventional and DAS21023 cotton, gene flow to native species is unlikely because there are no native Malaysian species sexually compatible to cotton. Insect protected trait such as DAS21023 would have little or no impact on non-agricultural habitats that generally do not receive pesticides application. Any DAS21023 that invades agricultural habitats could be easily controlled with mechanical cultivation and herbicides. Any spillage shall be collected and cleaned up immediately. Transportation of the consignment must be in secured and closed conditions.

d) Planting of seeds

Cotton is not a major crop in Malaysia. Cottonseeds are transported through different channel through supply chain that ensure seeds are transported and handled in a confined manner that restricts the potential for escape into local environment. Seeds are usually intended from port to processing facilities. The likelihood for it to be grown by local farmers is very unlikely. If seed were to be planted it would result in a poorly performing crop with inhibited growth characteristics due to the seed being of the F2 generation. In the unlikely event that seed intended for food and feed use is inadvertently planted by farmers, this is not expected to pose any significant risk. There must be clear labeling of the product to state that it is only for the purpose of food, feed and processing, and is not to be used as planting material.

e) Nutritional equivalence

No major significant differences between DAS21023 cotton and conventional cotton were observed from proximate analysis, analysis of fibre, amino acids, key nutrients and anti-nutrients present in cotton. The composition of DAS24326 cotton is comparable to that of the conventional cotton control. Anti-nutrients were assessed including cyclopropenoides fatty acid and total gossypol on almond (pip), flour and oil of cottonseed. Cyclopropenoid fatty acids are naturally present in cottonseed due to the existence of residual oil in flour fractions. High level of cyclopropenoid may cause adverse health effects in animals, particularly relating to altered metabolism, reproductive issues, and toxicity. Gossypol is a terpenoid substance found naturally in Gossypium plant as a source of resistance to herbivores and insects. High level of gossypol in human and animal food may cause toxicological problems (Berardi and Goldblatt, 1980).

No statistically significant differences were observed between DAS21023 cotton and control cotton. The results of the analysis of anti-nutrients in cottonseed demonstrate that DAS21023 cotton is comparable to conventional non-GM cotton. The data demonstrated that DAS21023 is not a major contributor to variation in anti-nutrient levels in cottonseed. However, applicant is required to update the National Biosafety Board immediately if additional tests indicate potential adverse effects or the possible presence of toxin or allergenic proteins.

IV - Proposed Terms and Conditions for Certificate of Approval

Based on the 18 potential hazards identified and assessed, GMAC has drawn up the following terms and conditions to be included in the certificate of approval for the release of this product:

- a) There shall be clear documentation by the exporter describing the product which shall be declared to the Royal Malaysian Customs.
- b) There shall be clear labeling of the product from importation to all levels of marketing stating that it is only for the purpose of food, feed and processing, and is not to be used as planting material.
- c) Should the approved person receive any credible and/or scientifically proven information that indicates any adverse effect of DAS21023 cotton, the National Biosafety Board shall be informed immediately.
- d) Any spillage (during loading/unloading/transportation) shall be collected and cleaned up immediately.
- e) Transportation of the consignment from the port of entry to any destination within the country shall be in secured and closed conditions.
- f) Any import or release of products derived from any new genetically modified lines bred using DAS21023 cotton will require a separate approval from the National Biosafety Board.

V - Other Regulatory Considerations

- a) Administrative regulatory procedures shall be arranged between the Department of Biosafety, Royal Malaysian Customs Department and relevant agencies to ensure accurate declaration of product information and clear labeling of the product is implemented.
- b) Administrative regulatory procedures shall be arranged between the Department of Biosafety and the Malaysian Quarantine and Inspection Services (MAQIS) to impose post entry requirements for accidental spillage involving the GM product.
- c) Administrative regulatory procedures shall be arranged between the Department of Biosafety and the Malaysian Quarantine and Inspection Services (MAQIS) and other competent agencies to impose post entry requirements for food safety compliance.
- d) Administrative regulatory arrangements shall be carried out between the Department of Biosafety and the Department of Veterinary Services (DVS) so that any unanticipated adverse effects in animals caused by any consumption of the GM products shall be reported immediately.
- e) Administrative regulatory arrangements shall be carried out by Food Safety and Quality of Ministry of Health to monitor compliance to the Food Act 1983 and Food Regulations 1985.
- f) Administrative regulatory procedures shall be arranged between Department of Biosafety and Ministry of Health to ensure that herbicide residues in cotton consignments are below the maximum residual level established. It is recommended that importers are required to provide certificate of analysis for herbicide residues prior to shipment.
- g) Administrative regulatory arrangements shall be carried out between the Department of Biosafety and the Department of Veterinary Services (DVS) to ensure that the imported GM cottonseed meets the standards of the Feed Act 2009, including the monitoring of gossypol levels and other anti-nutritional factors to safeguard animal health and productivity.

VI - Identification of issues to be addressed for long term use release of this product

- a) Continuous monitoring is required from the approved person and any unanticipated adverse effect caused by the DAS21023 cotton shall be reported to the National Biosafety Board.

VII –Conclusion and Recommendation

GMAC has conducted a thorough evaluation of the application for approval for importation for release [sale/placing on the market for direct use as food, feed and for processing (FFP)] of a product of a Living Modified Organism DAS21023 cotton and has determined that the release of this product does not endanger biological diversity or human, animal and plant health. GMAC recommends that the proposed application for release be **APPROVED WITH TERMS AND CONDITIONS** as listed in section IV - Proposed Terms and Conditions for Certificate of Approval.

VIII – Bibliography

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