

FACT SHEET
APPLICATION FOR APPROVAL FOR RELEASE OF PRODUCTS OF
SYHT0H2 SOYBEAN
FOR SUPPLY OR OFFER TO SUPPLY FOR SALE OR PLACING IN THE MARKET

NBB REF NO: JBK(S) 602-1/1/26

The objective of the Biosafety Act is to protect human, plant and animal health, the environment and biological diversity. Under the Biosafety Act, the National Biosafety Board (NBB) is currently assessing an application for approval submitted by Syngenta Crop Protection Sdn. Bhd and Bayer Co. (Malaysia) Sdn.Bhd.

1. What is the application for?

This application is to import and release SYHT0H2 soybean [*Glycine max* (L.) Merr.(soybean)] and its products.

2. What is the purpose of the import and release?

The purpose of the import and release is to supply or offer for sale/placing on the market SYHT0H2 soybean for direct use as food and feed and for processing (FFP).

3. How has the SYHT0H2 soybean been modified?

SYHT0H2 soybean contains the transgene *avhppd-03*, which encodes a *p*-hydroxyphenylpyruvate dioxygenase (HPPD) enzyme, which is more than 99.7% identical in amino acid sequence to the native HPPD in common oat (*Avena sativa* L.). HPPD is a ubiquitous enzyme in the tyrosine catabolic pathway that is essential to plants, animals, and many microbes. In comparison with the native soybean HPPD, the synthetic HPPD isozyme from oat has lower binding affinity for HPPD-inhibiting herbicides, such as mesotrione, and thus confers tolerance to these herbicides at application rates that would otherwise injure soybean. SYHT0H2 soybean also contains the transgene *pat* derived from *Streptomyces viridochromogenes*, a ubiquitous soil microbe. The gene *pat* encodes phosphinothricin acetyltransferase (PAT), an enzyme that acetylates L-phosphinothricin, the active form of glufosinate-ammonium herbicide, resulting in post-emergence tolerance. The transformation plasmid pSYN15954 was used to produce SYHT0H2 soybean by *A. tumefaciens*-mediated transformation of immature soybean seed.

4. Characteristics of SYHT0H2 soybean

(a) Details of the parent organism

The recipient or parental plant is *Glycine max* [L.] Merr.(soybean). Soybean is a dicotyledenous annual legume originating from northeast Asia that has been an important source of protein and oil for thousands of years. Soybean is cultivated widely around the world, with the largest production occurring in the United States, Brazil, Argentina, China, and India. The biology of soybean has been well characterized.

Soybean is commonly considered one of the oldest cultivated crops. The major soybean commodity products are seeds, oil, and meal. Unprocessed soybeans are not suitable for food, and their use for animal feed remains limited, because they contain antinutritional

factors such as trypsin inhibitors and lectins. However, adequate heat processing inactivates these factors. In addition to whole soybean oil for human consumption, refined soybean oil has many other technical and industrial applications. Glycerol, fatty acids, sterols, and lecithin are derived from soybean oil.

Whole soybeans are used to produce soy sprouts, baked soybeans, roasted soybeans, full-fat soy flour, and traditional soy foods (e.g., miso, soy milk, soy sauce, and tofu). Soybean protein isolate is used as a source of amino acids in the production of infant food formula and other food products. Soybean meal is rich in essential amino acids, particularly lysine and tryptophan, which are required supplements in animal diets for optimum growth and health. Soybean meal is used in diets for poultry, swine, dairy cattle, beef cattle, and pets.

(b) Details of the donor organism

SYHT0H2 contains the gene *avhppd-03* derived from *Avena sativa* (common oat), which encodes the enzyme AvHPPD-03, and the gene *pat* from the ubiquitous soil microbe *Streptomyces viridochromogenes*, which encodes the enzyme PAT. Neither species causes adverse health effects in humans, plants, or animals.

Oat, the donor organism for *avhppd-03*, is a safely consumed crop used for food and feed. Oat is commonly used for feed as pasture or forage. Oat grain is used primarily as fiber feed for dairy cattle, horses, mules, and turkeys. Oat is consumed by humans mainly in breakfast foods, infant foods, oat flour, and bran products. Oat is valued as a source of carbohydrates, protein, and soluble fiber.

The coding sequence of the gene *pat* is derived from, *S. viridochromogenes*, which is not known to be a pathogen. Acetyltransferase proteins occur frequently in nature and have not been described as toxic to humans or other animals. No adverse health effects have been related to these enzymes.

(c) Description of the trait(s) and characteristics which have been introduced or modified

SYHT0H2 soybean is tolerant to herbicides that inhibit *p*-hydroxyphenylpyruvate dioxygenase (HPPD), such as mesotrione, and to glufosinate-ammonium herbicides. SYHT0H2 soybean will offer growers the much-needed flexibility to use herbicides with alternative modes of action in their weed-management programs. It will also help mitigate and manage the evolution of herbicide resistance in weed populations.

The synthetic version of HPPD in SYHT0H2 is 99.7% identical to that of the native oat HPPD. The two proteins differ by a single amino acid residue that is not part of the enzyme's active site.

The gene *pat* encodes phosphinothricin acetyltransferase (PAT), an enzyme that acetylates L-phosphinothricin, the active form of glufosinate-ammonium herbicide, resulting in post-emergence tolerance.

(d) Safety of the expressed protein

HPPD proteins, are ubiquitous in commonly consumed food plants and animals. PAT protein has a long history of safe use in transgenic food crops. A comprehensive characterization and safety assessment of the PAT protein is available in a 2005 article published in *Regulatory*

Toxicology and Pharmacology (Hérouet *et al.* 2005). The levels of AvHPPD-03 and PAT proteins in SYHT0H2 soybean are low. The concentrations of both proteins are likely to be further reduced by heating and/or processing, and by digestion, resulting in negligible exposure when consumed by either humans and animals. Bioinformatic analyses demonstrated that AvHPPD-03 and PAT proteins have no significant amino acid sequence similarity to known toxins or allergens.

5. Assessment of Risks to Human Health

Food and feed products derived from SYHT0H2 soybean are not materially different from food and feed products derived from conventional soybean.

(a) Nutritional Data

SYHT0H2 soybean is compositionally equivalent to nontransgenic soybean in terms of proximate composition and concentrations of key nutrients, vitamins, minerals, and anti-nutrients. There are no biologically significant differences (including nutritional differences) between SYHT0H2 soybean and non-transgenic soybean with the exception of the intended traits conferred by expression of the AvHPPD-03 and PAT proteins, which have been demonstrated to be safe for food and feed uses.

(b) Toxicology

AvHPPD-03 proteins were demonstrated to be nontoxic at high doses in acute toxicity tests in mammals. PAT protein has a very specific and well-characterized mode of action and it is not acutely toxic. Bioinformatic analyses demonstrated that AvHPPD-03 and PAT proteins have no significant amino acid sequence similarity to known toxins.

(c) Allergenicity

Neither AvHPPD-03 nor PAT proteins is likely to be allergenic, based on their derivation from nonallergenic sources and lack of biologically relevant sequence similarity to known allergens. Exposure to AvHPPD-03 and PAT proteins is expected to be negligible, since both are expressed at low levels soybean and are rapidly digested in simulated gastric and/or intestinal fluids, or inactivated by heating and/or processing. Bioinformatic analyses demonstrated that AvHPPD-03 and PAT proteins has no significant amino acid sequence similarity to known allergens.

6. Assessment of Risks to the Environment

The application does not cover an environmental release. The release is intended only to cover the import of the SYHT0H2 soybean and its products from countries where the corn is already approved and commercially grown, and that may enter Malaysia as food, feed and for further processing (FFP).

7. What is the Emergency Response Plan

(a) First Aid Measures

No special first aid measures are required for exposure to this product

(b) Accidental Release Measures

It is possible for seed to be accidentally released during transport, however soybean (*Glycine max*) is not weedy in character. In managed ecosystems, soybean does not effectively compete with other cultivated plants or primary colonizers. The agronomic and phenotypic

characteristic of SYHT0H2 soybean was compared to that of conventional soybean. No differences indicative of increased weediness potential were observed in plant growth habit, life span, vegetative vigor, flowering characteristics, yield, stress adaptation or disease susceptibility.

(c) Handling and Storage

There are no specific instructions or recommendations for use, storage and handling of SYHT0H2 soybean. The characteristics of SYHT0H2 soybean and products derived from it are not different from those of its conventional counterpart, apart from the introduced trait. The same measures for handling and storage for conventional soybean are valid for SYHT0H2 soybean.

(d) Disposal Considerations

SYHT0H2 soybean has been assessed as being as safe as its conventional non-GM counterparts. Waste grain and processed products from SYHT0H2 soybean may be disposed of and treated in the same way as grain and processed products on non-GM soybean.

8. How can I comment on this application

Any member of the public may submit their comments or queries on publicly notified information about the application. Before submission of comments or queries, the person should review the information provided. Comments and queries on any possible impacts/risks to the health and safety of the people and the environment that may be posed by the proposed release are appreciated. The submission of comments or queries should be prepared carefully as it will be given the same scrutiny as the application by the NBB. The submission of comments and clarifications or queries should contribute to the NBB's assessment. Even if the submission is not science-based, and focuses on cultural or other values, it should still be developed in the form of a well-founded argument.

Please note that the consultation period closes on **30th October 2015** and written submissions are required by that date. Submissions must be addressed to:

**Director General, Department of Biosafety
Ministry of Natural Resources and Environment
Level 1, Podium 2, Wisma Sumber Asli
No. 25, Periaran Perdana, Presinct 4, 62574
Putrajaya, MALAYSIA.
E-mail: biosafety@nre.gov.my Fax: 03-88904935.**

Please include your full name, address and contact details in your submission.

Reference

Hérouet C, Esdaile DJ, Mallyon BA, Debruyne E, Schulz A, Currier T, Hendrickx K, van der Klis R-J, Rouan D. 2005. Safety evaluation of the phosphinothricin acetyltransferase proteins encoded by the *pat* and *bar* sequences that confer tolerance to glufosinate-ammonium herbicide in transgenic plants. *Regulatory Toxicology and Pharmacology* 41:134–149.