

**ASSESSORS' CONSOLIDATED REPORT ON MONSANTO PHILIPPINES AND DOW  
AGROSCIENCES, INC.'s APPLICATION FOR DIRECT USE AS FOOD AND FEED, OR FOR  
PROCESSING OF CORN MON89034 X TC1507 X NK603**

**EXECUTIVE SUMMARY**

On September 7, 2018, Monsanto Philippines and Dow Agrosciences, Inc. submitted corn MON89034 X TC1507 X NK603 application for direct use under the DOST-DA-DENR-DOH-DILG Joint Department Circular (JDC) No. 1 Series of 2016.

After reviewing the Risk Assessment Report and attachments submitted by the applicant, the STRP, BAI, and BPI-PPSSD found scientific evidence that corn MON89034 X TC1507 X NK603 is as safe as its conventional counterpart and shall not pose any significant risk to human and animal health.

The Department of Environment and Natural Resources – Biosafety Committee (DENR-BC), after a thorough scientific review and evaluation of the accomplished Project Description Report (PDR) and Environmental Risk Assessment (ERA) form along with the submitted sworn statement and accountability of the proponent, reported that the direct use of the regulated article will not cause any adverse effect on the environment (land and water) and biodiversity.

The DOH-BC, after a thorough scientific review and evaluation of documents related to Environmental Health Impact, found scientific evidence that Corn MON89034 x TC1507 x NK603 will not cause significant adverse effects to human and animal health, is unlikely to result in allergenic reaction, and is as safe as food or feed derived from conventional varieties.

Furthermore, the Socio-economic, Ethical and Cultural (SEC) expert, after reviewing thoroughly the accomplished SEC questionnaire, also recommended for the issuance of biosafety permit.

**BACKGROUND**

In accordance with Article VII. Section 20 of the JDC, no regulated article, whether imported or developed domestically, shall be permitted for direct use as food and feed, or for processing, unless: (1) the Biosafety Permit for Direct Use has been issued by the BPI; (2) in the case of imported regulated article, the regulated article has been authorized for commercial distribution as food and feed in the country of origin; and (3) regardless of the intended use, the regulated article does not pose greater risks to biodiversity, human and animal health than its conventional counterpart.

The BPI Biotech Office provided the assessors the complete dossier submitted by Monsanto Philippines and Dow Agrosciences Inc. Upon receipt of the individual reports from the assessors, the BPI Biotech Secretariat prepared this consolidated risk assessment report for the information of the public.

## STRP'S ASSESSMENT

### A. Gene Interaction

There is no plausible interaction among the novel proteins, Cry1A.105, Cry2Ab2, Cry1F, CP4 EPSPS and PAT, when produced in the corn plant. The probability of such interactions in which a new allergen or a new toxin could be produced, is indeed very insignificant and do not pose any adverse effect in humans, animals and the environment.

The resulting novel proteins **are** likely to accumulate in the cytoplasm (Cry1A.105, Cry1F, and PAT) and chloroplast (CP4 EPSPS, Cry2Ab2).

### B. Metabolic Pathways

The insecticidal proteins Cry1A.105, Cry2Ab2, Cry1F, and the herbicide-tolerance proteins CP4 EPSPS and PAT proteins expressed in Corn MON 89034 × TC1507 × NK603 do not act on any similar metabolic pathway(s) nor share any intermediate metabolites in the biochemical or physiological pathways that the proteins act on or interfere with.

Unexpected effects of the stacked genes on the metabolism of the plant are extremely unlikely **as** supported by weight of evidences encompassing the distinct mode of action of introduced proteins and the protein expression analysis.

Each single event has been shown to be equivalent to conventional maize and each protein is not designed to alter the maize plant metabolism. Since each protein has a different mode of action, interaction within these separate, distinct enzymatic activities and pathways is not expected, nor is a plausible mechanism of such interaction hypothesized. In accordance with this, the protein expression analysis showed that Cry1A.105, Cry2Ab2, Cry1F, PAT, and CP4 EPSPS proteins were expressed properly in the combined trait product MON 89034 × TC1507 × NK603 indicating that the inserted genes, *cry1A.105*, *cry2Ab2*, *cry1F*, *pat*, and *cp4 epsps*, are inherited and functioning properly when combined into the breeding stack.

Thus, production of the Cry1A.105, Cry2Ab2, Cry1F, PAT, and CP4 EPSPS proteins in the stacked trait product do not produce any adverse effects on plant metabolism.

### C. Gene Expression

Cry1A.105, Cry2Ab2, Cry1F, PAT, and CP4 EPSPS proteins were expressed properly in the combined trait maize product MON 89034 × TC1507 × NK603.

Protein level measurements using ELISA and subsequent statistical analysis clearly demonstrated that there is indeed no significant difference among the expression levels of the novel proteins in the individual events (MON89034, TC1507, NK603) and stacked MON 89034 × TC1507 × NK603.

## STRP'S RECOMMENDATION

The STRP find concludes that the regulated article applied for direct use has no evidence of interaction on the resulting gene products.

## BAI ASSESSMENT AND RECOMMENDATION

### A. Gene Interaction

Stability and expression levels of individual genes producing Cry1A.105, Cry2Ab2, Cry1F, PAT, and CP4 EPSPS proteins will not be significantly affected by any interaction between the genes and between their products and no new allergen or toxin will be produced in the combined trait product.

Cry1A.105, Cry1F, and PAT proteins will likely accumulate in the cytoplasm while Cry2Ab2 and CP4 EPSPS proteins are expected to accumulate in the chloroplast of maize cells.

### B. Metabolic Pathways

The mode of action is different for each gene product. Cry1A.105, Cry2Ab2, and Cry1F proteins produced by *cry1A.105*, *cry2Ab2*, and *cry1F* genes, respectively, are insect control proteins that act through a toxic action particularly with specific lepidopteran insects such as European corn borer, sugarcane borer, corn earworm, and fall armyworm.

Cry2A family has a common binding site for toxins which is not shared by Cry1A proteins indicating a different mode of action for each protein. Moreover, Cry1F and Cry1A proteins have different high-affinity binding sites.

On the other hand, CP4 EPSPS is an enzyme which produce aromatic amino acids in the chloroplasts that are involved in the biochemical shikimic acid pathway.

PAT protein acetylates phosphinothricin thus inactivating it and conferring tolerance to synthesized phosphinothricin compounds.

### C. Gene Expression

The stacked genes and their products Cry1A.105, Cry2Ab2, Cry1F, PAT, and CP4 EPSPS proteins are extremely unlikely to affect metabolism of the plant due to their having distinct modes of action as supported by protein expression analyses.

Cry1A.105, Cry2Ab2, Cry1F, PAT, and CP4 EPSPS proteins were expressed properly in the combined trait maize product MON 89034 × TC1507 × NK603. Stability and expression levels of each gene will not be significantly affected by any likelihood of interaction due to the distinct mode of action of each gene. Also, their interaction could not lead to production of a new allergen or toxin in the combined trait product

### D. Recommendation

After a thorough review of technical documents, BAI found no evidence of interaction between the genes and between their resulting products.

## **BPI-PPSSD'S ASSESSMENT**

### **A. Gene Interaction**

The presence of five proteins (Cry1A.105, Cry2Ab2, Cry1F, PAT, and CP4 EPSPS) will not interact to produce any new allergen or toxins since they have different modes of action.

Furthermore, the gene products will accumulate in different subcellular compartments of the plant parts. The Cry1A.105, Cry1F, and PAT proteins are likely to accumulate in the cytoplasm of maize cells, while the Cry2Ab2 and CP4 EPSPS proteins are expected to accumulate in the chloroplast of maize cells.

### **B. Metabolic Pathways**

Cry (Cry1A.105, Cry2Ab2, and Cry1F) proteins are insect control proteins and act through a toxic action in the gut of specific lepidopteran insects. Heterologous competition assays showed a common binding site for toxins belonging to the Cry2A family, which is not shared by Cry1A proteins, indicating a different mode of action for each protein. Cry1F and Cry1A proteins have also different high-affinity binding sites [1][2].

On the other hand, CP4 EPSPS protein belongs to the family of EPSP synthases, which are enzymes involved in the penultimate step of the biochemical shikimic acid pathway producing aromatic amino acids in the chloroplasts of plants [3].

The PAT protein, produced by the *pat* gene, acetylates phosphinothricin, inactivating the compound, and confers tolerance to synthesized phosphinothricin compounds [4].

There are no possible unexpected effects of the stacked genes on the metabolism of the plant as supported by weight of evidences encompassing the distinct modes of action of each resultant protein as well as protein expression analyses. The proteins have distinctive enzymatic activities and pathways.

### **C. Gene Expression**

It is reported that the proteins are expressed at low levels in stacked MON 89034 × TC1507 × NK603 plant and the expression levels are similar to the levels in their corresponding single event based on ELISA results. There is no possible interaction that could affect the stability and expression levels of any of the genes.

## **BAI-PPSSD'S RECOMMENDATION**

After a thorough review of the technical documents, the BPI-PPSSD concludes that there is no evidence of interaction on the resulting gene products of the regulated article.

## DENR BC'S ASSESSMENT

After a comprehensive review and evaluation of the documents including the scientific evidence from references and literature submitted by the applicant on its application for Direct Use as FFP of corn MON89034 x TC1507 x NK603, hereunder are the observations and appropriate actions:

1. The individual events of the gene stacked Corn MON89034 x TC1507 x NK603 have biosafety permits for direct use, which were previously issued. Therefore, each event has undergone rigorous safety assessment and is considered safe to the environment, biodiversity, and non-target organisms. Similarly, it is less likely to pose any significant adverse effect on the environment;
2. The incorporation of gene stacked event is through conventional breeding, which is regarded as innocuous for its long history of safe use. Furthermore, the method of crossing individual transgenic parents is similar with that of non-transgenic parents. This method does not introduce any greater variation in the genome beyond what is obtained [5]; and
3. The project description report discusses the specified environmental management plan indicating the possible risk and harm to the environment and non-target organisms as well as the mitigating measures and contingency plan. Furthermore, the chances of unintended release or planting of the regulated article is very minimal and will not cause any damaging and lasting effects because the receiving environment (areas near port, roads, railways, etc.) is not conducive for plant growth. Also, corn is a highly domesticated plant that requires human intervention for it to persist in the environment [6][7].

Based on the evaluation and review of literatures cited, the DENR-BC considered the regulated article safe to the environment and biodiversity.

## DOH BC'S ASSESSMENT

The DOH-BC, after thorough review of the documents, find that the regulated article applied for Direct Use as Food, Feed or for Processing (FFP) is as safe as its conventional counterpart and shall not pose any significant risk to human and animal health and environment.

The following are the observations and recommendations:

1. Scientific pieces of evidence from Toxicity studies and references, find that the regulated article will not cause significant **adverse effects** to human and animal health.
2. Dietary exposure to the regulated article is unlikely to result in allergic reaction.
3. The regulated article is as safe as food or feed derived from conventional corn varieties.
4. The regulated article is not materially different in nutritional composition from that of the non-transgenic corn or the conventional corn.

5. It is suggested that the Bureau of Plant Industry (BPI) ensure that there shall be clear instructions that the product is only for the purpose of direct use for FFP and is not to be used as planting materials.

### **SEC EXPERT'S ASSESSMENT**

Based on the SEC expert review of the SEC questionnaire answered by the applicant:

The expert concurred with the statement of the applicant that GM maize is widely produced and consumed and is a significant component of global trade of agricultural commodities. Based on the latest agricultural commodity data by the Philippine Statistics Authority (PSA), the volume of maize imports at 0.81 million metric tons grew by 13.15 percent. Its import payment was up by 7.33 percent and reached US\$ 212.21 million, accounting for 1.70 percent in the country's import value of agricultural products.

The SEC expert also agreed that the importation of GM corn will not drastically change current patterns of production, consumption and trade.

### **SEC EXPERT'S RECOMMENDATION**

The SEC expert has recommended for the approval and issuance of the biosafety permit of the GM product.

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