



Food/Feed and Environmental Risk Assessment of Insect-resistant and Herbicide-tolerant Genetically Modified Maize Bt11 x MIR604 in the European Union under Regulation (EC) No 1829/2003 (EFSA/GMO/UK/2007/50)

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Authors' contributions

This work was carried out in collaboration among all authors. The opinion has been assessed and approved by the Panel on Genetically Modified Organisms of VKM. All authors read and approved the final manuscript.

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Grey Literature

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ABSTRACT

In preparation for a legal implementation of EU-regulation 1829/2003, the Norwegian Scientific Committee for Food Safety (VKM) has been requested by the Norwegian Environment Agency (former Norwegian Directorate for Nature Management) and the Norwegian Food Safety Authority

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(NFSA) to conduct final food/feed and environmental risk assessments for all genetically modified organisms (GMOs) and products containing or consisting of GMOs that are authorized in the European Union under Directive 2001/18/EC or Regulation 1829/2003/EC. The request covers scope(s) relevant to the Gene Technology Act. The request does not cover GMOs that VKM already has conducted its final risk assessments on. However, the Agency and NFSA requests VKM to consider whether updates or other changes to earlier submitted assessments are necessary.

In preparation for a legal implementation of EU-regulation 1829/2003, the Norwegian Environment Agency (former Norwegian Directorate for Nature Management) has requested the Norwegian Food Safety Authority (NFSA) to give final opinions on all genetically modified organisms (GMOs) and products containing or consisting of GMOs that are authorised in the European Union under Directive 2001/18/EC or Regulation 1829/2003/EC within the Authority's sectoral responsibility. The Norwegian Food Safety Authority has therefore, by letter dated 13 February 2013 (ref. 2012/150202), requested the Norwegian Scientific Committee for Food Safety (VKM) to carry out scientific risk assessments of 39 GMOs and products containing or consisting of GMOs that are authorised in the European Union. The request covers scope(s) relevant to the Gene Technology Act. The request does not cover GMOs that VKM already has conducted its final risk assessments on. However, the Agency requests VKM to consider whether updates or other changes to earlier submitted assessments are necessary.

The insect-resistant and herbicide-tolerant genetically modified maize Bt11 x MIR604 (Unique Identifier SYN-BTØ11-1 x SYN-IR6Ø4-5) from Syngenta Seeds is approved under Regulation (EC) No 1829/2003 for food and feed uses, import and processing since 21 December 2011 (Commission Decision 2011/893/EC).

The genetically modified maize Bt11 x MIR604 has previously been risk assessed by the VKM Panel on Genetically Modified Organisms (GMO), commissioned by the Norwegian Food Safety Authority and the Norwegian Environment Agency related to the EFSA's public hearing of the application EFSA/GMO/UK/2007/50 in 2008 (VKM 2009a). In addition, Bt11 and MIR604 have been evaluated by the VKM GMO Panel as single events and as components of several stacked GM maize events (VKM 2005a,b, 2007, 2008, 2009b,c,d,e, 2012a,b, 2013a,b,c).

The food/feed and environmental risk assessment of the maize Bt11 x MIR604 is based on information provided by the applicant in the application EFSA/GMO/UK/2007/50, and scientific comments from EFSA and other member states made available on the EFSA website GMO Extranet. The risk assessment also considered other peer-reviewed scientific literature as relevant.

The VKM GMO Panel has evaluated Bt11 x MIR604 with reference to its intended uses in the European Economic Area (EEA), and according to the principles described in the Norwegian Food Act, the Norwegian Gene Technology Act and regulations relating to impact assessment pursuant to the Gene Technology Act, Directive 2001/18/EC on the deliberate release into the environment of genetically modified organisms, and Regulation (EC) No 1829/2003 on genetically modified food and feed. The Norwegian Scientific Committee for Food Safety has also decided to take account of the appropriate principles described in the EFSA guidelines for the risk assessment of GM plants and derived food and feed (EFSA 2011a), the environmental risk assessment of GM plants (EFSA 2010), selection of comparators for the risk assessment of GM plants (EFSA 2011b) and for the post-market environmental monitoring of GM plants (EFSA 2011c).

The scientific risk assessment of maize Bt11 x MIR604 include molecular characterisation of the inserted DNA and expression of novel proteins, comparative assessment of agronomic and phenotypic characteristics, nutritional assessments, toxicology and allergenicity, unintended effects on plant fitness, potential for gene transfer, interactions between the GM plant and target and non-target organisms and effects on biogeochemical processes.

It is emphasised that the VKM mandate does not include assessments of contribution to sustainable development, societal utility and ethical considerations, according to the Norwegian

Gene Technology Act and Regulations relating to impact assessment pursuant to the Gene Technology Act. These considerations are therefore not part of the risk assessment provided by the VKM Panel on Genetically Modified Organisms.

The genetically modified maize stack Bt11 x MIR604 has been produced by conventional crossing between GM inbred lines of maize containing the single events Bt11 and MIR604. The maize hybrid was developed to provide protection against certain lepidopteran and coleopteran target pests, and to confer tolerance to glufosinate-ammonium based herbicides.

Molecular Characterization:

Conventional crossing methods were used to produce the stacked maize Bt11 x MIR604. Southern blot analyses have indicated that the recombinant inserts in the parental maize lines Bt11 and MIR604 are retained in the stacked maize Bt11 x MIR604. Genetic stability of the inserts has previously been demonstrated in the parental events. Protein measurements show comparable levels of the Cry1Ab, mCry3A, PAT and PMI proteins between the stacked and single maize lines.

The VKM GMO Panel considers the molecular characterisation of maize Bt11 x MIR604 and the single maize events Bt11 and MIR604 as adequate.

Comparative Assessment:

Comparative analyses of agronomic and phenotypic data from field trials located at representative sites and environments in USA in 2005 indicate that maize stack Bt11 x MIR604 is equivalent to its conventional counterpart, with the exception of the insect resistance and the herbicide tolerance, conferred by the Cry1Ab, mCry3A and PAT proteins. The field evaluations support a conclusion of no phenotypic changes indicative of increased plant weed/pest potential of maize Bt11 x MIR604 compared to conventional maize varieties.

The applicant has performed a compositional analysis on the triple-stack Bt11 x MIR604 x GA21 instead of maize Bt11 x MIR604. The analysis was performed on plant materials from maize Bt11 x MIR604 x GA21 and a near-isogenic control hybrid from field trials in USA in 2006. With the exception of small intermittent variations, no biologically significant compositional differences were found between the triple-stack and the near-isogenic control. The results of the study are considered valid by EFSA also for maize Bt11 x MIR604, since maize Bt11 x MIR604 x GA21 encompasses the transgenic properties of maize Bt11 x MIR604. This is in accordance with the EFSA guidance document for the risk assessment of genetically modified plants containing stacked transformation events (EFSA, 2007b).

The VKM GMO Panel is of the opinion that the applicant should have performed a compositional analysis of maize Bt11 x MIR604 and not only referred to analyses of the triple- stack Bt11 x MIR604 x GA21. However, based on all information available, including agronomic and phenotypic data from field trials with maize Bt11 x MIR604, a feeding study on broilers showing nutritional equivalence to non-GM maize, and assessments of the single events Bt11 and MIR604, the VKM GMO Panel concludes that forage and grain from maize Bt11 x MIR604 are compositionally equivalent to its conventional counterpart.

Food and Feed Risk Assessment:

A whole food feeding study on broilers has not indicated any adverse effects of maize Bt11 x MIR604, and shows that maize Bt11 x MIR604 is nutritionally equivalent to conventional maize. The Cry1Ab, PAT, mCry3A, and PMI proteins do not show sequence resemblance to other known toxins or IgE allergens, nor have they been reported to cause IgE-mediated allergic reactions. Some studies have however indicated a potential role of Cry-proteins as adjuvants in allergic reactions.

Based on current knowledge, the VKM GMO Panel concludes that maize Bt11 x MIR604 is nutritionally equivalent to conventional maize varieties. It is unlikely that the Cry1Ab, PAT, mCry3A,

or PMI proteins will introduce a toxic or allergenic potential in food or feed based on maize Bt11 x MIR604 compared to conventional maize.

Environmental Risk Assessment:

The scope of the application EFSA/GMO/UK/2007/50 includes import and processing of maize stack Bt11x MIR604 for food and feed uses. Considering the intended uses of maize Bt11 x MIR604, excluding cultivation, the environmental risk assessment is concerned with accidental release into the environment of viable grains during transportation and processing, and indirect exposure, mainly through manure and faeces from animals fed grains from maize Bt11 x MIR604.

Maize Bt11 x MIR604 has no altered survival, multiplication or dissemination characteristics, and there are no indications of an increased likelihood of spread and establishment of feral maize plants in the case of accidental release into the environment of seeds from maize Bt11 x MIR604. Maize is the only representative of the genus *Zea* in Europe, and there are no cross-compatible wild or weedy relatives outside cultivation. The VKM GMO Panel considers the risk of gene flow from occasional feral GM maize plants to conventional maize varieties to be negligible in Norway. Considering the intended use as food and feed, interactions with the biotic and abiotic environment are not considered by the GMO Panel to be an issue.

Overall Conclusion:

Based on current knowledge, the VKM GMO Panel concludes that maize Bt11 x MIR604 is nutritionally equivalent to its conventional counterpart, except for the presence of the newly expressed proteins. It is unlikely that the Cry1Ab, PAT, mCry3A, or PMI proteins will introduce a toxic or allergenic potential in food or feed derived from maize Bt11 x MIR604 compared to conventional maize.

The VKM GMO Panel likewise concludes that maize Bt11 x MIR604, based on current knowledge, is comparable to conventional maize varieties concerning environmental risk in Norway with the intended usage.

Keywords: *Maize, Zea mays L.; genetically modified maize Bt11 x MIR604; EFSA/GMO/UK/2007/50; insect-resistance; herbicide-tolerance; cry proteins; cry1Ab; mcry3Ab; pat; pmi; glufosinate-ammonium; food and feed risk assessment; environmental risk assessment; Regulation (EC) No 1829/2003.*

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NOTE:

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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