

## Review of studies assessing the impact of *Bt*-maize events expressing Cry3Bb1 on non-target organisms

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### Introduction



To ensure that genetically modified *Bt*-crops do not cause unacceptable harm to other organisms than the pests they target, termed non-target organisms (NTOs), an environmental risk assessment (ERA) needs to be conducted as part of the regulatory approval process. In particular, the ERA needs to assess whether NTOs and the ecological and anthropocentric functions (hereafter ecosystem services) they provide might be adversely affected.

Via a literature review, it was explored whether the cultivation of the *Bt*-maize events MON88017 and MON863, expressing the insecticidal Cry3Bb1 protein against corn rootworms (Coleoptera: Chrysomelidae), causes adverse effects to NTOs and the ecosystem services they provide.

### Overview of NTOs & assessment endpoints considered in lower- and higher-tier studies\*

#### Terrestrial arthropods

- **Herbivores:** Acari: Tetranychidae (*Tetranychus urticae*); Coleoptera: Chrysomelidae (*Callosobruchus maculatus*, *Galerucella vittaticollis*, *Gastrophysa viridula*, *Leptinotarsa decemlineata*, *Oulema melanopus*, *Phaedon cochleariae*), Coccinellidae (*Epilachna vigintioctopunctata*), Curculionidae (*Anthonomus eugeni*, *Anthonomus grandis*, *Sitophilus oryzae*), Elateridae, Tenebrionidae (*Tribolium castaneum*); Hemiptera: Aphididae (*Rhopalosiphum maidis*, *Rhopalosiphum padi*), Cicadellidae, Miridae; Lepidoptera: Crambidae (*Ostrinia nubilalis*), Danaidae (*Danaus plexippus*), Noctuidae (*Helicoverpa zea*); Orthoptera: Gryllidae; Thysanoptera: Thripidae
- **Natural enemies:** Araneae: Theridiidae (*Phylloneta impressa*); Coleoptera: Carabidae (*Agonum cupripenne*, *Agonum placidum*, *Amara pennsylvanicus*, *Calathus ambiguus*, *Calathus fuscipes*, *Chlaenius tricolor*, *Harpalus affinis*, *Harpalus caliginosus*, *Harpalus pennsylvanicus*, *Patrobus longicornis*, *Poecilus chalcites*, *Poecilus lucublandus*, *Pseudophonus rufipes*, *Pterostichus melanarius*, *Scarites quadricaps*), Cicindelidae, Coccinellidae (*Adalia bipunctata*, *Coleomegilla maculata*, *Hippodamia convergens*, *Stethorus punctillum*), Staphylinidae (*Atheta coriaria*); Diptera: Syrphidae; Hemiptera: Anthracoridae (*Orius insidiosus*), Nabidae; Hymenoptera: Braconidae, Formicidae, Pteromalidae (*Nasonia vitripennis*); Neuroptera: Chrysopidae (*Chrysoperla carnea*), Osmyidae
- **Pollinators:** Hymenoptera: Apidae (*Apis mellifera*)
- **Decomposers:** Chilopoda; Coleoptera: Lathridiidae, Nitidulidae; Diplura: Japygidae; Diptera: Drosophilidae (*Drosophila melanogaster*), Phoridae (*Megaselia scalaris*); Mecoptera: Panopidae

\* The examples given at species level are species tested in lower-tier studies

#### Soil arthropods

Acari: Acaridae; Collembola: Isotomidae (*Folsomia candida*)

#### Aquatic arthropods

Cladocera: Daphniidae (*Daphnia magna*); Diptera: Chironomidae (*Chironomus dilutus*), Tipulidae (*Tipula (Nipoptipula) abdominalis*); Isopoda: (*Caecidotea communis*); Trichoptera: Lepidostomatidae, Limnephilidae

#### Non-arthropod NTOs

- **Annelida:** Haplotaxida: Enchytraeidae (*Enchytraeus albidus*); Lumbricidae (*Eisenia fetida*, *Lumbricus terrestris*)
- **Molusca:** Pulmonata: Agriolimacidae (*Deroceras reticulatum*), Arionidae (*Arion lusitanicus*, *Arion vulgaris*)
- **Rhabditida:** Rhabditidae (*Caenorhabditis elegans*)
- **Nematoda**

#### Assessment endpoints (lower-tier studies)\*\*

- **Life-history parameters:** Mortality, survival time, growth (biomass, head capsule width), development time or rate, weight, elytra length, longevity, mobility, predatory ability
- **Reproductive parameters:** Pre-oviposition period, fecundity, fertility

\*\* For higher-tier studies abundance was assessed

### Relevance in terms of environmental risk assessment (ERA)

Not all the data reported in the scientific literature are equally informative to the ERA of maize events MON88017 and MON863. Their relevance depends on: (1) the representativeness of the species tested for a valued group of NTOs, including their likely exposure to maize under field conditions; (2) the experimental design of the study; (3) the type of study conducted; and (4) the Cry3Bb1 protein variant considered.

### Conclusions

1. Available data do not reveal adverse effects of Cry3Bb1 on various NTOs that are representative of potentially exposed taxonomic and functional groups.
2. The insecticidal activity of Cry3Bb1 proteins is limited to species belonging to the coleopteran family of Chrysomelidae.
  - Non-target (NT) chrysomelid beetle species are only at risk if they are exposed to harmful concentrations of the plant-produced Cry3Bb1 protein under realistic conditions of exposure.
    - **Larvae:** The potential risk to NT chrysomelid larvae ingesting *Bt*-maize pollen deposited on host plants is minimal, as their abundance in maize fields and the likelihood of encountering harmful amounts of pollen in and around *Bt*-maize fields are low;
    - **Adults:** NT adult chrysomelids, which may occasionally feed on *Bt*-maize plants, are not expected to be affected due to the low activity of Cry3Bb1 proteins on adults.
  - No endangered and threatened chrysomelid beetle species are listed for the USA. The only protected chrysomelid species (*Macrolea pubipennis*) in the EU does not occur in maize fields.
3. Impacts on NTOs caused by potential unintended changes in *Bt*-maize MON88017 and MON863 are not expected to occur, as no differences in composition, phenotypic characteristics and plant-NTO interactions were observed between MON88017 and MON863 and their near-isogenic lines.

### More information

Devos Y. & De Schrijver A., De Clercq P., Kiss J., Romeis J. (2012) *Bt*-maize event MON88017 expressing Cry3Bb1 does not cause harm to non-target organisms. *Transgenic Research*, DOI:10.1007/s11248-012-9617-z