

Non-target effects of Bt maize in field studies revisited– a systematic review

Michael Meissle^{1*}, Steven E. Naranjo² & Jörg Romeis¹

¹Research Division Agroecology and Environment, Agroscope, Zurich, Switzerland

²USDA-ARS, Arid-Land Agricultural Research Center, Maricopa, USA

*e-mail: michael.meissle@agroscope.admin.ch

Abstract

Although previous meta-analyses have addressed non-target effects of genetically modified (GM) crops producing insecticidal protein from *Bacillus thuringiensis* (Bt), many field studies from Europe and other parts of the world have been published in the last decade. We conducted a systematic review to answer the question: “Does the growing of Bt maize change abundance or ecological function of non-target animals compared to the growing of non-GM maize?”

Systematic review methodology ensured unbiased, comprehensive, transparent, repeatable, and robust evidence synthesis including statistical meta-analyses. Literature published until August 2019 was searched systematically. An effort was made to acquire appropriate data from the authors. A publicly available database was developed with abundance data of invertebrates from experimental field studies with Bt- and non-Bt-maize. Critical appraisal was applied to each record in the database to estimate the risk of bias and the suitability to answer the review question. Detailed meta-analyses on different taxonomic levels and functional groups were conducted. Untreated Bt maize was either compared to untreated non-Bt maize, or to insecticide-treated non-Bt maize. The influence of private involvement on reported effects was investigated. Our approach ameliorates shortcomings of prior analyses, such as level of analysis, data-dependence issues, and consideration of bias.

The review confirms that Bt maize is a selective pest control technology with relatively few negative consequences on a wide array of taxa associated with maize production. When compared to the alternative use of broad-spectrum insecticides for managing Bt-targeted pests, positive effects became evident. It thus supports the conclusions of the regulatory risk assessments that Bt maize poses no unacceptable risk for non-target organisms. Further research, however, is needed on the link of significant differences in field populations of invertebrates in experimental studies and meta-analyses to ecosystem functions and when differences might be considered harmful. Future publications should make full datasets publicly available to foster future meta-analyses.

Key words: critical appraisal, *Bacillus thuringiensis* corn, systematic literature search, sensitivity analysis, non-target invertebrates