European Commission

Science for Environment Policy

10 August 2017
Issue 494

Subscribe to free weekly News Alert

GM risk assessments: the importance of *in planta* studies in the sustainable management of GM plants

Assessments of the effects on organisms likely to come into contact with genetically modified (GM) plants have been reviewed in a recent study. The researchers say such assessments help to understand the potential ecological impacts within the environment and are an important part of the risk assessments for GM plants.

Genetically modified organisms (GMOs), including GM plants, are subject to an environmental risk assessment (ERA) prior to being authorised for commercial use in the EU. An important aspect of this assessment is the potential impact of the GM plant on non-target organisms (NTOs), particularly for species found in areas where GM crops are grown.

Agricultural land can support high levels of biodiversity, with many species coming into frequent contact with plants — either directly during feeding on crops, or, indirectly, by consuming prey animals that eat crops. Therefore, the potential impact of GM crops on these non-target species needs to be evaluated.

EU guidance[1] on the ERA of GM plants requires risk assessment to consider the whole plant, and any substances it produces, as well as the specific gene or trait that has been altered. This is because of the potential for genetic alteration, intentionally or otherwise, to change aspects of the plant's metabolites or biology, such as its structure or composition (e.g. lignin, cuticle, hairiness), which in turn may affect ecological interactions and thus ultimately harm NTOs. *In planta* studies expose NTOs (e.g. insects) to the test plant (e.g. to the leaves, stem, seeds, pollen or flowers) and identify any possible impact. This study reviewed scientific studies which focused on the use of *in planta* studies to assess the environmental impact of GM plants.

In planta studies are used to examine both intended and unintended effects of genetic modifications of plants. For example, intended changes include the production of crops with proteins derived from bacteria to act against insect pests. The researchers suggest that ERAs need to consider the structure of the genes used, how they act on insects, how they interact with other plant substances, how they affect different groups of species and their concentration within the plant.

The researchers point out the limitations of laboratory tests, which don't replicate changes to soil composition throughout the growing season. Multi-trophic relationships between plants, soil microorganisms, earthworms, microbial, arthropod and pest species in the soil can be affected by changes to plant structure or composition over multiple growing seasons and result in changes in the ecosystem's equilibrium; therefore, *in planta* information on how these associations may be affected is an important part of the assessment of these GM plants. The researchers point out that studies[2] have shown no *in vitro* effects on nematodes, micro-arthropods, earthworms and snails but several *in planta* studies identified significant effects on the same organisms.

Continued on next page.

Source: Arpaia, S., Birch, A.N.E., Kiss, J., van-Loon, J.J.A., Messéan, A., Nuti, M., Perry, J.N., Sweet, J.B. & Tebbe, C.C. (2017). Assessing environmental impacts of genetically modified plants on non-target organisms: The relevance of *in planta* studies. *Science of The Total Environment*. 583:e0149253. DOI:10.1016/j.scitotenv.2017.01.039.

Contact:
salvatore.arpaia@enea.it

Read more about:
Agriculture, Biodiversity, Biotechnology, Risk assessment

1. Guidance on the environmental risk assessment of genetically modified plants: https://www.efsa.europa.eu/en/efsajournal/pub/1879

2. The EU ECOGEN studies (Griffiths, B.S., Caul, S., Thompson, J., Birch, A.N.E., Scrimgeour, C., Cortet, J., *et al.*, 2006. Soil microbial and faunal community responses to Bt maize and insecticide in two soils. *Journal of Environmental Quality*. 35, 734–741.)

European Commission

Science for Environment Policy

GM risk assessments: the importance of *in planta* studies in the sustainable management of GM plants *(continued)*

10 August 2017
Issue 494

Source: Arpaia, S., Birch, A.N.E., Kiss, J., van-Loon, J.J.A., Messéan, A., Nuti, M., Perry, J.N., Sweet, J.B. & Tebbe, C.C. (2017). Assessing environmental impacts of genetically modified plants on non-target organisms: The relevance of *in planta* studies. *Science of The Total Environment*. 583:e0149253. DOI:10.1016/j.scitotenv.2017.01.039.

Contact:
salvatore.arpaia@enea.it

Read more about:
Agriculture, Biodiversity, Biotechnology, Risk assessment

In planta studies can also be used to assess unintended effects on NTOs at different levels of the food chain. This can include non-target species that feed on the GM plant, or predator species that feed on the target species. For example, genetic modification can alter the levels of chemical substances produced as plant defence mechanisms; most GM crop development is focused on improving yields, rather than pest resistance, which can result in a reduction of these pest-resistance substances in GM plants.

The researchers say that the importance of *in planta* studies is that they help scientists understand the ecological impacts of GM plants within the environment. For example, impacts on species at different levels in the food chain can be hard to determine from laboratory studies alone. Similarly, for soil microorganisms, the majority cannot be cultured in the laboratory for testing and many species are dependent on interactions with other species, including their interactions with the roots of certain plants, so have to be assessed in the real world.

The researchers say their review demonstrates how genetic modification can have a wide range of intended and unintended effects on plants and they suggest the environmental impact therefore needs to be considered on a case-by-case basis. Assessments also need to account for different real-life conditions to understand how factors such as time of exposure and life stage influence the effect on NTOs. The researchers say the added advantage of *in planta* studies is that they can provide insight into how the GM crop will withstand environmental variability, which can help inform risk managers and decision-makers and ensure the sustainability of GM crops into the future.