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Refining risk assessment for GM crops and aquatic environments

Although methods to assess the impact of genetically modified (GM) crops on terrestrial ecosystems are well defined, impacts on aquatic ecosystems have received less attention. A recent study has shown how the first step of an Environmental Risk Assessment could be applied in an aquatic environment, to assess the exposure of aquatic organisms to proteins in GM crops, using Bt maize as a case study.

Current terrestrial risk assessments for pesticides, biopesticides and GM crops use a tiered approach to gauge the risks from GM crops to the species present in the local environment. Such testing begins with worst-case scenarios for exposure and only moves to more refined risk assessment if some element of risk is clearly identified. These tests may use surrogate species to represent species present in the specific environment of the crops. However, for aquatic ecosystems these surrogate species are not as well-defined or standardised for GM crops, as they are for pesticides.

To address this, the researchers showed how comprehensive problem formulation, the first step in an environmental risk assessment, can help to identify and characterise the risks to aquatic ecosystems of growing GM crops nearby. The framework produced by this study could help policymakers and regulators assess and manage risks from GM crops planted near wetlands, rivers, lakes, streams or ponds more accurately.

At the problem formulation stage, the researchers first identified the information required to define potential risks. This includes understanding the GM trait, which gene was used, its biological function, and where and when it is expressed in the plant. This stage analyses the aquatic environment and the invertebrates present, and the goals for protecting that environment. For example, in the case of Bt maize, some invertebrates might consume plant material, but may not be present in the environment after harvest when maize plant material is available.

The researchers then developed a conceptual model exploring how aquatic organisms could be exposed to genetically modified plant material. The researchers identified several exposure routes, including erosion of soil and surface run-off containing the GM protein, wind-blown pollen and crop dust, and movement of plant tissue and residues. For Bt maize, the most important exposure route is likely to be through feeding on plant tissue, which could affect a functional group of invertebrates described as 'shredders'.

Finally, they explored possible surrogate species for use in tiered exposure tests. They began by considering which organisms might be exposed, eliminating those that could not be cultured or tested in the laboratory, were not commercially available or which did not have standardised test procedures. The choice of test species also depended on the exposure routes identified. In addition to the current available test organisms, the researchers recommend two species, an amphipod and a chironomid, that could be used for testing when 'shredder' invertebrates are likely to be exposed. In the Bt maize case study, the researchers determined that even with worst-case assumptions, aquatic exposure was low therefore risk to aquatic organisms was also low. The authors determined that the processes described in their paper could serve as a model for future GM crop risk assessments in aquatic ecosystems.