GREENPEACE Briefing

Environmental and health impacts of GMOs: the evidence

Effects on biodiversity

The environmental effects of genetically engineered crops designed to resist insect pests and herbicides are well documented. They are as follows.

Insect-resistant crops kill specific pests known to threaten the crop. In addition to their intended deadly effects, they are also:

- Toxic to 'non-target' organisms, such as butterflies. Long-term exposure to pollen from GM maize that expresses the *Bacillus thuringiensis* (Bt) toxin has been found to cause adverse effects on the behaviour[1] and survival[2] of the monarch butterfly, the best-known of all North American butterflies. Effects on European butterflies are virtually unknown, as few studies have been conducted. Those few do, however, suggest cause for concern that European butterflies would suffer as a result of insect-resistant GM crop being planted[3, 4, 5, 6].

- Toxic to other, beneficial insects. Genetically engineered Bt crops adversely affect[7] insects that are important in the natural control of maize pests, such as green lacewings.[8, 9, 10, 11] In the EU (as elsewhere), environmental risk assessment for Bt crops considers direct acute toxicity alone, and not effects on organisms higher up the food chain. These effects can be important. The toxic effects of Bt crops on lacewings were via the prey that they ate. The 'single-tier' risk assessment approach has been widely criticised, with scientists suggesting that the effects of Bt crops need to be studied at multiple levels of the food web[12, 13, 14, 15].

- A threat to soil ecosystems. Many Bt crops secrete the toxin from the root into the soil[16]. Residues left in the field contain the active Bt toxin[17, 18, 19]. The long-term, cumulative effects of growing Bt maize have not been considered in a European context, even though this is required under EU law (Directive 2001/18)[20].

In addition to the above, risk assessments to date have failed to foresee at least two other impacts of Bt maize:

- Agricultural wastes from Bt maize have been identified entering water courses, where the Bt toxin might be toxic to certain insects[21]. This demonstrates the complexity of interactions in the natural environment and underlines the shortcomings of the risk assessment.

- Bt maize is more susceptible to a plant lice (aphid) than conventional maize, caused by changes in sap chemistry. These changes have not been described in a single application to market Bt maize but have important ecological implications. This demonstrates that plant-insect interactions are too complex to be assessed by the risk assessment.

Herbicide tolerant (HT) crops are associated with:

- Toxic effects of herbicides on ecosystems. Roundup, the herbicide sold by Monsanto in conjunction with its Roundup Ready GM crops, has been shown to be a potential endocrine disrupter, i.e., could interfere with hormones[22]. It is also toxic to frog larvae(tadpoles)[23].

- Increased weed tolerance to herbicide. Evolution of weed resistance to Roundup is now a serious problem in the US and other places where Roundup Ready crops are grown on a large scale[24, 25, 26, 27]. Increasing amounts of herbicide have to be used to control these weeds[28], or else additional herbicides have to be used to supplement Roundup[29].

- Loss of weeds and other biodiversity. A UK government study found there were 24 % fewer butterflies in the margins of GM oil-seed rape (canola) fields, because there were fewer weed flowers (and hence nectar) for them to feed on[30]. In addition, there were fewer seeds for birds from oil-seed rape and sugar beet[31, 32, 33]. HT maize only compared favourably (in terms of impacts on biodiversity) to maize treated with the herbicide atrazine, which is now banned in the EU.

- Reduction in soil bacteria. The use of herbicides on GM soy leads to reduced amounts of beneficial nitrogen-fixing bacteria[34, 35].

GM maize MON810 is intended to prevent the need for three applications of insecticide. Yet this and other Bt maize varieties continuously release a toxin into the environment in quantities 3-5,000 times higher than sprays used for non-GM farming.

Effects on health

Independent studies on the wholesomeness of GM crops for either animals or humans are severely lacking from scientific literature[36, 37, 38, 39].

Sir David King, the UK government's former chief scientist, was forced in December 2007 to admit he had been mistaken to claim that improved crop yields in Africa were due to GM plants. They weren't. The project he described used a sophisticated pest control and crop management technique that involved neither GMOs nor pesticides.

Almost all GMOs commercialised in the world either produce or tolerate pesticides. Yet while pesticides are tested over two-year periods prior to approval in Europe, the longest safety tests for GMOs are 90 days, including pesticide-producing GM plants.

We simply do not know if GM crops are safe for animal or human consumption, because long-term studies have seldom been performed. This is reflected by the ongoing controversy surrounding their safety assessment. The dispute over the pesticide-producing Bt maize MON863, for example, arose from concerns expressed by independent scientists[40] over observed differences in animal feed trials. Rather than admitting uncertainty concerning the food safety of MON863 and carrying out further research, EFSA[41] and the biotechnology[42] industry have used their efforts to try to refute the significance of these findings.

It is ungrounded and misleading to argue that GMOs must be harmless to health on the grounds that people living in the US have been consuming them for 10 years and no visible damage has been observed. There has not been a study on this specific matter.

What is not in doubt is that GM crops have the potential to cause allergenic reactions, more so than conventional breeding[43, 44]. During a long-term field trial in Australia, for example, GM peas were found to cause allergenic reactions in mice[45]. Eating the GM peas also made the mice more sensitive to other food allergies.

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