Environmental Dangers of Insect Resistant Bt Crops

Of the 40 million hectares of genetically engineered (GE) crops grown throughout the world in 1998, 22% (8.8 million hectares) were varieties developed to be resistant to insects[1]. Most such crops are created by inserting a synthetic version of a gene from the naturally occurring soil bacterium, *Bacillus thuringiensis* (*Bt*), so that the plants produce their own *Bt* toxins to destroy pests. Insect resistant *Bt* maize, cotton and potatoes have already been grown extensively on a commercial scale, particularly in the USA, and many other *Bt* crops are under development (e.g. oilseed rape, rice and tomatoes).

However, there is strong evidence to indicate that the rush to commercialise *Bt* crops will have serious environmental consequences.

Impact on non-target beneficial organisms

In its natural form, *Bt* has been used by farmers practising organic and other sustainable growing methods since the 1950s as a spray to kill pests without damaging non-targeted insects or other wildlife. The *Bt* toxins produced by insect resistant crops such as Novartis' GE maize, however, are significantly different and have been shown to be harmful to beneficial predator insects.

Natural *Bt* sprays have no effect on non-target organisms because the bacterial "pro-toxin" is in an inactivated state and only becomes toxic when processed in the gut of certain (targeted) species of insect larvae. In contrast, many insect resistant plants contain an artificial, truncated *Bt* gene and less processing is required to generate the toxin. It is therefore less selective, and may harm non-target insects that do not have the enzymes to process the pro-toxin, as well as the pests for which it is intended.[2]

Research has suggested that transgenic *Bt* plants could also be harmful to non-target organisms that feed on pests exposed to their toxins. Two 1998 Swiss laboratory studies, for example, have demonstrated that the mortality of green lacewing larvae almost doubled after ingesting European corn borers fed on Novartis' GE maize[3,4]. The disturbing conclusion is that *Bt* toxins from GE plants can kill non-target species and be passed higher up the food chain, an effect which has never been observed with the *Bt* toxin in its natural form. A 1999 US laboratory study showed that monarch butterfly larvae are at risk of increased mortality after feeding on the pollen of Bt maize[5].

Furthermore, insect resistant crops produce *Bt* toxins (or toxin-like proteins) throughout their lives and in all parts of the plant. Post-harvest

decomposition of these plants may therefore result in the accumulation of *Bt* toxins in soil at concentrations high enough to constitute a hazard to non-target organisms

such as beneficial insects (e.g. pollinators, parasites, and predators of insect pests) and other animal classes[6]. Recent studies showed that Bt crops may secrete the toxin from the root into the soil.[7]
Novartis' maize for example has shown harmful effects for spingtails. At certain dose levels springtails were killed and/or showed reproductive impairment. Springtails are members of the flightless insect family. They feed on fungi and debris in soil and are generally considered as beneficial insects.[8]

Resistance problems

An additional environmental hazard of insect resistant crops is that targeted pests could develop resistance to the effects of *Bt*. This is because constant exposure to the *Bt* toxin produced by these plants encourages the survival of individual pests which have a genetic immunity to *Bt*. Over time, this could lead to the proliferation of resistant individuals to the extent that *Bt* would no longer be effective against the majority of the targeted pest population.

There is overwhelming scientific data to support this concern[9], and if widespread resistance were to occur, the insect resistant properties of the GE crops would become ineffective. The application of new and even more toxic chemical pesticides would therefore be almost inevitable. Furthermore, increased resistance would pose a serious threat to sustainable and environmentally friendly agricultural methods.

Impact on sustainable farming methods

The use of naturally occurring *Bt* toxins in foliar sprays has provided organic and other environmentally conscious farmers with an invaluable weapon against harmful pests for several decades. *Bt* pesticides kill targeted pests without harming beneficial predator insects[10] and the toxins have no known detrimental effect on mammals or birds.

Because of its effectiveness and safety compared to the pesticides it displaces, *Bt* is probably the single most important insecticide ever discovered. If pests develop resistance to its effects, however, organic farmers will be deprived of a powerful pest control mechanism and other users may switch to more environmentally damaging pesticides. Organic pest control methods could also be jeopardised by the destruction of beneficial predator insects, such as the green lacewing, which are essential to environmentally friendly pest management.

References

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