Problems with genetically-engineered crops in the field

GE (genetically-engineered) crops have repeatedly failed to perform as intended in the field and have given rise to new agronomic problems. Commercialised GE crops depend upon the consistent expression of inserted herbicide resistance and/or toxin genes in order to perform. If these genes do not function as intended, crop losses may result. GE varieties have also demonstrated new susceptibility to pests and diseases, for unknown reasons. Genetically engineering plants to resist insects also has an impact upon pest populations, since troublesome new pests - that require heavy use of insecticides – can emerge as a result.

Bt Cotton susceptible to hotter days

In China, scientists have demonstrated that high temperatures can lead to problems with cotton varieties genetically engineered to produce Bt (Bacillus thuringiensis) toxins. Investigating reports of Bt cotton failing to control bollworms, scientists noted that the problem appeared to correlate to periods of high temperature. They hypothesised that heat may reduce the Bt plants' resistance to insects.

To test the theory, the Yangzhou University-based group grew GE cotton under controlled conditions. At key stages, such as flowering, they exposed the plants to high (37°C) temperatures encountered in China's cotton-growing areas. The plants exposed to heat produced 30-63% less Bt toxin, making them less resistant to the caterpillar pests. Control plants not exposed to the heat did not show the same problem. The experiments were repeated a second year with similar results (Chen et al, 2005).

Scientists are uncertain why the GE cotton varieties react to high temperatures in this fashion, showing once again that the consequences of genetic engineering are not fully understood.

Roundup Ready crops not quite ready

In glyphosate-resistant 'Roundup Ready' crops, there is growing evidence that heat and water stresses cause reduced herbicide resistance (Cerdeira & Duke 2006). When their resistance is reduced, plants are damaged when Roundup is sprayed to control weeds, resulting in crop losses.

Cotton farmers in Texas report that they have experienced this problem and that Monsanto has failed to warn farmers of it. Charging the company with 'a longstanding campaign of deception', 82 Texas farmers have sued Monsanto, alleging deceptive trade practices (Musick v. Monsanto Co. 2006).

According to the Texas farmers' complaint, GE cotton planted in 2004 and 2005 was damaged by glyphosate: "In truth, even [glyphosate] applications applied strictly in compliance with Monsanto's instructions can, and often do, significantly damage the reproductive tissues in the cotton plants. This damage substantially reduces cotton yields from otherwise healthy plants…" (Musick v. Monsanto Co. 2006).

Texas farmers additionally allege that Monsanto knew that the cotton would be damaged by glyphosate, but failed to disclose this fact. "We feel like Monsanto's been lying to us all along," one farmer told Reuters. Another said that glyphosate damage to his Roundup Ready cotton reduced his yield by nearly 40% (Gillam, 2006).

The case is pending in US federal court in Texas.

Unanticipated susceptibility to disease and insects

Chinese and Norwegian scientists have compared the susceptibility of GE and non-GE cotton to infection by the destructive fungus *Fusarium oxysporum*. They found that conventional Chinese soya varieties resisted *F. oxysporum* better than the same varieties when they were genetically engineered (Li, 2009). Similarly, Swiss and UK scientists have found that insect-resistant GE maize varieties are more susceptible to the corn leaf aphid than the conventional parent plants (Faria, 2007).

The genetic mechanisms of these disease and insect susceptibilities are not understood. It is clear, however, that they are related to genetic engineering because in both cases conventional parent varieties of GE plants do not show the same susceptibility as the GE types.

Emergence of secondary pests

All major field crops are threatened by not just one but many pest species. These threats are unevenly distributed; a major pest in one region may be of little concern elsewhere, and vice versa.

GE crops do not incorporate complex transgenic traits that allow plants to respond to changing pest threats and to resist a wide variety of their enemies. For example, Bt cotton, which kills bollworms (*Helicoverpa*), has succumbed to a related genus, armyworms (*Spodoptera*) in Colombia (Lopez Gonzales, 2008).

Thus, even if successful at controlling a target pest species, other pests (called ‘secondary pests’) may then emerge as more prominent threats to the plants, resulting in crop loss and the need to apply additional pesticides.

For example, Bt cotton is designed to resist bollworms and reduce the need for pesticides to control them - but researchers have found that Chinese farmers spray as many pesticides on Bt varieties as conventional ones. What has prompted farmers to do this is the increased prevalence of secondary pests that Bt toxins do not control. The cost of additional spraying made Bt cotton less profitable than its conventional counterpart in five provinces surveyed: “Economic gains experienced by adopters of Bt cotton seed in 1999-2001 evaporated by 2004 largely due to the rapid increase in the pressure from secondary pests.” (Wang, 2008).

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