

The End of the World as we know it: The Environmental Costs of Genetic Engineering

History has shown that the destructive consequences of new technologies may not become apparent for many years. When Du Pont started to produce CFCs in 1931, for instance, they were believed to be totally harmless. It was not until 1975 that their potential to destroy the ozone layer was first recognised and it took a further ten years for this to receive scientific acknowledgement.

In the case of genetic engineering, the products of the technology are living organisms which could never have evolved naturally. They are capable of reproducing, mutating and moving within the environment and have the ability both to affect, and be affected by, their surroundings. Because they are alive, they are inherently unstable, and the consequences of releasing them into the environment cannot be predicted.

One thing is certain, however. Once harmful effects become apparent, it will already be too late. Damage caused by releasing genetically modified organisms (GMOs) into the environment in many cases would be irreversible.

Displacement of native species

At a time when an estimated 50,000 species are already expected to become extinct every year¹, any further interference with the natural

balance of ecosystems could cause havoc.

Since they do not evolve in nature but are designed in the laboratory, GMOs have no natural habitat. Their introduction into the environment could therefore result in the displacement of natural wild species.

The drive towards improving an organism's fitness for survival has given rise to genetically engineered (GE) 'super-crops'. Since these are designed to protect themselves against their main enemies (insects, disease, etc), it is likely that they will proliferate at the expense of other plants, which will be unable to compete. With the disappearance of natural flora, the wildlife that depends on them could also be threatened.

The same applies to 'super-animals'. Fish which have been genetically engineered to tolerate cold could escape from fish farms to wreak havoc in the habitats of native fish where they may live longer and use up vital food.

Whenever a newly introduced gene enhances the mating success of a GE fish while at the same time decreasing the viability of its offspring, a few GE



fish could ultimately cause the extinction of healthy, wild populations. This has recently been verified by researchers at the Purdue University in the USA who discovered that even a small number of growth-enhanced GE fish could eradicate a large population of wild fish².

Such issues cannot be dismissed as alarmist speculation as past experiences have taught us that introducing non-native species into new habitats can have catastrophic consequences.

Genetic pollution

Environmental damage caused by GMOs cannot even be confined to the original habitat in which they are first introduced.

The commercial growing of GE crops, for instance, carries a very real threat of the transfer of the 'foreign' gene(s) into wild native flora. Where the crop has been genetically engineered to tolerate the application of herbicides, the herbicide resistance property could be transferred to related wild species. This could result in the emergence of 'super-weeds', which would be difficult to eradicate and would therefore cause serious problems for farmers.

The likelihood of genetic pollution is particularly strong in the case of herbicide resistant oilseed rape, which is well known for its ability to cross-pollinate with wild relatives, which are widespread throughout Europe. The possibility that foreign genes from the oilseed rape may enter the native gene pool through the creation of hybrids is therefore inescapable.

Although AgrEvo, one of the developers of herbicide resistant oilseed rape, claims that the risk of cross-pollination would be minimal, recent research has suggested otherwise. Studies have demonstrated, for instance, that spontaneous hybridisations can in fact

occur between the crop and its wild relatives such as wild radish³ and hoary mustard^{3,4}. Furthermore, it has been shown that pollen from the oilseed rape can travel distances of up to two kilometres⁵. This is considerably further than had previously been estimated from small scale field trials⁶.

An additional consequence of genetic pollution is the potential for gene transfer to organic or conventional crops to occur. This could seriously affect the livelihood of farmers wishing to supply the non-GE market and could further undermine the efforts of food producers to source GE-free ingredients.

Increased herbicide use

The self-styled 'life science' companies who are developing GE plants and animals have been particularly keen to create crops which are resistant to certain types of herbicide. This, they allege, will be beneficial to farmers, who will be able to spray the crop with the herbicide to destroy weeds without harming the crop itself.

AgrEvo and its subsidiary, Plant Genetic Systems, have, for instance, developed varieties of oilseed rape which are resistant to the herbicide, glufosinate. They claim that, because glufosinate is a broad spectrum herbicide, no other weed killers will need to be used. This, they argue, will reduce the overall usage of herbicides and therefore benefit the environment.

However, there is little evidence to support this claim. Even though only one type of herbicide will need to be used, its high toxicity to plants could cause as much, if not more, environmental damage than the combined use of a range of specifically targeted weed killers. Farmers can now broadcast or aerially spray the

chemical, which will kill virtually any plant life it touches. Many harmless plant species would be destroyed unnecessarily. This would lead to a further decrease in wild plant diversity with damaging consequences for insects, birds and mammals dependent on these plants.

Many critics have also expressed concern that herbicide resistant crops could actually *increase* the overall use of herbicides. Firstly, farmers may be less restrained in applying the herbicide because they know that the crop will not be damaged.

Secondly, ever more powerful herbicides may be required to control the emergence of herbicide resistant weeds. These would not only occur through the genetic pollution of wild, native flora. In crop rotations, it is common for seed from one crop to survive and emerge amongst different crops in the following year or years. These 'volunteer' weeds, as they are known, are already a major problem in the UK, where it has been estimated that over 750,000 hectares of cereal rotations are infested with oilseed rape volunteers. If these volunteers were to become herbicide resistant, the problem would be greatly exacerbated. Such consequences can already be observed in Canada.

Most herbicide resistant crops are being developed by the same agrochemical companies which also manufacture the herbicide itself. These companies are obviously motivated to sell more of their products, and not to reduce their use. AgrEvo (now part of Aventis, the merger between Hoechst and Rhone Poulenc) for instance produces glufosinate, and thus has a vested interest in developing GE crops which are resistant to it. In fact, AgrEvo have increased production facilities for glufosinate in the USA and Germany and expect sales to increase by \$560

million in the next five to seven years⁷. Indeed, AgrEvo's introduction of glufosinate resistant crops to increase sales of its herbicide products is considered to be its underlying aim in entering the GE market in the first place⁸.

Damaging effects of insect resistant crops

Another major class of GE crops consists of varieties designed to be resistant to insects. These have been genetically engineered to produce their own insecticides to destroy pests. However, there is strong evidence to indicate that this will have serious environmental consequences.

One example of a GE insect resistant crop is the maize variety developed by Novartis to protect itself against the European corn borer. This has been achieved 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.

In its natural form, *Bt* has been used for many years by organic and conventional farmers as a spray to kill pests without damaging non-targeted insects or other wildlife. The *Bt* toxins produced by the Novartis maize, however, are significantly different and have been shown to be harmful to beneficial predator insects. A 1998 Swiss laboratory study, for example, demonstrated that the mortality of green lacewing larvae almost doubled after ingesting pests fed on the GE maize⁹. And a 1999 US laboratory study showed that monarch butterfly larvae are at risk of increased mortality from feeding off the pollen of the *Bt* maize¹⁰.

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.

An additional environmental hazard of insect resistant crops is that constant exposure to the *Bt* toxin produced by these plants could result in the pests themselves developing a resistance to its effects. There is overwhelming scientific data to support this concern¹¹. A serious threat to sustainable and environmentally friendly agricultural methods would be posed if an insecticide which occurred naturally was rendered ineffective. The loss of *Bt* could cripple much organic farming. Organic farmers have used *Bt* in its traditional, environmentally friendly form for decades.

Inadequate safety regulations

Despite the rising tide of research warning of the risks associated with releasing GMOs into the environment, regulatory authorities continue to approve the commercial cultivation of GE crops. In 1999 alone, this resulted in 40 million hectares of GE crops being planted throughout the world. Of these, 71% were herbicide resistant and 22% were insect resistant¹².

In most cases, regulatory authorities have based their decisions on evidence provided solely by the companies which have developed the crops. Most trials are therefore designed to assess agronomic characteristics (e.g. yield) rather than ecological impacts.

Field trials which are conducted to assess environmental safety are grossly inadequate. For instance:

- Such trials are usually short term and small scale. They rarely last for more than one growing season, whereas it could take years for

most ecological effects to become apparent.

- Test sites do not accurately reproduce the real conditions the crops will meet once grown in the environment.
- Studies are currently conducted on a case-by-case basis neglecting the potential for cumulative impacts (e.g. as ever increasing numbers of herbicide resistant crops are grown).
- Secondary effects on biodiversity as a result of the effects of GMOs on agricultural practice, and vice versa, are not considered. For example, any increase in the use of broad spectrum herbicides could significantly reduce important sources of food for insects, birds and mammals, thereby threatening their ability to survive.
- Effects on other farming systems are not considered (e.g. the problems of cross-pollination of organic and conventional crops).

Conclusion

No-one - including genetic scientists themselves - can predict the consequences of releasing GMOs into the environment. Even so, the advocates of genetic engineering, in common with their counterparts in the nuclear power industry of some decades ago, are undeterred by the risks.

Such complacency is an attitude shared by many regulatory authorities, which continue to approve GE crops for commercial growing on an enormous scale throughout the world. Yet GMOs, with their completely new and unnatural combinations of genes, have a unique power to disrupt our environment and cause irreversible damage. The more they are released into the environment,

the more the integrity of nature will be violated.

References

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