Genetically Modified Organisms and the Environment

Introduction

Unlike the other subjects in this journal, this consideration of Genetically Modified Organisms (GMOs) and the environment does not come under the remit of personal injury liability. Although there are public concerns over the health implications of genetically modified foods and gene therapies, this report addresses the potential liabilities of the agricultural use of GMOs with regard to the environment.

Genetic modification is an application of biotechnology involving the manipulation of DNA and the transfer of gene components between species in order to encourage replication of desired traits. It offers the potential to improve crop management by introducing desired traits such as herbicide resistance or insect resistance to the plants. The potential applications for genetic engineering in agriculture are wide-ranging, e.g. extended crop-growing conditions or increased nutritional content of food.

However, there are a number of concerns with GM technology. GM technology can bring together new gene combinations that are not found in nature. The implications of these new gene combinations, how they are expressed, how this translates into organism behaviour, and any possible indirect effects of organism behaviour are all extremely difficult to predict. Potential hazards include:

- Changes in the fitness of the GMO (e.g. increase in weediness)
- Transfer of genetic material from the GMO into other plants or organisms (e.g. transfer of herbicide resistance)
- Pollution (e.g. escape of GMO-related proteins)
- Implications for biodiversity (e.g. increased competition for habitats)

Potential for harm: Hazards

Changes in the behaviour of the GMO

Do GM plants have any fitness advantages over non-GM plants in the wild? The experimental data available to date suggests that in the case of transgenic herbicide tolerance an increased weediness is highly unlikely in the absence of selective conditions. However there have been many calls for longer duration studies, i.e. longer than 3 years.

Transfer of genetic material from the GMO into other plants or organisms

One of the key concerns with GMOs is the escape of genetic material from the GMO into other organisms in the environment. Gene flow between crops on different farms could result in reduced yields or reduction in weed control. Gene flow from GMOs into other organisms could have any number of effects, e.g. confer sterility or a competitive advantage.

Gene flow may occur in two ways:

- Vertical gene transfer (sexual, between the same or closely related species) using vectors such as pollen dispersal. Vertical gene transfer does present a quantifiable probability, however there is little consistency in scientific studies.
- Horizontal gene transfer (non-sexual, between unrelated species), e.g. by GM viral infection. Horizontal gene transfer remains more a theoretical hazard than one that has been demonstrated in the field. However little work has been done on this subject to date, a situation which may well change.

Pollution

Pollution may occur as a result of the escape of proteins or other substances produced by the GMO.

- Insect control toxins in crops may bio-accumulate in non-target species.

Implications for biodiversity

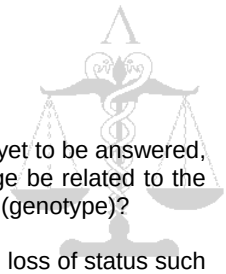
Biodiversity (species, habitats and gene pools) is affected by a combination of pressures derived from many areas, e.g. agriculture, urbanisation, industry, recreation and climate. These result in a dynamic equilibrium that is inherently unstable.

In particular, the changes required to manage GMOs may have an effect on this balance.

- Changes in weed control practices (increase or decrease in herbicide usage) may alter the ecological balance or promote soil erosion.

- Some methods used to introduce genes in GMOs may be more susceptible to subsequent horizontal gene transfer.
- Agricultural management practices have been altered throughout history e.g. hedgerow removal and increased use of persistent mono-cultures. GMO usage may accentuate these changes.

Many of these hazards remain theoretical. However, proof of gene transfer in the field may well provide strong evidence against many of the usual liability defenses, such as uncertainty of origin of contaminant, uncertainty of the bio activity of contaminant and so on.



Identification of harm: Quantification

Direct damage to crops

The question of what constitutes damage to crops in terms of its genetic identity has yet to be answered, e.g. can GM-contaminated crops be considered as damaged *per se*? Would damage be related to the appearance/functioning of the plant (phenotype) or to the genetic identity of the plant (genotype)?

Some more tangible losses may occur as a result of perceived damage to crops, e.g. loss of status such as the Soil Association mark or organic status.

Biodiversity

Biodiversity, as mentioned above, is a dynamic process. Change will be happening, to a greater or lesser degree, on a constant basis. Separating what change would be due to 'natural' processes and what change would be due to the influence of GMOs would be a difficult task.

Moreover, there is no agreed measure for biodiversity. Without such a measure, it is hard to see how the relative seriousness of different kinds of environmental change could be assessed. For example, it is thought that fewer than 1% of species of microorganisms in the soil have been properly classified let alone their populations measured.

In the DETR Circular 02/2000 (Environmental Protection Act 1990: Part IIA - Contaminated land) a 20% diminution or loss in yield or value was defined as significant harm. However this still requires a value to be placed on the object being harmed.

English Nature, the government's statutory advisory body on the environment, advocates the precautionary principle. Therefore it is possible that harm could be defined as any change in biodiversity. Questions that would be raised over such an approach include:

- What is change? Alterations at a genetic level, loss of a species, loss of a habitat?
- Is there an acceptable level of change?
- What level of change is natural?
- What degree of biodiversity change (increase/decrease) would be defined as harm?
- Would the change be defined in absolute or relative numbers, i.e. for sites with different amounts of biodiversity?

Foreseeability

GMO behaviour

It is clear that all agricultural activities have some level of environmental impact. Therefore, it is reasonable that any assessment of harm by a GM crop must take into account the level of harm currently associated with the crop it may replace. The risk assessment process currently required by regulations is based on the relative risk compared to the non-GM version of the crop.

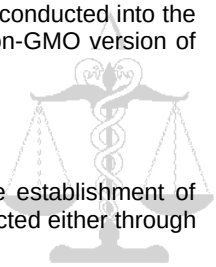
Concerns have been raised at the standards set for the risk assessment of GMOs. Criticisms of the current regulatory regime include:

- It can selectively identify hazards to be considered and therefore might not be considered comprehensive.
- The extent of the issues considered relevant is not clarified.
- Currently, applications are considered on a case-by-case basis. This may not be sufficient to assess the combined impact of several GM crops on the environment properly.
- No regulatory body is charged with monitoring for impacts.
- Long term and indirect environmental effects need to be sufficiently considered and regulated at both national and international level.

Current applications for release are based on relatively simple genetic modifications. Future applications may involve more complicated genetic modifications and so the potential effects may be more difficult to predict.

Gene flow

It must be emphasised that genetic crossing can occur naturally. Research has been conducted into the question of whether GMOs would have a smaller or larger out-crossing rate than non-GMO version of the same species. However, no significant results have been forthcoming.



Surveillance

The traceability of gene product or gene fragments would be very important in the establishment of causation. In principle, the presence of modified DNA or gene products might be detected either through the use of nucleic acid probes or the direct assay of gene products, i.e. proteins.

A key point in testing for GM content is prior knowledge of either the protein expressed or the precise DNA sequence of at least part of the DNA construct. With commercial DNA constructs, unless they are patented, this is likely to become increasingly difficult.

The limit of detection for DNA or proteins varies according to the degree of processing the sample has undergone, as DNA or proteins tend to either have been degraded or be absent.

It is technically possible to test these variables (gene flow, effect on bio-diversity, harm from new proteins, changes in fitness) in controlled trials, but this is not always performed.

Environmental liabilities: Duty of care

Common Law

There are a number of common law torts that could protect interests in land use and the environment. The application of these torts to GMO contamination of private land appears possible, however the law is complex and uncertain. The situation is even more unclear when the damage to the environment at large is considered, the torts historically being applied just to land use. In the absence of any case law, it is hard to judge how the courts will treat claims under tort for environmental damage.

UK Environmental Law

Current UK statutes that could be applicable to the release and use of GMOs, and to any resultant contamination, are generally aimed at preventing damage, encouraging clean-up of contamination or remedying nuisance. They provide no civil liability in respect of compensation for any damage.

In the UK the release of GM plants into the environment is subject to regulatory regimes with the aim that products and releases are carefully assessed before approval is given (outlined under the Foreseeability heading).

EU Environmental Law

Possibly the most significant environmental legislation-in-waiting is the EU White Paper on Environmental Liability. This aims to implement the "polluter pays" principle and the precautionary principle. It expressly covers biotechnology. Although the white paper can be regarded as a step forward, there are many problems.

- The concepts appear to cover damage to plants, animals, water and land which are either not the objects of property rights or are owned by the person causing the damage. Can satisfactory definitions be worked out?
- The tests of proximity and foreseeability will come under scrutiny when considering the wider implications of GM plants on biodiversity and farming practices.
- The EU has hinted that under the proposed environmental liability regime granting of a license would relieve the licensee of any liability if the GMO proves to be hazardous, placing the liability on the regulator instead. This approach is not consistent with UK legislation, and appears distant to the 'polluter pays' principle.
- Proposals include the partial reversal of the burden of proof. If so, claims may prove especially difficult to defend unless a defence of due diligence is accepted.

Taking into account these problems and the variation in legal regimes across in the EU, it is at present, hard to see that the legislation would make rapid progress into the statute books.

Remediation

Without any agreed quantification for biodiversity, it would obviously be difficult to assign a value for any environmental damage. If compensation amounted to a total, permanent reinstatement of biodiversity, the costs could be very high. Would all species need to be replaced? How long would the remediated state need to be maintained? How long would liability for biodiversity changes on a remediated site remain?