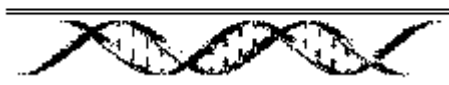


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This briefing is based on a more detailed GeneWatch report. Available from GeneWatch, price £3.00.

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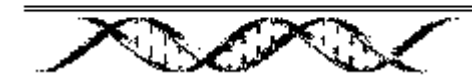
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GENETICALLY ENGINEERED OILSEED RAPE: Agricultural Saviour or New Form of Pollution?

GeneWatch



Briefing Number 2
May 1998

This briefing examines the proposed commercial cultivation of genetically engineered oilseed rape and includes:

- an assessment of potential risks for the environment, human health and agriculture
- an appraisal of the regulatory authorities' reactions
- proposals for improvements

Genetically engineered (GE) oilseed rape could be growing in British fields from 1999 and would be the first genetically engineered crop to be grown here on a commercial scale. This would signal a new industrialisation of British agriculture and could have enormous significance for the environment and consumer choice. Within current regulations, oil from the rape will be mixed with oil from conventionally grown plants and find its way into a whole range of foods from salad oils and dressings to margarines and biscuits. None of these products would be labelled as being produced from a GE crop¹.

The GE oilseed rape varieties currently in their final stages of regulatory approval in Europe are produced by AgrEvo and its subsidiary, Plant Genetic Systems (PGS). The strains have been genetically engineered to be resistant to the herbicide *glufosinate* and both contain an antibiotic resistance gene for *neomycin* and *kanamycin*². The producers claim that yields will increase, inputs of chemical herbicides will decrease and farmers will be able to produce cheaper food. They promise the crops will be harmless to the environment and safe to eat, supporting their claim by pointing to their compliance with existing regulations.

However, and in complete contrast, environmentalists and supporters of organic agriculture say that the commercial production of GE oilseed rape will mean *increased* dependence on chemical herbicides. In this

analysis, far from being harmless, GE crops could pose long term risks to human health, genetic pollution of native flora would inevitably occur - carrying significant risks to the environment - and farmers would be buying into the problem of herbicide resistant weeds.

Environmental Risks

Genetic Pollution

The commercial growing of GE crops carries a very real threat of the transfer of the foreign gene(s) into wild native flora. This could lead to the emergence of new species of weeds which would be difficult to eradicate and which would disrupt ecosystems by displacing the existing flora.

Genetic pollution would be inevitable with oilseed rape (*Brassica napus*) which is well known for its ability to cross-pollinate. Since feral or 'escaped' populations of oilseed rape are widespread throughout the UK, especially on disturbed and waste land, and wild related species of the brassica family are found near to existing rape fields, the potential for the foreign genes to enter the native gene pool through the creation of hybrids is inescapable. Such hybridisations have already been demonstrated in field experiments with the wild radish³, wild turnip⁴, hoary mustard⁵, and mustard greens⁶.

The extent of the genetic pollution cannot be

predicted although its effects would be far-reaching and irreversible. Pollen from oilseed rape can travel distances of up to two kilometres and since the crop is now grown on such a large scale in Britain (around 400,000 hectares annually), even rare hybridisation events will arise.

The extent of the genetic pollution cannot be predicted although its effects would be far-reaching and irreversible.

Herbicide Use

The AgrEvo and PGS varieties of GE oilseed rape are resistant to the herbicide *glufosinate*, which is itself manufactured by AgrEvo (trade names: *Liberty*, *Challenge*, *Harvest*). Both companies claim that the introduction of such products will provide benefits by reducing the environmental impacts of herbicides⁷. However, any reduction in herbicide use would be directly attributable to *glufosinate*'s potency. Hence, whilst it may be true that fewer litres will be required, the toxic effect will be the same or even greater.

Any reduced usage claim seems even less convincing when AgrEvo have increased production facilities for *glufosinate* in the US and Germany and expect sales to increase by \$560 million in the next five to seven years⁸. Indeed, the introduction of *glufosinate* resistant crops to increase sales of its herbicide products is considered to be AgrEvo's underlying aim in entering the GE market in the first place⁹.

AgrEvo and PGS also claim that *glufosinate* products will have a net environmental benefit because of the displacement of other more harmful chemicals, although this is an equally debatable claim. *Glufosinate* is a broad spectrum herbicide and consequently has a wider impact than other more specific herbicides. By displacing these, it may therefore have negative effects on plant diversity in the crop and in the field margins by destroying species unnecessarily. Furthermore, because *glufosinate* is highly soluble in water and can be leached from soil, contamination of groundwater may occur. This is of particular concern as *glufosinate* is toxic to aquatic life.

The cultivation of herbicide resistant oilseed rape in partnership with *glufosinate* will alter patterns of use of the herbicide and increase its overall usage with serious environmental consequences for already declining arable flowers and farmland seed eating birds¹⁰.

Glufosinate resistant oilseed rape will increase the overall usage of the herbicide.

Human Health Risks

Herbicide Exposure

Glufosinate is not only toxic to plants and aquatic life, but can also affect humans. Neurological symptoms of *glufosinate* poisoning in humans include convulsions and short-term memory loss¹¹ and recent studies have shown that it can cause deformities in rat and mouse embryo cultures¹².

If the use of *glufosinate* increases as a result of the cultivation of GE oilseed rape, the health of consumers could be put at risk through residues in foods and water.

the proposed introduction of GE oilseed rape

Human Health

MAFF's Advisory Committee on Novel Foods and Processes considered PGS's and AgrEvo's oilseed rapes and the safety of oil extracted from them in 1994 and 1995²⁶. The conclusion of the Committee was that the composition of oil from the PGS oilseed rape was the same as oil from traditional varieties and there were no unintentional changes in the plant. Issues such as the transfer of the antibiotic resistance genes from the oilseed rape to human gut bacteria and problems of allergenicity were not thought to be relevant as no proteins would be present in the oil after processing.

Conclusions

Glufosinate resistant oilseed rape is the first of many herbicide resistant crops that chemical companies are developing. There are some serious shortcomings in the present regulatory system which the assessment of GE oilseed rape illustrates. 'Taken-for-granted' assumptions about the desirability of, and justification for, genetic engineering appear to have led to conclusions which may not be valid in the light of new evidence. Lack of proactive policies or strategies on the part of regulatory authorities mean that the introduction of GE crops is being driven solely by commercial interests with little regard for public concerns. The ethical dilemmas, inherent unpredictability of the technology and justification for potential risks appear to have been neglected in the rush to commercialise.

Steps need to be taken both to reconsider the specific case of GE oilseed rape and to examine the wider issues involved:

- In the light of new scientific findings about its environmental risks, the Government should withdraw the consent to market GE oilseed rape and undertake a re-evaluation of the environmental safety aspects.
- The licensing of herbicides for use on herbicide resistant crops should only be considered when basic research has been completed and a coherent policy is in place.
- All new applications to commercialise GE crops should be subject to:
 - * an evaluation of the public benefit
 - * an evaluation of the risks from each class of crop (e.g. herbicide, insect and viral disease resistance)
 - * mandatory segregation and monitoring throughout the food chain
 - * a system of compulsory liability for any damage to the environment or human health resulting from the commercialising of a GE crop

Safety regulations in themselves can only hope to minimise dangers which can be predicted. They cannot prevent unwelcome surprises. The UK Government should therefore follow the example of the French Government and announce a moratorium on the commercial exploitation of GEOs until a full public consultation has taken place and has considered the conditions under which the public would be willing to sanction the risks of GE crops.

There are serious shortcomings in the present regulatory system which the assessment of GE oilseed rape illustrates.

The Government should announce a moratorium on the commercial exploitation of genetically engineered organisms.

invasiveness) would be low:

*“In general, any sampling effort of < 3years (regardless of the number of sites) provided a very poor estimate of [oilseed rape] rate of increase. If this example portends a general trend, then experimental assessments of GEO risks will require several years of data, with shortcuts to speed up the process coming at high cost in terms of predictive power.”*²³ (emphasis in original)

Studies rarely meet these requirements. The experiments conducted by PGS for their application to market their GE oilseed rape were only of one to two years duration.

Evidence is also now emerging that oilseed rape *can* form established populations and are not simply transitory. All of this new information has led one ex-member of ACRE, Mark Williamson, to conclude that:

*“Despite these demonstrations that much of the biology of B. napus has been misdescribed, the earlier risk assessments have not been revisited and revised.”*²⁴ (emphasis added)

The environmental risks will also be affected by the use of the herbicide. In the presence of *glufosinate*, hybrid plants and volunteers containing the resistance gene will have a huge competitive advantage. However, the crucial issue of how *glufosinate* should be used together with resistant oilseed rape is not part of ACRE's remit.

Herbicide Safety

Whilst ACRE's remit is to consider the plant's potential risks to the environment, its impact on herbicide use is assessed by an entirely separate body, the Pesticide Safety Directorate (PSD). An agency of The Ministry of Agriculture, Fisheries and Food (MAFF), the PSD's view is that there is no special requirement to treat the use of herbicides on GE crops any differently than any other application²⁰.

Such a situation highlights a major regulatory problem that there is no single system to assess both the risks posed by the GE oilseed rape itself *and* the implications for herbicide usage even though they are inextricably intertwined. MAFF has so far considered it unnecessary to adopt an overall policy position or strategy regarding herbicide resistant crops, their environmental, human and agricultural risks. It intends to rely on voluntary codes of practice to control weed problems. However, the National Farmers Union believes restrictions on growing areas by zoning or other means will be unpopular with farmers and difficult to police²⁵. To compound the problem still further, Monsanto are developing *glyphosate* resistant oilseed rape varieties. If these are grown in the same areas as *glufosinate* resistant plants, cross fertilisation, seed spillage and outcrossing mean, at worst, that weeds with multiple resistances could develop or, at best, that a complex mixture of volunteers resistant to various herbicides would emerge in subsequent crops.

Furthermore, MAFF and Department of the Environment research on the potential implications for herbicide usage will not be completed until the year 2000 - *after*

Higher application frequencies could also have serious consequences for farm workers through increased exposure. Recent experiences with organophosphates - in sheep dip, flea sprays, etc. - indicate that we should avoid even low level exposure to chemicals which affect the nervous system.

Antibiotic Resistance

The AgrEvo and PGS oilseed rape varieties both contain an antibiotic resistance gene for *neomycin* and *kanamycin*, used as a marker in the early stages of the genetic engineering of the plant. This gene could potentially be transferred to bacteria in the human gut, which may lead to increased antibiotic resistance in pathogenic bacteria and therefore weaken or nullify the effectiveness of antibiotics.

Kanamycin and *neomycin* are not important clinically, except in cases of drug resistant tuberculosis, and because oilseed rape is processed, most of the DNA should be degraded and thus the risks would be minimised. However, because the resistance gene is a by-product of the genetic engineering technique and serves no function in the oilseed rape, the GE plant could have been produced without it. Given the serious problems that exist with antibiotic resistance, it is not clear why any risk of this nature, however small, should be tolerated. Indeed, the presence of an antibiotic resistance gene in a Novartis GE maize led the UK's Advisory Committee on Novel Foods and Processes to recommend that marketing approval be denied¹³. The gene was included purely to simplify seed production and was described by a Ministry of Agriculture official as “sloppy genetic engineering”¹⁴.

Food Allergies

The incidence of food allergies is increasing and this is thought to be associated, at least in part, with the growth in production and consumption of processed foods. There are certainly dangers if genes from well known allergenic species such as nuts are introduced although, in such cases, testing is reasonably straightforward as it is possible to conduct tests using human volunteers who are known to be allergenic. This has already proved to be the case when a brazil nut protein gene was transferred into soybean to improve its methionine content and development of the crop had to be halted¹⁵.

With other GE crops, however, the presence of novel proteins has raised safety concerns about the potential to cause *novel* allergies. Testing for new allergens is extremely difficult and never foolproof. Although very few novel proteins are likely to reach the human food chain from GE oilseed rape because only trace amounts (if any) remain in oil which is used for human consumption, there is still an element of risk which many will be unwilling to accept. A large food producer has told GeneWatch that they avoid peanut oil in their products because of the *remote* possibility that trace amounts of peanut proteins could find their way into products and trigger dangerous and possibly life threatening allergic reactions in susceptible individuals.

Higher herbicide application frequencies could have serious consequences for farm workers through increased exposure.

Testing for new allergens is extremely difficult and never foolproof.

Agricultural Risks

Public Rejection

Research studies have shown that the public are not only concerned about the effects of genetic engineering on human health and the environment, but that many have severe reservations over the ethics of the technology itself¹⁶. Since it is not intended to segregate the GE rape or to label food products made from it, consumers may therefore reject goods which cannot be guaranteed to be GE free. Food producers and retailers would consequently be forced into looking for sources of conventionally grown oilseed rape. Supply could become difficult, however, if crops of traditional oilseed rape are pollinated by GE crops in nearby fields. This danger has recently been highlighted by the case of a leading organic vegetable grower who may lose his right to advertise his produce as 'organic' if another company's plan to plant GE maize in adjacent fields is carried out¹⁷.

New Weed Problems

In addition to consumer rejection, farmers could also be faced with infestations by herbicide resistant weeds through the introduction of GE oilseed rape. 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.

The growing of herbicide resistant oilseed rape would clearly exacerbate this situation by creating volunteer weeds which would be extremely difficult to eradicate:

*"Herbicide-tolerant rape will undoubtedly become part of established volunteer weed populations that occur in many cereal rotations..."*¹⁸

Such infestations are also likely to occur even where farmers do not grow the GE rape themselves. A field of GE oilseed rape may pollinate plants in neighbouring fields so that the seed they produce is herbicide resistant. Research in Germany has shown that the *glufosinate* resistance gene can be transferred to crops in fields 200 metres away¹⁹ and contractors working for a variety of clients may disperse the seeds even further.

Evaluating Safety

Evaluating the safety of products developed with new technologies is inevitably a difficult process and therefore often inadequate. GE crops are no exception:

- there is little experience to draw on and all of the environmental data so far have been derived from small scale field trials
- extrapolating to the wider environment inevitably brings considerable scientific uncertainty given varying climatic and agricultural practices
- most trials are designed to look at agronomic characteristics (e.g. yield) rather than ecological impacts

- 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)
- with regard to human health, testing has to date relied on laboratory studies with laboratory species

Environmental Safety

In the UK, the environmental risks of GE crops are assessed by the Government's Advisory Committee on Releases to the Environment (ACRE), which advises the Secretary of State for the Environment on whether a release should be allowed. Despite a minority of the Committee taking a more cautious view, the majority position on *glufosinate* resistant oilseed rape was that:

"It was thought extremely unlikely that the modified rape could cause interference with ecosystems outside the agricultural environment since rape is not known to invade natural habitats, and the herbicide resistance gene would not alter its ability to invade. The likelihood of any hybrids of herbicide resistant rape and wild relatives surviving and establishing was deemed to be very low, and therefore such hybrids would not pose a risk either to ecosystems or to man's property."

However, if problems did occur - such as the emergence of herbicide resistant volunteer weeds - ACRE concluded that:

*".. suitable alternative herbicides, for example glyphosate, and other management strategies are available for effective control if necessary."*²⁰

Scientific advisers will inevitably have to bring their own opinions to bear on whether risks are justified and in the public interest. Nevertheless, despite mounting concerns about environmental risks and the need for objectivity, such assessments on the part of regulatory bodies tend to involve an implicit, 'taken-for-granted' assumption that GE crops represent positive progress²¹.

This, in part, has led to a number of major uncertainties and assumptions in ACRE's analysis of the risks attached to GE crops. Most notable of these are:

- that gene flow to wild species will be minimal
- that gene flow is unimportant
- that transgenic oilseed rape will not be invasive
- that the risks of herbicide use and the growing of herbicide resistant crops can be safely regarded as separate issues

Before the advent of GE crops, there was little scientific interest in the movement of genes into native species and little hard data on which to base assessments. Since ACRE assessed the PGS oilseed rape in 1994, however, important new evidence has emerged. Field trials have, for instance, produced vigorous, fertile hybrids between oilseed rape and hoary mustard, wild radish and wild turnip²².

Other research published since 1994 has also thrown doubt on the adequacy of data used to support the assumption that the ecological impacts (such as

Consumers may reject goods which cannot be guaranteed to be GE free.

The glufosinate resistance gene can be transferred to crops 200 metres away.

New evidence throws doubt on the assumption that ecological impacts would be low.