Attitudes and Policies on Herbicide Tolerance in the U.K.

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Introduction

There is considerable discussion in the UK on the potential impact of herbicide tolerance introduced into crop plants through genetic modification. The concept of selective tolerance of a crop to a particular herbicide is well understood and is the basis of most farmers weed control strategies. However the potential of introduced specific crop resistance to broad spectrum herbicides such as glyphosate and glufosinate ammonium raises a number of issues.

In parallel with consideration of the impact on weed control strategies there has been discussion of the risk of transfer of herbicide tolerance to weeds and the build up of tolerant volunteers in subsequent crops. With regard to the former it is worth bearing in mind that weed tolerance to herbicides is not a new issue. Tolerance can and does arise naturally through the selective pressure of repeated applications and so the risk of tolerance through introduced genetic modifications must be considered as an additive factor in an existing situation and not in isolation.

The UK Advisory Committee on Release to the Environment (ACRE) of genetically modified organisms has recently considered these issues. The following extracts from the ACRE discussion paper gives an overview of the attitudes and developing policies in the UK. The paper covers all the crops and herbicides which are subject to release consents in the EC for research purposes on a small controlled scale and those for which wide scale marketing applications have been made to the EC. The full paper is included in the ACRE Annual Report (1) which is available from the Department of the Environment (DoE), London.

Extracts from ACRE paper on Genetically Modified Herbicide Tolerant Crops

Between February 1993 and March 1997, 55 consents were granted in the UK for the experimental release of crops genetically modified for tolerance to herbicides. These releases consist of small scale experimental field trials with risk management procedures such as border rows, isolation distances and post-trial monitoring in place for the purposes of confinement. Similar releases have also been carried out in other European Member States. The types of crops with herbicide tolerance traits granted consent for experimental releases in the UK and the European Community (EC) are summarised in the table below:

TABLE 1: GM herbicide tolerant crops released in EC for trials

GM Crop	Herbicide Tolerance Trait	Purpose
Oilseed rape	Ioxynil & Bromoxynil Glufosinate ammonium Glyphosate	Selectable marker and for herbicide application
Swede	Glyphosate	Herbicide application
Potato	Asulam	Selectable marker only
Sugar beet	Glufosinate ammonium Glyphosate	Selectable marker and for herbicide application
Maize	Glufosinate ammonium Glyphosate	Herbicide application Selectable marker only
Wheat	Glufosinate ammonium	Selectable marker and for herbicide application
Chicory	Glufosinate ammonium	Selectable marker only
Eucalyptus	Glyphosate	For herbicide application
Tobacco*	Isoxazole herbicides	For herbicide application
Soya beans*	Glyphosate	Herbicide application
Carnations*	Sulfonylurea herbicides	Selectable marker only
Sunflowers*	Glufosinate ammonium	Selectable marker and for herbicide application?
Cauliflower*	Glufosinate ammonium	Selectable marker only
Broccoli*	Glufosinate ammonium	Selectable marker only

* Releases not carried out in the UK

Over the same period and in addition to the experimental releases, we have considered 10 applications for consent to market GM crops with herbicide tolerance in the European Community. These are summarised below:

TABLE 2: Marketing applications on GM herbicide tolerant crops in the EC

GM Crop	Herbicide Tolerance Trait	Applicants (and purpose)
Oilseed rape	Glufosinate ammonium	PGS*# (as selectable marker) AgrEvo* (for herbicide application) PGS (as selectable marker)
Maize	Glyphosate	Pioneer (as selectable marker)
Maize	Glufosinate ammonium	AgrEvo (for herbicide application) Ciba Geigy# (as selectable marker) Novartis* (for herbicide application)
Soya beans	Glyphosate	Monsanto*# (for import and processing only)
[redacted]		

Consideration of Risks and Controls of GM Herbicide Tolerant Crops

The Genetically Modified Organisms (Deliberate Release) Regulations 1992 and 1995 implement Directive 90/220/EEC to control the release and marketing of GMOs, including GM crops, for which DOE has lead responsibility. Issues relating to the safety of GM herbicide tolerant crops are focused by this legislation. ACRE's remit is restricted to the consideration of the safety of GM crops *per se* in the environment, and does not extend to consider the wider issues such as the environmental risks of herbicide use of GM crops. In reviewing previous applications for consent, both for experimental releases and marketing, we have considered the following specific concerns relating to the GM herbicide tolerant crop *per se*:

i. that herbicide tolerance could confer a competitive advantage to the GM crop that may increase potential weediness in agricultural environments as a volunteer, and invasiveness in semi-natural habitats as feral populations;

ii. that the insertion of a herbicide tolerance gene could result in pleiotropic effects in the genome which results in a phenotype with more vigorous growth and reproduction, resulting in increased weediness or invasiveness;

iii. that herbicide tolerance in the crop could compromise the use of the herbicide it is tolerant to if the active ingredient is an important component of a weed control strategy for volunteers in following crops;

iv. that gene transfer from the GM herbicide tolerant crop to sexually compatible weed species could occur, resulting in hybrids that then become more difficult to control in agriculture or semi-natural habitats;

v. that gene transfer could occur between sexually compatible GM crops with tolerance to different herbicides, resulting in hybrids with tolerance to more than one herbicide - "multiple tolerance" - which could be more difficult to control than plants with tolerance to one herbicide;

vi. that seeds of GM crops with tolerance to different herbicides may be sown in the same field in subsequent years, resulting in the build up of a seed bank with tolerance to more than one herbicide.

A further concern that has not yet arisen is that different groups of herbicide active ingredients may have the same mode of action. For example, sulfonylurea herbicides have the same mode of action as imidazolinone herbicides. Thus, genes which give tolerance to one group of herbicides may also unintentionally allow tolerance to the other group.

We consider that these concerns apply equally to GM crops where it is intended to apply the herbicide for weed management, and to GM crops containing selectable markers where the herbicide would only be used in the development and

selection phase. Although the herbicide is not intended to be used on the GM crop, the genes still exist within the plant genome and the risks of gene transfer are the same; if the GM crop is able to survive field application rates of the herbicide, its control as a volunteer or feral population may be comprised.

In practice, the consideration of GM herbicide tolerant crops has been on a "first come, first served" basis, in that the applicants for GM glufosinate ammonium tolerant oilseed rape did not have to address multiple tolerance issues in detail, as there were no other GM oilseed rape crops with tolerance to other herbicides yet on the market. An applicant who submits a marketing application for a second type of herbicide tolerance in GM oilseed rape, for example glyphosate, would have to take the existence of glufosinate ammonium tolerance into account and consider the risks of multiple tolerance arising in oilseed rape and compatible weed species.

Controls of Use of Herbicides

Agricultural pesticides are currently regulated under UK national legislation - the Control of Pesticides Regulations 1986 (COPR), made under the Food and Environment Protection Act 1985 (FEPA) - for which Pesticides Safety Directorate (PSD) of the Ministry of Agriculture, Fisheries and Food (MAFF) has lead responsibility. Only pesticides approved under COPR may be sold, supplied, stored, advertised or used. Since Directive 91/414/EEC on Plant Protection Products came into force, regulation of agricultural pesticides will become subject to EC rules which will progressively ensure that all pesticides are regulated on a similar basis across Europe. EC Directive 91/414 seeks to ensure that, among other things, farmers throughout the Community have access to a sufficient range of safe and effective plant protection products which have no unacceptable impact on the environment. This Directive is implemented in the UK by the Plant Protection Products Regulations 1995 (PPPR) which apply to pesticides whose active ingredients have been included in Annex 1 of the Directive. Annex 1 is currently empty, but will be filled after the assessment of new active ingredients and the review of those already in use. Existing pesticide products remain under the control of COPR. The COPR and PPPR control regimes will operate in parallel until the reviews of active ingredients are complete.

Herbicides for agricultural and non-agricultural use are controlled under this regime by PSD on the basis of safety and efficacy. Ministers are advised by the Advisory Committee on Pesticides (ACP). As for releases of GMOs, all pesticides are banned unless there is an overt approval. If approval is granted, it is subject to a number of specific conditions, including: maximum application quantities; application frequencies and windows; specific uses (eg. named crops); and, special conditions (eg. "no-spray" zones to protect water bodies, etc).

An approved herbicide will have approval for use on particular crops which are clearly stated. If a GM crop with tolerance to that herbicide is granted consent for release or marketing, the herbicide to which it is tolerant cannot automatically be marketed for use on that GM crop. An application for approval for extension of use

on the GM crop must be submitted and approval given before the herbicide can be marketed and used for that purpose. For the foreseeable future, use of herbicides on GM herbicide tolerant crops is likely to be regulated under COPR.

Management of Herbicide Tolerance

As we have already stated, herbicide tolerance is not a new issue. The development of tolerance in target weeds or volunteers will result in the loss of efficacy of a product in a particular situation but would not be a risk to human health and safety or the environment. If there was some loss of efficacy of a herbicide as a result of a small proportion of target weeds developing tolerance, the application of the herbicide would not result in harm to the environment because: the application would still effectively control most other target weeds; and, the application *per se* would not cause harm to the environment, for example soil biota, because it has been given an approval for that use on the basis that it is considered safe as well as effective.

With these considerations in mind, MAFF's principle is that GM herbicide tolerance should not be treated any differently than other types of tolerance which occur, and that each will be reviewed on a case-by-case basis. Where problems are encountered with reduced efficacy as a result of tolerance arising in target weed species, the use of the herbicide would be reviewed. MAFF would consider non-regulatory methods to protect the safe use of the herbicide and to maximise its efficacy, for example recommending weed control strategies and issuing guidance. This approach is currently being implemented to tackle current problems with tolerance to isoproturon based herbicides in blackgrass. It is MAFF's policy that farmers should be allowed to respond to their own problems within the existing framework, choosing the appropriate solutions and approved products for the circumstances encountered. Where a serious loss of efficacy of an active ingredient occurs, it is likely that commercial pressure would result in companies withdrawing products based on that active ingredient from the market.

Conclusions

The above extensive extracts from the ACRE Annual Report 1996-97 show the complex interactions between: the regulations covering environmental protection; the regulations covering pesticide usage and safety; and potential agronomic practice. The overall objective has been: to facilitate proper risk assessment; to protect the environment and human health; and to ensure the safe introduction of any new technologies derived from genetic modifications.

SOURCE

ACRE Annual Report 1996-97 - available from the Department of the Environment, Biotechnology Unit, Romney House, 43 Marsham Street, LONDON SW1P 3PY, UK.