GeneWatch UK

Briefing 2 - September 2000

Growing Genetically Modified Crops - Financial and Farm Management Implications

Farmers Information Series

For farmers considering whether or not to grow genetically modified (GM) crops, there are a number of issues to take into account including their financial and farm management implications. To help inform farmers' decisions, this briefing considers what is known about yields and weed control together with other practical considerations such as land values, separation distances from other non-GM crops and insurance. It focuses on herbicide tolerant crops as these are likely to be the only GM crop seeds to be commercially available in the next five years (see Briefing 1 in this series).

The agronomic performance of GM crops

Information about the performance of GM crops in a farming situation has to come largely from North America and Canada where farmers have been growing GM crops commercially since 1996. Studies of agronomic (yield and economic) performance of GM herbicide tolerant crops have used experimental plots or farmer surveys to compare conventional and GM regimes, but none of the studies include comparisons with organic agriculture. However, the results have been highly variable (see Table 1 for a selection of these). For example, the review by Oplinger[1] showed GM Roundup Ready soybean yields ranged from 14% lower to 13% higher than conventional soybeans. It is difficult to tell whether the differences are due to the additional genes causing a change in the characteristic of the plant, particular weather conditions affecting a certain area, or different management techniques.

Table 1: The performance of herbicide tolerant crops in the USA and Canada

AUTHOR	METHOD	CROP/ TRAIT	YIELDS	PESTICIDE COSTS	SEED COST	RETURNS
Duffy [2]	Farmer survey	Soybeans (RR)	up 4%	down 30%	up 40%	same
Oplinger [1]	Experimental	Soybeans (RR)	down 5%	N/A	N/A	N/A
USDA [3]	Farmer survey	Soybeans (RR)	up <1%	glyphosate up 1-5% others down 1-5%	N/A	same
USDA [3]	Farmer survey	Cotton (RR)	up 1-5%	same	N/A	up 1-5%
Ferrell & Witt [4]	Experimental	Maize (RR)	same	N/A	N/A	same
SARDA [5]	Experimental	Oilseed rape (RR)	up 6%	down 65%	up 134%	N/A
SARDA [5]	Experimental	Oilseed rape (LL)	up 43%	down 9%	up 196%	N/A

Key: LL = Liberty Link; RR = Roundup Ready

Experimental UK data is hard to come by. In one study, three glufosinate tolerant oilseed rape hybrids were compared with three non-GM open pollinating varieties and two non-GM hybrid varieties (Pronto and Synergy) to explore the differences in yield and herbicide use[6]. The results showed that the GM crops produced yields which were higher than the open pollinated varieties but lower than the hybrid varieties. Margins over herbicide ranged from £13 to £99 per hectare higher with the GM crops but this did not take account of the higher seed costs of GM varieties.

The high GM seed costs (see Table 1) are because of an added 'technology fee' to allow companies to recoup the cost of research and development. Farmers will have to be sure of the benefits before paying such additional costs. In the case of Bt maize which is genetically engineered to be toxic to corn borers, a US pest management and crop development bulletin[7] suggests it is only economical where the pest causes serious damage in six or more years out of ten. Where corn borer damage occurs in one to three years out of ten, it is better (in economic terms) to sow conventional seed and only use insecticide if corn borers are actually spotted in the field.

A recent report from the European Commission's Agriculture Directorate also concluded that "*The available studies do not provide conclusive evidence on the profitability of GM crops*" [8]. The widespread use of GM herbicide tolerant crops by farmers in North America (e.g. Roundup Ready soybean now accounts for about 50% of the total US soybean crop) must therefore be attributable to the lower labour requirements and ease of application (e.g. using one broad spectrum herbicide rather than tank mixtures).

GM crop failures

Some farmers growing GM crops have experienced problems. In April 2000, 160,000 US farmers collectively tried to sue Monsanto for reduced crop yields of Roundup Ready soybeans but the court ruled that there was not necessarily one reason for the yield loss. Some farmers will now seek damages individually[9].

Monsanto's Roundup Ready soybeans have also been found to suffer in hot weather, especially when soil temperatures reach 45°C. Research at the University of Georgia[10], prompted by farmer reports of unexpected crop losses, found that the plants were stunted in high temperatures and that a higher percentage of stems were split, leaving the plants open to fungal attack and yield loss. The researchers suggest that the added genes that make the crop herbicide tolerant may also have the side effect of increasing lignin production and making stems more brittle.

In 1997, 54 farmers on the Mississippi sought compensation when Monsanto's herbicide tolerant cotton failed to grow properly. The bolls, which provide the cotton, were deformed and many fell off prematurely. The Arbitration Council eventually ruled that Monsanto's Roundup Ready cotton failed to perform as advertised and recommended payments of nearly $2 million to the three farmers who had not settled out of court. Monsanto are reported to have argued that an abnormally wet spring slowed cotton growth and the breakdown of glyphosate in the plants[11].

Weed control

The biotechnology industry claims that the clearest benefit of herbicide tolerant crops is ease of weed control. However, their usefulness could be undermined if:

- **Resistance to the herbicide evolves rapidly in weeds.** Crops throughout the world are being genetically modified to be tolerant to the same two broad spectrum herbicides (glufosinate and glyphosate). If weed resistance evolves quickly, not only will the GM crops be useless, farmers may change to less effective or relatively unsafe alternative herbicides. There is already resistance to glyphosate occurring in the Australian populations of annual ryegrass and Malaysian populations of goosegrass[12].
- **A new spectrum of weed problems emerges.** If two herbicides come to dominate weed control, the spectrum of weeds may change and create new problems as those which are naturally resistant to the chemicals flourish. A paper by an AstraZeneca scientist states that in Southeast Asia, glyphosate has been used extensively, leading to a marked dominance in annual broad-leaved weeds and now several applications of both glyphosate and paraquat are required to eliminate weeds[13].
- **Genes are transferred from the GM crops to related weed species making them herbicide tolerant** (only possible with oilseed rape and sugar/fodder beet in the UK). If this occurred, weed management would become

more difficult as alternative weedkillers would have to be used.

- **Volunteer weeds become unmanageable.** In MAFF's experimental trials with herbicide tolerant crops, volunteers tolerant to both glyphosate and glufosinate have been detected[14]. In Canada, where herbicide tolerant oilseed rape has been grown for five years, there is a report of a triple herbicide tolerant oilseed rape[15]. It is thought that this volunteer oilseed rape arose because herbicide tolerant varieties were planted too close together so they cross-pollinated. Although these volunteers can be controlled with other herbicides, it is worrying that resistance can build up so quickly. Oilseed rape seed can remain dormant in soil for several years creating the potential for long-term volunteer problems and the potential to 'contaminate' future non-GM crops in the same field.

Conflicts of interest with neighbouring farmers

One of the factors that will affect where GM crops can be grown on any particular farm will be how far they have to be separated from non-GM and organic crops to protect those farmers from contamination of their crop. The current separation distances in the SCIMAC (Supply Chain Initiative on Modified Agricultural Crops) guidelines are shown in Table 2. Under the guidelines, the onus is on the GM crop farmer to notify neighbouring farmers in writing and to resolve differences. However, the separation distances are currently under review as a result of the conventional Advanta oilseed rape seed imported into the UK which was found to contain around 1% contamination with herbicide tolerance genes from GM crops. The separation distance used in Canada when growing this seed was 4,000 metres, some 80 times greater than the minimum separation distance in the SCIMAC guidelines.

Table 2: Separation distances for GM crops (in metres) [16]

CROP TYPE	CERTIFIED SEED CROPS (same species)	REGISTERED ORGANIC CROPS (same species)	NON-GM CROPS (same species)
Oilseed rape	200m	200m	50m
Sugar beet	600m	600m	6m
Fodder beet	600m	600m	6m
Forage maize	200m	200m	200m sweetcorn; 50m forage maize

Pressure to increase separation distances is unlikely to stop at those that may ensure no more than 1% contamination of non-GM crops. The Environment Minister, Michael Meacher, recently told the Agriculture Select Committee that he favoured a maximum contamination level of 0.1%[17].

Liability

Given the sensitivities around GM crops, the issue of contamination of neighbouring farmers' crops could lead to claims against a GM crop farmer for damage to their business. Insurance companies have proved reluctant to provide insurance for farmers participating in the farm scale evaluations of GM crops in relation to cross-contamination and farmers have had to make their own arrangements with the companies conducting the trials. For neighbouring farmers who might be concerned about loss of non-GM or organic status, they cannot obtain insurance to cover these risks. The position of the insurance industry is seen in a statement from NFU Mutual Insurance that:

> "*A decade or so ago the insurance industry as a whole adopted a standard exclusion clause for damage caused by gradual pollution (which now includes GMOs). This means that no insurer provides insurance cover for the risks of GM crop contamination"* [18].

Land value

Market forces are not only affecting the saleability of GM crops but, at least within the European Union, they are raising concerns about land values. For example, the European Landowners Association has said that: "*if GMOs contaminate land clearly this would have an effect on the value of the property, as well as raising the possibility of service of a remediation notice requiring monies to be spent on clean up.*" [19]

A Royal Institute of Chartered Surveyors survey of rural land managers in Britain showed that 58% believed land prices would be affected by growing GM crops (16% did not); 63% believed previous or present growing of GM crops would make the land harder to sell (25% did not); and 75% would advise landlords not to allow tenants to grow GM crops (11% would)[20].

The European Society for Chartered Surveyors (ESCS) has called on the EU to set up a register of land where GM crops are grown. They feel it is important that any future problems can be traced back to source and also that future buyers of the land will know the land's history[21].

Conclusions

Farmers in the UK will be faced with a complex decision if GM herbicide tolerant crop seeds become commercially available here. North American experiences with GM crops have been variable and it is impossible to say whether herbicide tolerant crops will increase or decrease profit margins. Farmers will have to weigh up benefits such as simplified weed control against problems such as separation distances. An important question is whether the benefit of easier weed control will be maintained in the medium to long term.

Whether or not there is even a market for the produce of GM crops is another crucial question and is the subject of Briefing 3 in this series, "*The Market for Genetically Modified Crops*".

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GeneWatch UK

The Mill House, Manchester Road, Tideswell, Buxton, Derbyshire, SK17 8LN, UK
Phone: 01298 871898 Fax: 01298 872531 E-mail: mail@genewatch.org

Website and online database: http://www.genewatch.org