THE FARM SCALE EVALUATIONS OF GENETICALLY MODIFIED CROPS: THE STORY SO FAR

Les Firbank from the Centre for Ecology and Hydrology, Grange-over-Sands, describes progress with this major assessment of the ecological impacts of herbicide-tolerant crops

Introduction

We are now roughly at the half-way mark of the Farm Scale Evaluations of genetically modified herbicide-tolerant crops. This is perhaps the largest agro-ecological experiment ever undertaken, and was prompted by concerns that the widespread use of herbicide-tolerant crops would lead to reduced levels of biodiversity in and around British arable land. Such a reduction would, it was feared, lead to the continued decline of farmland birds that are already the subject of action under the UK Biodiversity Action Plan.

In response to this concern, Government and the industry group SCIMAC (Supply Chain Initiative for Modified Agricultural Crops) came to a voluntary agreement to defer decisions regarding the commercial plantings of GM crops until after the completion of a large experimental programme designed to assess the impacts of genetically modified herbicide tolerant crops on biodiversity, seeking both positive and negative effects. This research programme began in April 1999, and the crop plantings are due to be completed in the seasons 2002 (for spring oil seed rape, maize and beet) and 2002–2003 for winter rape. An independent Scientific Steering Committee supervises the research, and its approval is required for methodologies and site selections.

The research has proved highly controversial because it involves the first large-scale plantings on GM crops in the UK. There has been great interest from the press; there have been numerous regional and local public meetings discussing the experiment and instances of direct action against individual sites.

Progress so far

The first round of plantings, in 1999, were designed purely to develop the field methodology, and not to contribute to the final analyses. It was clear right at the start that the experiment would involve growing pairs of GM and non-GM crop varieties, but it was not clear whether to use split or paired fields. Both were included in these pilot studies, and it became clear that split fields were preferable, because the background differences in species abundance were reduced, and also it was easier for farmers to keep crop treatments consistent where required. Other issues resolved during this period were the choice of which species to record, and how and when to record them. These decisions were largely based on previous experience of agro-ecological studies, but needed to take into account the practicalities of working in the selected crops on the one hand (*e.g.* monitoring butterflies in a maturing maize crop requires a ladder) and the required frequency of visits, and numbers of sample locations at each visit for the different groups of species.

Sample size was one of the most important issues. Too small, and biologically real differences may not be detected; too large, and the experiment becomes inefficient, and involves planting more crops than are required. Initial studies suggested that a figure of 60 replicates per crop should suffice to detect differences in key biological indicators of around 50% with around 80% probability. Subsequent analyses, of data both from the pilot studies and from the main set of field sites, have tended to confirm these figures, leading to a current requirement of 60–75 sites per crop, spread over three years. The experiment is very much larger, and much more sensitive, than any other similar study that we are aware of. Moreover, it is very likely that smaller differences will be detected, especially if they occur across more than one crop, or more than one group of species.

Another issue is whether sugar and fodder beet should be regarded as one crop or as two separate crops. Recent analyses of data from 2000 indicate that they can be regarded as a single crop for our purposes, although both sugar and fodder crops are required in order to make sure that the range of farms in the experiment remains typical of beet farming as a whole.

The choice of field sites

Farmers volunteer to take part in the study. They approach SCIMAC first, and the seed suppliers must ensure that the farm is capable of delivering the contract to grow the crop, within the conditions required for GM crops. SCIMAC then passes the details to the team of scientists. It is our job to select from these farms to make sure that the whole sample represents the range of geography, farming systems and biodiversity resources likely to be encountered should these crops be grown commercially within the United Kingdom. This strategy preserves both the scientific independence of the study, and the responsibility of industry. In summer 2000, 48 field sites were successfully grown; 12 sites of spring rape, 12 of fodder maize and 24 of beet. The distribution of these sites was broadly representative of where the crops are grown currently, except for under-representation of the south west and of the north of England and Scotland. The range of biodiversity was also encouraging, with up to 23 species of arable plant being encountered on some fields.

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The target numbers of sites for 2001 were 25 winter rape and 32 for each of the spring-sown crops. Final numbers are not available at the time of writing, but some sites have been lost because of poor weather conditions affecting establishment and the impacts of foot and mouth disease.

What is involved

The study involves allowing farmers to manage the two halves of the field, one with GM and one with a non-GM variety of the same crop, as they would under commercial conditions (using the SCIMAC code of practice for growing GM crops). The only extra stipulation is that the half-fields should be treated the same, unless there are agronomic reasons to do otherwise. Thus it is hard to defend different fungicide or insecticidal seed treatments for the two halves of the field, but the farmers may well opt to use a pre-emergence herbicide on one treatment only. The management of the crop is monitored by the researchers, partly to allow the management to be audited against sound agronomic practice, and partly to help explain differences in biodiversity between sites and years.

The biodiversity measurements focus on the plants within the field and the invertebrates that feed on them. Seedbank samples are taken before and after the crop, and weeds are recorded at seedling stage, after herbicides are applied, at maturity and in following crops. Seed rain is also recorded within the fields. Vegetation is also assessed in the field boundary. Slugs, snails and a variety of other invertebrates (including bees and butterflies) are recorded both within the crop and in the field boundary.

Breeding and wintering birds were recorded on most sites in 2000 as a pilot study by the British Trust for Ornithology. Also, gene flow is being studied, from GM crops to non-GM crops and to wild relatives of oil seed rape, by the Central Science Laboratory and the Centre for Ecology and Hydrology.

Publishing the results

The data analyses centre on tests of the null hypothesis for the different ecological indicators, addressing the effects of covariates such as location and differences in crop management. Interim results are not being published, because early results might falsely be considered as typical of the final results. Given the contentious nature of the experiment, such early release of data might prejudice the entire debate about GM crops. Instead, the results will be released for each crop upon completion of the study, and they will be published through the refereed scientific literature.

Looking ahead

The Farm Scale Evaluations represent a fascinating collaboration between farmers, industry, research and Government, that may well prove a valuable model for agri-environmental research well into the future.

The research is conducted by the Centre for Ecology and Hydrology, the Institute for Arable Crops Research and the Scottish Crop Research Institute, and is funded by the Department of the Environment, Transport and the Regions, the Ministry of Agriculture, Fisheries and Food and the Scottish Executive. Full details of the project are available on the DETR website http://www.environment.detr.gov.uk/fse/index.htm.

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