UK field-scale evaluations answer wrong questions

To the editor:

On October 16, 2003 the UK Royal Society published a special volume of *Philosophical Transactions* that reported the results of extensive field-scale evaluations (FSEs) of herbicide-tolerant GM crops in the UK[1]. On the basis of extrapolations from this information, certain media and various environmental groups are citing the FSEs as proof that genetically modified (GM) crops are environmentally damaging and bad for biodiversity.

Such a conclusion is not justified by the published findings. In the introduction to the papers, the study authors forewarn us that "the FSEs address one particular environmental risk of one particular trait in one particular agro-ecosystem, and the results should not be extrapolated to other socio-environmental systems."[2] The studies show that for two herbicide-resistant GM crops—oilseed rape (canola) and beet—fewer weeds and fewer insects from species that live in or on weeds were observed. Highly effective weed control practices such as those the study chose to use with these GM crops lead to low numbers of weed seeds and insects. In turn, fewer insects and decreased weed seed *might* reduce the numbers of birds that feed on these insects and seeds. In a conclusion that seems dire for crops that in any given year cover less than 15% of the farmed area in the United Kingdom[3], the media announced that GM crops *will* hurt bird populations, and therefore are bad for biodiversity and should not be planted (*e.g.*, see ref. 4).

It is important to note that birds were never counted nor was biodiversity measured in these studies. The media discussion assumes two important points: first, that availability of weeds and weed-associated insects are the dominant factors determining bird populations—which is clearly not proven; and second, that biodiversity can be equated with insects and weeds in crop fields. The studies in question measured numbers of a few kinds of organisms in a several small, selected habitats. They tell little about how these individuals interact as populations and communities in these habitats and they tell nothing about the biodiversity of the larger surrounding ecosystem.

Furthermore, such conclusions ignore the fact that weed populations are a result of the management strategy, not the GM status of a crop. For example, an organic farmer who thoroughly hoes a field would be equally effective at destroying potential bird feed and habitat. A farmer who uses conventional herbicides effectively along with mechanical tillage might do likewise. Thus, if leaving more weeds in the fields really were deemed an appropriate public policy for UK farmers' fields, farmers would simply need be mandated to use less herbicide, rather than having their right to use GM crops curtailed. Indeed, the studies demonstrated that weeds and some insects were more common in oilseed rape crops, GM or conventional, than in beet or maize crops. Therefore, a more effective method of increasing the numbers of arable weeds and insects in crops would be to legislate crop choice.

To truly test the impact of the GM nature of crops for their effect on biodiversity—rather than the effect of a cropping system—the UK trials could have focused on comparison of a single crop with a carefully matched conventional counterpart.

Although the study designers acknowledge that it is unlikely to be the case, the FSEs assumed current crop management systems would not change with the advent of herbicide-tolerant crops[3]. In actual practice, during seven years of planting GM crops in the United States, agricultural practices have changed in a manner that can broadly be described as beneficial for the environment and biodiversity. A rapid adoption of no-till practices has accompanied the adoption of herbicide-resistant crops[5]. A move toward no-till agriculture leads to decreased energy inputs, lower soil erosion and soils that are much healthier with respect to structure[6–8], microbes[9], invertebrate species[10] and organic matter content[5]. As a consequence of these changes, concluded Fawcett and Towery, "the habitat for birds and mammals improves"[5].

Crop management strategies also influence aspects of environmental impact beyond numbers of weeds and insects in the field. For example, the FSE studies totally ignore the effect of pesticide residues on and off the farm field. The impact could easily be evaluated and compared—for example, by using Cornell University's (New York, NY, USA) Environmental Impact Quotient (http://www.nysipm.cornell.edu/publications/EIQ.html).

To truly test the impact of the GM nature of crops for their effect on biodiversity—rather than the effect of a cropping system—the UK trials could have focused on comparison of a single crop with a carefully matched conventional counterpart. For example, FSEs could have grown replicated, randomized plots of sulfonylurea-tolerant GM oilseed rape and conventional sulfonylurea tolerant-oilseed rape, with and without sulfonylurea treatment. This matched crop design would have tested the inherent safety and impact of the GM nature of the crop. In all likelihood, the studies would have found little difference in biodiversity between the planting of GM and conventional sulfonylurea-tolerant cultivars. They would have found the highest numbers of putatively 'bird-beneficial' organisms in the untreated plots, regardless of cultivar, and the least weed seeds and weed-associated insects in the treated plots, again regardless of the GM nature of the cultivar. Put another way, these studies were not even about GM crops!

The ultimate question that should be asked is which agricultural technologies will maximize production while minimizing environmental impact in the broad sense. Herbicide-tolerant technology—notice that

we do not say GM, because we do not believe that it makes a difference what process was used to develop the herbicide tolerance—may be one of those rare technologies that improves both yield and product quality while reducing the environmental footprint of agriculture. Besides contributing to the efficiencies of current European farm systems in small spaces, judicious use of herbicides on both conventional and GM crops could go the next step of maximizing food production on existing farmland. With the resulting increased food production, society could dedicate the land thus conserved as natural reserves, where many species could truly flourish, providing even greater biodiversity—after all, farmland has never been intended to be a natural habitat for any form of life except crops and farmers.

The publication of the FSEs demonstrated, as the investigators themselves foretold, that GM critics will seize any opportunity to continue their anti-GM campaign. News coverage of the FSE results also confirms that certain parts of the media may be more interested in sensationalism than in getting the story right. On a scientific basis, the most damming result from the FSEs is that GM crops can make it too easy to control weeds! Perhaps most disappointing to us as food and agricultural scientists is that the FSEs have created an unwarranted negative impression of GM technology while answering all the wrong questions.

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