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Unintended Effects of Genetic Manipulation
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Increased Herbicide Use on GMO Soybeans Consistent with Growing Weed Resistance, New Study Concludes from 1998-2011 Field Data

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As soybean farmers in the U.S. between 1998 to 2011 planted ever more land in seeds genetically modified to resist glyphosate (the active ingredient in Monsanto's Roundup herbicide), their total use of herbicides rose, consistent with growing weed resistance to glyphosate, according to a major new study. In fact, their use of pesticides was higher by 28 percent per hectare of land, averaged over that entire period, than for farmers growing non-GMO soybeans.

Farmers growing maize genetically engineered to resist glyphosate used slightly less herbicides (by about 1.2 per cent), averaged for that whole period. But researchers also found that by the end of the study period, the use of herbicides was rising faster for farmers growing either glyphosate-resistant soybeans or glyphosate-resistant maize than for farmers who were not.

On the other hand, farmers growing maize genetically engineered to resist a particular insect pest used 11.2 per cent less insecticide over the entire period, compared to farmers who did not adopt seeds engineered to resist an insect pest. And the gap between how much less insecticide farmers used who were growing maize engineered to resist a particular insect, relative to farmers growing maize not resistant to the insect, grew the most in the last years of the study.

"Increased glyphosate use," the study found, "came at the expense of other herbicides, although for soybeans there was also an increase in total herbicide use that began in 2007 and steadily rose through 2011."

The authors – four economists at state universities in the United States – added: "The estimated pattern of change in herbicide use over time is consistent with the emergence of glyphosate weed resistance."

The study also tried to shed light on whether the development of glyphosate-resistant weeds has "eroded" whatever benefits crops genetically engineered to tolerate glyphosate (GT crops) might have once conveyed, related to the use of either less, or less harmful, herbicides.

The authors of the research, titled "Genetically Engineered Crops and Pesticide Use in U.S. Maize and Soybeans," did this by trying to estimate whether the changing mix and amounts of herbicides farmers are using increased or decreased the overall environmental impact of herbicide use for the entire period in question. They also looked at the environmental impact of changes in the use of insecticides. They relied on a measurement tool for the negative health and environmental impacts of individual pesticides that was developed by the Environmental Impact Quotient (EIQ) project of the New York State Integrated Pest Management Program (IPM), which is now managed by Cornell University's extension offices.

Based on that tool's formula for calculating the negative impacts of glyphosate, versus the pesticides it has been displacing, and also its quotients for insecticides, the researchers concluded, for the entire period: "When pesticides are weighted by the environmental impact quotient … we find that (relative to nonadopters) GE adopters used about the same amount of soybean herbicides, 9.8% less of maize herbicides, and 10.4% less of maize insecticides" [1, 2].

However, by the last year of the study, 2011, the use of herbicides on both maize and soybeans engineered to resist glyphosate had risen so much that even after weighting herbicides by their EIQ impact, GE adopters were clearly applying more herbicide per hectare of farmland than farmers not growing genetically engineered soybeans or maize. In effect, that means the negative impacts of herbicides were also growing.

The study relied on an unusually large database, which included yearly records for planting and pesticide use for more than 5,000 soybean farmers and more than 5,000 maize farmers. It also extended over a time period much longer than the one or two years that most past studies have included, according to the authors.

Notes

1. In estimating total maize insecticide use, the study did not take into account the fact that maize genetically engineered to resist insects expresses the natural bioinsecticide *Bacillus thuringiensis,* or Bt maize. Including the production of that natural insecticide within the plant cells of Bt maize would significantly raise estimates of how much insecticide is being used – whether applied externally or produced internally – in the overall production of engineered Bt maize, as the researcher Charles Benbrook indicated in a 2012 research paper in *Environmental Sciences Europe.*

2. The EIQ for glyphosate used in the study has not been updated by the New York State EIQ project since 2008. That was well before the World Health Organization's International Agency for Research on Cancer's 2015 finding – based on a review of all studies on glyphosate up to that time – that glyphosate is "probably carcinogenic to humans." New York's EIQ for glyphosate was calculated under the assumption that glyphosate is not carcinogenic, and hence of less chronic toxicity than other herbicides that are.

The chronic toxicity of a pesticide to workers and to consumers who are exposed to it is an important factor in how the EIQ is calculated for each pesticide. If those values were to be recalculated in line with the WHO panel's conclusion, glyphosate's EIQ would worsen. And that would challenge the study's calculation of the positive contributions that the increasing use of glyphosate, relative to other herbicides, made to reducing the environmental impacts of herbicides over the entire 1998-2011 period, as well as for any particular year.

The New York State Insect Pest Management program is, in fact, considering reviewing its EIQ for glyphosate, depending on the outcome of an ongoing review of glyphosate by the U.S. Environmental Protection Agency (EPA) — this according to an email response from Brian Eshenaur, the senior extension associate at Cornell University who is now the curator for New York State's EIQ project.

Sources

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