

Growing Roundup-resistant weed problem must be dealt with, expert says

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Penn State weed scientist David Mortensen.

(PhysOrg.com) -- When Penn State weed scientist David Mortensen told members of the U.S. House Oversight Committee this summer that the government should restrict the use of herbicide-tolerant crops and impose a tax on biotech seeds to fund research and educational programs for farmers, it caused quite a stir.

The growing problem with weeds that have become resistant to the most common herbicide used by American corn, soybean and cotton farmers has gotten so serious that new strategies are needed to combat them, he contended.

Mortensen should know. The professor of weed ecology in the College of [Agricultural Sciences](#) has spent his career researching weeds that affect [agricultural production](#), sustainable ways to control them, and the relationships between crops, native and [invasive weeds](#), and pollinators. He has published several peer-reviewed papers on the subject in recent years.

The resistant weeds cannot be killed by the sole use of glyphosate, the active ingredient in Roundup herbicide. Roundup has become broadly popular with farmers since the advent more than a decade ago of soybeans, cotton, corn and other crops that are resistant to the chemical. The weeds now infest about 11 million acres -- a fivefold increase in three years, Mortensen reported.

The problem is most prevalent in cotton and soybean fields in the South but is spreading to other regions. And he told lawmakers it will get worse if farmers don't take measures to control the weeds, including nonchemical methods such as planting [cover crops](#) to suppress weeds, rotating crops and spraying herbicides other than glyphosate.

"With the rise of glyphosate-resistant weeds, farmers have to quit relying so heavily on Roundup to control weeds," he said. "Farmers value the convenience and simplicity of these crops without appreciating the long-term ecological and economic risks."

Testifying before the Domestic Policy Subcommittee of the House Oversight and Government Reform Committee July 28, Mortensen explained that weed management is a serious matter for farmers. While weed management almost always comprises several tactics, herbicide use is central and accounts for 70 percent of all pesticides used in agriculture.

"Since the mid-1990s, adoption of genetically engineered crops resistant

to the herbicide glyphosate has been widespread, and herbicide-resistant crops are now grown on more than 143 million acres of cropland internationally, with 92 percent of the U.S. soybean crop planted to glyphosate-resistant varieties," he said. "Genetic engineering makes it possible to take a crop that was formally susceptible to glyphosate and genetically transform it to be resistant to the plant-killing effects of the herbicide."

The adoption and widespread use of genetically engineered, herbicide-resistant crops has greatly changed how farmers manage weeds, enabling them to rely solely on a single-tactic approach to weed management (application of glyphosate). Unfortunately, Mortensen noted, this approach has resulted in an unintended, but not unexpected, problem -- a dramatic rise in the number of weed species that are resistant to glyphosate and a resulting decline in the effectiveness of glyphosate as a weed-management tool.

"During the period since the introduction of glyphosate-resistant crops, the number of weedy plant species that have evolved resistance to glyphosate has increased dramatically, from zero in 1995 to 19 in June of 2010," Mortensen said.

This list includes many of the most problematic weed species, such as common ragweed, horseweed, johnsongrass and several of the most common pigweeds -- many of which are geographically widespread.

"In practice, the problem of glyphosate resistance goes far beyond a species count," Mortensen said. "More important, perhaps, is the increase in acreage infested with glyphosate-resistant weeds. The reported extent of infestation in the United States has increased dramatically since just November of 2007, when glyphosate-resistant populations of eight weed species were reported on no more than 3,251 sites covering up to 2.4 million acres."

In the summer of 2009, glyphosate-resistant weeds were reported on as many as 14,262 sites on up to 5.4 million acres, and the most recent summary indicates 30,000 sites infested on up to 11.4 million acres, according to Mortensen. In a period of three years, the number of reported sites infested by glyphosate-resistant weeds has increased nine fold, while the maximum infested acreage increased nearly fivefold.

"There is reason to believe this trend will continue into the future," he said. "The cost of forestalling and controlling herbicide-resistant weeds is estimated to cost farmers almost \$1 billion each year, at an additional cost of \$10-20 per acre."

Mortensen expressed concern about herbicide- and germplasm-development companies responding to the glyphosate-resistance problem by developing a new generation of genetically engineered crops in which glyphosate-resistant cultivars are being engineered to have additional resistance traits introduced into the crop's genome.

"These additional gene inserts will confer resistance to other herbicide active ingredients, including 2,4-D and dicamba," he said. "For a variety of reasons, it is quite likely that such crops will be widely adopted. Disturbingly, that would result in a significant increase of older, higher use-rate herbicides in soybean and cotton production.

"If they are adopted in the way I expect they will be, herbicide use in soybean production would increase by an average of 70 percent in a relatively short time after the release of these new genetically engineered, herbicide-resistant cultivars."

Vapor drift of more toxic herbicides has been implicated in many incidents of crop injury and may have additional impacts on natural vegetation interspersed in agricultural landscapes, Mortensen told lawmakers. Scientists have documented that nontarget terrestrial plant

injury was 75 to 400 times higher for dicamba and 2,4-D, respectively, than for glyphosate.

Together the herbicide and seed-breeding industries are moving to address the problem of resistance with crops that have been engineered to be resistant to multiple herbicide active ingredients, according to Mortensen. If these new crop introductions occur as reported, we should expect to see herbicide use continue to increase and a significant proportion of those added herbicides will be older, less environmentally benign compounds, he predicted.

Mortensen suggested that federal regulation should play a strong role in forestalling the further development of herbicide-resistant weeds. He advocated steps that could significantly improve the sustainability of weed-management practices in American agriculture.

"Biotech companies are trying to deal with the problem by engineering new crop varieties that will be immune to more than one herbicide, but even those products will eventually run into resistance problems if farmers aren't careful," he said. "The U.S. Environmental Protection Agency and the U.S. Department of Agriculture's Animal and Plant Health Inspection Service should require that registration of new herbicide/transgenic crop combinations explicitly address herbicide-resistance management.

"Regulations should limit repeated use of herbicides in ways that select for resistance or that result in increased reliance on greater amounts of herbicide to achieve weed control," Mortensen added. "We should provide environmental market incentives, possibly through the Farm Bill, to adopt a broader integration of tactics for managing weeds.

"Transgene seed and associated herbicides should be taxed and proceeds used to fund and implement research and education aimed at advancing

ecologically based integrated weed management," he concluded.

Provided by Pennsylvania State University

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