

transported by pollen or seed from another field where a resistant population has taken hold.

Unfortunately, horseweed, waterhemp and giant ragweed are not only prone to evolving resistance, they can be highly mobile. That means even if you do everything right to avoid selecting for resistance, you could still end up with resistant weeds in your fields.

A horseweed seed can drift for miles or float on floodwaters from field to field. The tiny, hard-hulled seeds of waterhemp and other pigweeds can hitch a ride on boots, hooves, truck tires and farm equipment. Even more frightening, airborne waterhemp pollen can spread resistant genes about three miles per year, according to a gene flow model developed at the University of Illinois, and many people suspect the pollen could be traveling even farther. Windblown giant ragweed pollen can also confer resistance to plants miles away.

Higher Input Costs

Johnny Dodson has battled glyphosate resistant weeds for years on his 1,500 acres near Halls, Tenn. "It's terribly expensive," he warns. "We're using a whole host of chemistries from Ignite in burndown programs to multiple residuals. We're spending \$60 to \$70 an acre where we used to spend \$6 to \$10 an acre."



Horseweed is often referred to as marestalk.

Photo: Iowa State University

Needless to say, losing glyphosate as a stand-alone herbicide changes the profitability picture for soybeans. It also requires much more management.

Dodson applies Dual™ in corn and soybeans, along with atrazine in corn. In tilled fields, he'll pre-plant incorporate Treflan™ and Prowl™, then follow up with postemergence tankmixes. On some farms – especially cotton and wide-row soybeans – he'll even run a tractor with four seats mounted on a toolbar up

“Farmers won’t realize they have a problem until about 30 percent of the population has the trait.”

**– Mike Owen
Iowa State University**

Photo: Mark Jackson

No Cavalry Coming

If the story of glyphosate were an old-fashioned cowboy movie, this would be the part where the cavalry would come charging over the hill to rescue the beleaguered hero.

Don't listen for bugles. There's no cavalry coming, no miracle herbicides in the pipeline to deliver a new mode of action and save us from weed resistance. We're down to the tools we already have, coupled with the knowledge farmers can apply to solving the problem and a strong commitment to good stewardship to help those tools stay as sharp as possible. The more tools we lose to resistance, the more we erode at the profit margin of soybeans and corn. Resistance management is good economic stewardship as well as ecological stewardship.

"The way I'm looking at it, I have to be the good steward here, locally," says Hebenstreit. "I have to manage my own backyard and do the best I can. The ultimate responsibility lies with the farmer."

If you think you have resistant weeds, talk to someone – a neighbor, an agronomist or an extension agent, urges David Wright, director of contract research and strategic initiatives for the Iowa Soybean Association. "The emergence of a resistant weed population on your farm isn't a mark of shame, and it doesn't make you a bad farmer," says Wright. "But it does mean you need to kick your weed management program into high gear. Get help planning an



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Nobody agrees with that more than Johnny Dodson in Tennessee.

"The best way to avoid this train wreck is to start alternating your chemicals before you even develop the problem," Dodson says. "Alternate modes of action, use residuals – spend the money now and make an investment in the future.

"If you continue to do business the way you've done it and you think you're going to avoid a resistance issue," he warns, "you're wrong. Dead wrong."

Other Technologies are Being Challenged, Too

Glyphosate isn't the only stalwart crop protection product encountering resistance in the Midwest. Single-mode-of-action Bt corn hybrids are starting to come under attack by western corn rootworm populations that have found a way to defeat the crop's built-in defenses. Resistance is also starting to appear in populations of the fungus that causes frogeye leaf spot.

The same dynamics apply in Bt corn as in a soybean field facing glyphosate resistance, notes Erin Hodgson, Extension entomologist at Iowa State University.

"Farmers that are in continuous corn and are using the same Bt traits year after year are losing that performance," Hodgson says. "It all goes back to being proactive, always mixing things up so you're confusing the pest. If you're not mixing it up, you can't expect tools to last long."



Rootworm damage to rootworm resistant corn plant (right)

Photo: Erin Hodgson, Iowa State University

Rotating to soybeans is the best way to break the resistance cycle with the new rootworm populations, says Hodgson. Switching among corn rootworm Bt traits is an important step, especially in continuous corn. If you suspect that your rootworm population is becoming resistant to your Bt hybrid, she adds, alternate the Bt trait and apply a full labeled rate of insecticide seed treatment to add another mode of action to your program.

Resistance also works the same way among pathogens, notes Carl Bradley, Extension plant pathologist at the University of Illinois. In many ways, the fungus that causes frogeye leaf spot is a lot like waterhemp, he points out.

"There's a lot of genetic diversity in that fungus," says Bradley. "The more genetic diversity there is in the pathogen population, the more likely it is some resistant individuals are just lurking out there in the field. When you apply the same mode of action again and again, you start selecting for those resistant individuals. It doesn't matter if you're looking at insects or weeds or fungi; we can't just rely on one tool to control these complex biological organisms. Integrated management is important for all of them."

Just as an infestation of glyphosate resistant weeds can seem to appear overnight after building up for several years, pathogen and insect populations can also shift unseen.

The lesson is that stewardship principles are the same across the board, says Wright.

"In fact, using only chemical tactics to manage pests, without the inclusion of cultural and mechanical control tactics, will inevitably fail and the pest complex will adapt," Wright notes. "Nature will always find a way around it. As stewards of these tools, we need to manage them well to keep them viable for the long haul, even if that means putting them aside or investing in supplemental controls in the short term."



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Giant ragweed can spread resistant genes by wind.

As Easy As 1, 2, 3

It's been a long time since many growers have taken the time to sort through once-familiar herbicides like metribuzin, trifluralin and dicamba, let alone try to remember how each one acts on target weeds. With a dizzying array of product names and premixes, the market is flooded with options. It's downright confusing.

That's why American chemical companies have adopted a global system of classifying modes of action in numbered groups, which makes mixing and matching modes of action literally as easy as 1, 2, 3. For instance, any member of the ALS inhibitor family is identified as a Group 2 herbicide; glyphosate is in Group 9.

Remember, almost all waterhemp populations are resistant to ALS-inhibiting herbicides. Any new resistance that evolves in waterhemp (i.e. glyphosate) will make the waterhemp population multiple resistant to both ALS and the other herbicide mechanism(s) of action. That is why it is important to understand the mode of action of the herbicides you use in your soybean and corn production systems. Your crops may change from year-to-year but the weeds, and the herbicides to which they are resistant, don't.

Visit www.iasoybeans.com/productionresearch/ for an online, color-coded chart that lists soybean and corn herbicides by their mode of action and site of action group number. It assists the user with options to rotate among herbicides with different sites of action to delay the development of herbicide resistance.

Additional Resources

www.weeds.iastate.edu
www.glyphosateweeds crops.org
www.weedscience.org
www.planthealth.info
www.iasoybeans.com/productionresearch/

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