Unyielding to Herbicides

Are weeds the next group to demonstrate resistance?

By Scott J. Nissen

We've all heard about antibiotic-resistant, flesh-eating bacteria resulting from the overuse of common antibiotics. We've heard about insects, like mosquitoes, that are now resistant to common insecticides. But how many people know that weeds can become resistant to certain herbicides in the same way? What causes resistance to develop, and why should anyone in the turfgrass industry care?

Resistance is caused by selecting for rare individuals (bacteria, insects, plants, rodents, etc.) that carry some kind of genetic mutation that provides a mechanism for that individual to survive and produce resistant offspring. The selection pressure comes from highly effective antibiotics, insecticides, herbicides or rodenticides. As long as the resistance mechanism can be passed from one generation to the next, those resistant individuals will become a major part of the population over time.

The Weed Science Society of America, in conjunction with major herbicide manufacturers, maintains a database on the worldwide occurrence of herbicide-resistant weeds. The Web address is www.weedscience.org/in.asp and there are 11 weed species known to be resistant to one of the most common herbicides used in turf — pendimethalin. Fortunately, there are no reports of pendimethalin-resistant crabgrass, but there are reports of pendimethalin-resistant annual bluegrass, goosegrass and green foxtail in the United States. The Web site is a great resource if you suspect you might be dealing with an herbicide-resistant weed population.

As an extension educator for 30 years, I've found it a challenge to convince applicators they should know something about how herbicides work. Knowing how herbicides work is the first step in managing herbicide resistance. I often start a presentation by showing a long list of herbicide trade names and asking my audience how many modes of action are represented by this long list of familiar products.

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There are five to seven major herbicide modes of action, depending on how you group related modes of action. Of course, it's a trick question. From a list of perhaps 15 commonly recognized herbicides, there will only be a single mode of action. So what's the point?

The point is, even if the name on the jug has changed, the applicator hasn't alternated herbicide modes of action. The most widely recognized strategy to reduce the possibly of selecting herbicide-resistant weeds is to alternate or combine herbicide modes of action. This strategy reduces the intensity of the selection pressure, making it more difficult for resistant weeds to become dominant.

The problem is that even with good IPM (integrated pest management) strategies, herbicide-resistant weeds can still become established and weeds can be resistant to herbicides that you have never used. How is that possible?

The answer is pollen. Pollen from resistant plants miles away can pollinate susceptible weeds and produce resistant seeds. For many types of herbicide resistance, the resistance trait is dominant or semi-dominant, which means

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Annual bluegrass is a weed in many superintendents' eyes that needs to be eradicated.

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that plants only need one copy of the resistance gene to produce highly resistant seed. So even if you're doing all the right things, herbicide resistance can be an issue on your golf course and sod farm. Annual broadleaf weeds can be highly competitive and reduce the quality of new sod, especially during grass establishment. Most often, these annual weeds are likely to be herbicide-resistant.

In much of the western United States, kochia (*Kochia scoparia*) is the poster child for herbicide resistance. Kochia is highly resistant to several major herbicide families and sometimes the same plant is resistant to several different herbicide modes of action.

The 800-pound gorilla in the room, as far as herbicide resistance is concerned, is glyphosate-tolerant crop technology. Glyphosate is the active ingredient in Roundup and many other generic products. Transgenic technology was used to produce a number of important crop plants that are tolerant to this non-selective herbicide. For most major crop plants, there are glyphosate-tolerant varieties, also known as Roundup Ready varieties. Farmers rapidly adapted this technology because weed control was simple and it allowed for significant reductions in tillage, resulting in less soil erosion. Herbicide applications require smaller equipment and they allow growers to farm more acres.

Monsanto and many others (I include myself in this group) didn't feel that glyphosate resistance would be a significant issue with this new technology primarily because of glyphosate's unique mode of action.

What we didn't fully anticipate was that, given enough selection pressure (millions and millions of acres being treated with the same herbicide year after year), weeds would find new resistance mechanisms. So starting as early as 1997, glyphosate-resistant weeds began to appear, and today there are 15 confirmed cases of glyphosate-resistant weeds worldwide. There's little evidence so far that these glyphosate-resistant crop plants have become weedy or have crossed with weedy relatives. So what does all this have to do with the turf industry: Well, can you say glyphosate-tolerant creeping bentgrass?

Glyphosate-tolerant creeping bentgrass is still under regulated status by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service in Oregon. Applying transgenic technology to a wind-pollinated, outcrossing, perennial grass species has raised some concerns. The concerns are primarily about pollen flowing from these genetically engineered plants to naturalized populations, increasing their invasiveness.

Since creeping bentgrass requires significant moisture, it's most likely to be more competitive or invasive in riparian areas, which are high-value sites for biological diversity. The other issue is the potential of creeping bentgrass to hybridize with other closely related species and these hybrids becoming invasive.

This represents one more situation in which selection for glyphosate-resistant weeds can take place. While the regulated status of glyphosate-tolerant creeping bentgrass may soon be resolved, the deregulation of this genetically engineered plant is likely to have some unintended consequences. In all likelihood, these consequences will be minor, but I wonder what's more likely to happen.

Will superintendents find themselves dealing with glyphosate-resistant weeds from nearby cropland, or will farmers and ranchers have to manage weeds selected on the local golf course? Only time will tell.

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QUICK TIP

When choosing a turfgrass seed or mixture, it's important to review the performance characteristics of the turf varieties in the product. The National Turfgrass Evaluation Program (www.ntep.org) offers extensive variety data by species over a wide range of locations and maintenance levels. John Deere Golf submits all of its turf varieties for review through the NTEP. For more information on turfgrass varieties, contact your John Deere Golf sales representative, or visit www.johndeere.com.

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