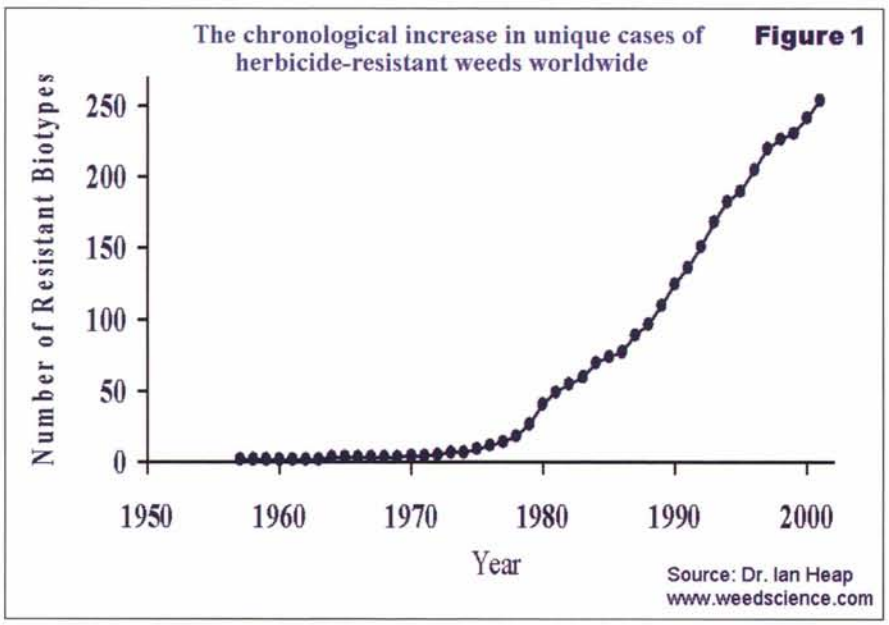
Lee Miller *Chicago District Golf Association*

Herbicide Resistance Issues –

Not a Common Weed to Hoe

Other than being a beautiful photo of New South Wales, this picture shows a population of glyphosate-resistant rigid ryegrass in a wheat field. The site had been exposed to 10 to 15 years of glyphosate use, with multiple applications each year.

As pesticide resistance goes, fungicide resistance has had the most impact and claimed the most notoriety thus far, mainly because we apply more and spend more on fungicides than insecticides and herbicides put together. With the advent of new and exciting technologies for selective Poa annua *and other weed control, the times may be a-changing. We should take heed of what we have learned about using chemicals to control other organisms, and pay attention to what has been taking place in the nation's farmland.*



Herbicide resistance is nothing new, but has not gained nearly the attention that fungicide and insecticide resistance have received. The first report of herbicide resistance occurred in 1968 with the discovery of common groundsel resistant to the triazine herbicides. To date, that number has increased exponentially (see Figure 1). Two main reasons for this increase are that more herbicides are being used now, and these herbicides are more selective in their mode of action on the target weed. This makes them much less toxic, but also makes it easier for a plant population to overcome their activity because a plant only needs a single gene mutation to confer resistance (more on that later).

(continued on page 12)

There are now 276 resistant biotypes of 166 different species (99 dicots and 67 monocots) of resistant weeds that have been identified. Turfgrass managers may not be familiar with herbicide resistance because most of these cases have occurred in agricultural crops. In Illinois, the documented herbicide-resistant weeds have all been agricultural (for example, lambsquarters, ragweed, pigweed and waterhemp), and have been mainly resistant to the herbicides in the triazine or ALS inhibitor families.

Well, what about herbicide resistance found in the turf realm, then? Here are some of the notable examples, most of which have occurred in the southeastern U.S. and have only been found very recently.

North Carolina, South Carolina, Georgia, Tennessee, Alabama, Mississippi, Florida: Goosegrass resistant to the dinitroanilines and dithiopyr (Treflan, Pendulum, Dimension).

New Jersey, Virginia: Smooth crabgrass resistant to fenoxaprop (Acclaim).

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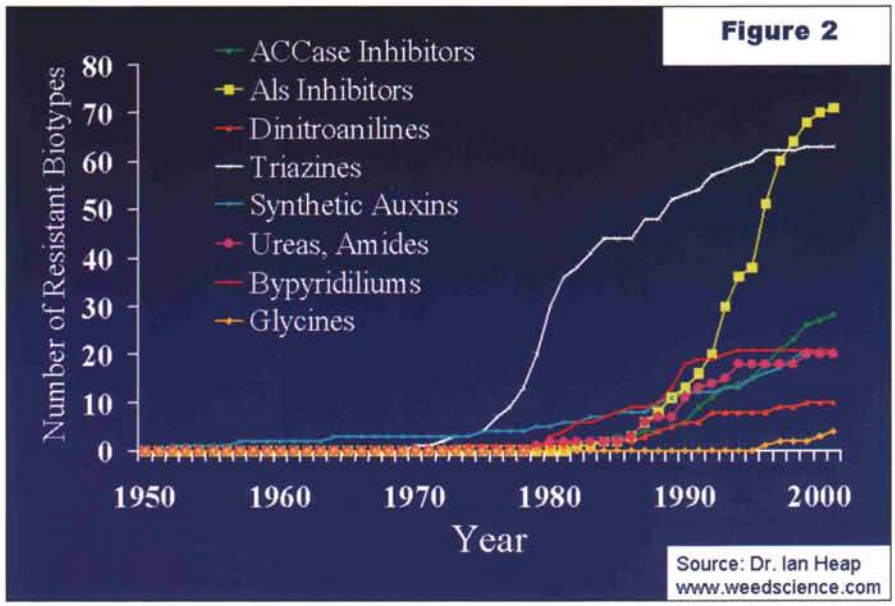

California: Smooth crabgrass resistant to quinclorac (Drive).

California, Texas, Arkansas: Perennial ryegrass resistant to fenoxaprop and selfometuron (Acclaim, Oust).

Oregon, North Carolina, Alabama, Mississippi, Virginia: *Poa annua* resistant to triazines, ethofumasate, pendimethalin and diuron (Atrazine, Prograss, Pendulum, Karmex).

Notice the geography of the last one? When you look at it from an ecological sense (and not from a pain in the you-know-what sense), *Poa* is quite incredible in the way it infests all different types of environments by using genetic variation. *Poa* makes huge amounts of seed that can potentially be different genotypes from the parent. These genotypes land where they may and will either die in an environment unsuited to them or establish themselves as a biotype and continue to their next generation. It has been estimated that *Poa* could have hundreds or even thousands of different biotypes, that each might have a different color, texture, growth habit or response to external stimuli like . . . chemicals. Two new chemicals, Velocity and Roundup via Roundup Ready (RR) bentgrasses, are on the horizon as ways to selectively control *Poa* out of bentgrass.

The chemistries of Velocity and Roundup are very different and lend themselves to different risks of resistance development. Velocity is in the class of ALS inhibitors, inhibiting a single enzyme so the target weed can't produce essential amino acids. This class of herbicides is known for its susceptibility to trigger resistance (see Figure 2), presumably because of this single site of action. On the other hand, Roundup, which also acts on a single enzyme in the shikimic acid pathway (although this is under debate), is in the glycine family and has only had four species that have developed resistance to it, after a long time of use. However, these biotypes, most notably of horseweed, have become economically important because they are surviving in fields planted with RR crops.

So what does all this mean for selective control of *Poa* out of bent with Velocity or with RR bentgrasses? "Maybe nothing," say experts Dr. Bruce Branham at the University of Illinois and Dr. Zac Reicher at Purdue University, "because we don't know if there is any natural resistance in *Poa* to these herbicides." After all, herbicide resistance is theorized to work in much the same way as fungicide resistance. The herbicide doesn't cause the weed to mutate, but selects for naturally occurring biotypes that have a higher tolerance to the application. If there isn't naturally occurring resistance out there in the population, then

there is nothing to select for. This may be why, in some instances, an applicator can use the same herbicide for 10 to 15 years with good results and have no indication of a problem. To answer this question, Dr. Reicher at Purdue, with his colleagues in New Jersey and Nebraska, is formulating plans on evaluating a range of susceptibilities of naturally occurring *Poa* to Roundup.

Hopefully nobody has been pulled into a full panic yet, because I must say that Dr. Branham, Dr. Reicher and myself are extremely excited about the prospect of having Velocity and RR bentgrass as tools to control *Poa*. As Dr. Reicher puts it, "Would you have said no to Heritage when it came out because resistance in some populations of grey leaf spot and anthracnose are popping up today?" I yell back, "H-E-double hockey sticks NO!" But we do need to think about using some of the same resistance-delaying techniques that we use for fungicides if and when we get these herbicides.

If using Velocity to eradicate *Poa*, you will need to commit to the action. "Don't spray it once and then leave it to recuperate; you will have started the selection process and wasted an application," says Dr. Branham. "Once you start the path, you must see it through until completion." (Sounds a bit like Yoda, doesn't he?) Dr. Branham also says that the path is probably about three applications to realize the full eradicative effect of the Velocity.

Most important, don't rely on just one of these herbicides for *Poa* or other weed control once initial eradication has been achieved. "Velocity, being in a different herbicide class, would be an excellent choice as a rotational partner with Roundup on RR bentgrass," Dr. Reicher suggests. Prograss or some preemergents could also be part of a plan to limit the number of applications for *Poa* control with either Velocity or Roundup. For broadleaf weed control in RR bentgrass, continued use of phenoxy and other types of herbicides is recommended so a chemical diversity is maintained and Roundup isn't overused.

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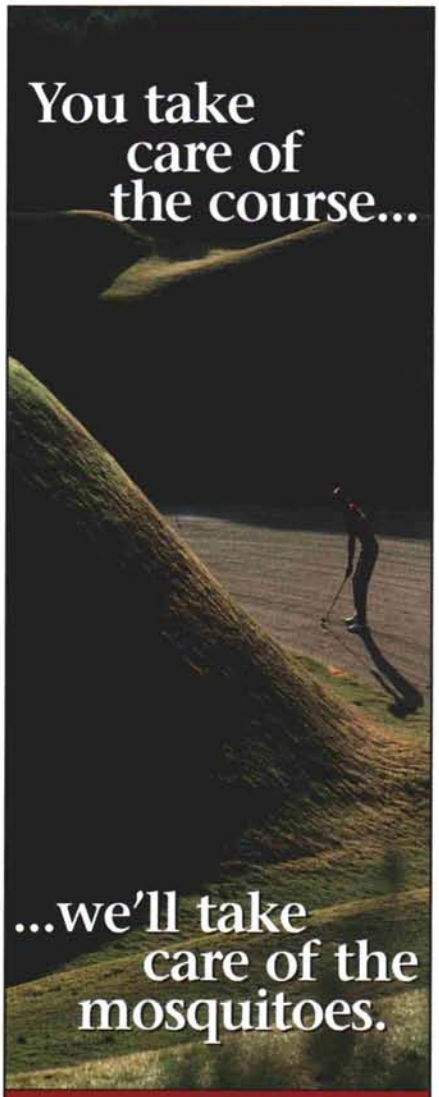
In conclusion, if you choose to use these new herbicides, use them with a level head. That way we can hopefully extend them to their full potential of having many summers without worrying about the *Poa*.

Much of the recent information about herbicide resistance contained in this article is from ***www.weedscience.org****, a fabulous Web site maintained by Dr. Ian Heap. If you would like more information about herbicide resistance cases, I highly recommend you pay it a visit.*



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