FEATURE ARTICLE

Annual Bluegrass Resistance to Dinitroaniline Herbicides Identified

Fred Yelverton

In a previous issue of Turfax, we discussed the mechanisms of herbicide resistance in weed populations. To summarize, herbicides do not cause genetic changes in plants that trigger resistance. Continuous use of the same herbicide, family of herbicides, or herbicides with the same mode-of-action selects for a weed population that has resistance to the herbicide. For instance, for a weed population to become resistant to an herbicide, there must be at least one plant in the original population that has the genetic make up to be resistant to that herbicide. This is why herbicide resistance never occurs in some weed populations with some herbicides; the naturally occurring plants that have genetic resistance do not exist in the wild population. Therefore, it can be stated that the development of herbicide resistance is an evolutionary process that is a result of selection pressure exerted by an herbicide.

In recent years on golf courses in North Carolina and Mississippi, annual bluegrass (*Poa annua*) resistance to triazine herbicides has been identified. However, these are not the first cases of resistance identified with triazines and annual bluegrass. Triazine-resistance in annual bluegrass was first identified in France in 1975 on a highway roadside. However, a case of annual bluegrass resistance to dinitroaniline herbicides has not previously been identified. Recently, in North Carolina, we **identified the first case of annual bluegrass resistance to dinitroanilines.** The following is an example of what happened on this golf course and the herbicide program for annual bluegrass control.

The golf course was constructed and grow-in was completed in 1990. An herbicide program for annual bluegrass control of the winter-annual biotype was initiated in the autumn of 1991, and proceeded until herbicide resistance was identified in 1998.

Starting in 1996, the golf course superintendent at this site noticed control from his herbicide program was starting to deteriorate. In the autumn of 1997 and the spring of 1998, control from Barricade was very poor. It should be noted that annual bluegrass control of the annual biotypes of *Poa annua* is very good with Barricade. Samples were taken from the annual bluegrass population and appropriate greenhouse and laboratory tests identified resistance as the reason for poor control.

It should also be noted that in this case, **herbicide resistance developed to a group of herbicides with a similar mode-of-action.** Simply rotating herbicides with the same mode-of-action will not break the resistance cycle. Dimension is not a dinitroaniline herbicide, but the mode-of-action is the same as that of dinitroanilines. Therefore, Dimension will not break the resistance cycle.

Rotating herbicides with a different mode-of-action is the only way to prevent herbicide resistance from developing. Annual bluegrass is a species that is known to have many different biotypes, which indicates genetic diversity. It should be expected that annual bluegrass populations have the genetic make up to be resistant to many different herbicide modes-of-action. With annual bluegrass management, rotating herbicides with different modes-of-action will be important in preventing the development of herbicide resistance.

Year	Herbicide	Herbicide Family	Herbicide Mode of Action
1991	Dimension	pyridine	mitotic inhibitor
1992	Dimension	pyridine	mitotic inhibitor
1993	Surflan	dinitroaniline	mitotic inhibitor
1994	Surflan	dinitroaniline	mitotic inhibitor
1995	Team	dinitroaniline	mitotic inhibitor
1996	Team	dinitroaniline	mitotic inhibitor
1997	Barricade	dinitroaniline	mitotic inhibitor

The Amazing Grass Plant

The grasses (*Poaceae* plant family) are the most ubiquitous of the higher plant groups found on this earth. With an estimated 600 genera and 7,500 species, the *Poaceae* ranks third in number of genera among families of flowering plants. With respect to completeness of representation in all regions of the world and to percentage of the total world's vegetation, grasses surpass all other genera. Grasses are one of the first permanent vegetations to reappear after disasters, such as volcanic activity, extended droughts, floods, fires, explosions, abandoned urban ghettos, and battlefields. Without the forgiveness of grasses, many ill-advised construction excavations and agricultural activities would have had far more disastrous effects on our vital natural resource—the earth's surface soil mantle.

To humans, grasses are the most important of all plants. The cereal grains and corn—all members of the grass family—serve as food for humans and animals. A host of grazing ruminant animals use grasses for their major food source as forage, pasture, and prepared feeds. Bamboo, a grass, is a major building

Continued on page 7

RESEARCH SUMMARY

Treatments of Petroleum Spills on Bermudagrass Turf

A field study was conducted on Tifgreen hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) to determine the best corrective treatments and subsequent turf recovery rates from various petroleum spill damage. Five petroleum products commonly used in turfgrass maintenance equipment were applied as spill treatments to the turf growing on Lufkin fine sandy loam. Three replicate spray treatments of gasoline, motor oil, hydraulic fluid, and brake fluid, plus direct spreading of grease were made over 1-m^2 plots. Calcined clay fines, activated charcoal, and detergent were evaluated as potential corrective treatments. Each corrective treatment was applied within 20 minutes of each spill in three replications.

The detergent corrective treatment proved effective in enhancing turf recovery in 3 to 4 weeks from motor oil, hydraulic fluid, and brake fluid damage. None of the corrective treatments were effective on either the gasoline or grease-damaged turf. The turf recovered rapidly in 3 to 4 weeks from gasoline spills without corrective procedures. More than 10 weeks were required for turf recovery from grease spills.

Comments. The removal of spilled hydraulic fluid and motor oil by means of a detergent washing proved to be an effective corrective treatment for enhancing turfgrass recovery from the initial foliar injury. In both cases, complete recovery of the turf was achieved 3 to 6 weeks sooner than with the other corrective procedures, such as calcined clay, activated charcoal, or a water drench. Also, detergent washing enhanced turfgrass recovery by 1 week in the case of brake fluid spills.

The detergent is sprinkled over the spill area, then thoroughly drenched with water, and the suds are completely removed from the surface area, preferably with a vacuum. **Use of this corrective detergent treatment should be restricted to within the boundaries of the spill area to avoid transferring the spilled material to the surrounding turf, where additional turfgrass injury is likely to occur.** It is worthwhile to treat a petroleum spill even if the shoots are severely damaged, because **removal of the petroleum residue from the grass shoots enhances the turfgrass recovery rate from the nodes of lateral stems.** This situation would be negated in the less common occurrence where (a) large-volume spills are lethal to the auxiliary buds or lateral stems, (b) the underlying soil becomes saturated with the spilled petroleum, and/or (c) the grass species has a bunch-type growth habit.

Under field operating conditions, the heat from hydraulic fluid or motor oil could cause additional damage to the upper nodes of lateral stems and retard turf recovery. Although the hydraulic fluid and motor oil applied to the bermudagrass in this study were at ambient temperatures, death of leaves and some lateral shoots did occur. Thus, a corrective detergent washing could still be used effectively to enhance turf recovery. Field observations where the detergent washing technique has been used on high-temperature hydraulic fluid spills support this position. **Source: Effects and treatment of petroleum spills on bermudagrass turf. By D. Johns and J.B Beard. *Agronomy Journal*, 71:945–947.**

The Amazing Grass Plant

Continued from page 6

material. Grasses of all types represent a large source of biomass for production of methanol, an energy source.

Our perennial turfgrass species evolved more than 45 million years ago during the Paleocene Epoch of the Tertiary Period, which is relatively recent in the earth's history. They have been cultured by humans to provide an enhanced environment and quality-of-life for more than 10 centuries. The complexity and extent of the environmental benefits that improve our quality-of-life are now quantitatively documented (1, 2).

Functional Benefits Include:

- Excellent soil erosion control and dust stabilization, thereby protecting a vital soil resource.
- Improved quality protection and recharge of groundwater, plus flood control.
- Enhanced entrapment and biodegradation of synthetic organic compounds.
- Soil improvement via organic matter–carbon additions.
- Accelerated restoration of disturbed lands.
- Substantial urban heat dissipation and temperature moderation.
- Reduced noise, visual glare, and visual pollution problems.
- Decreased noxious pest problems and allergy-related pollens.
- Lowered fire hazard via open, green turfed firebreaks.
- Safety in vehicle operation on roadsides and engine longevity on airfields.
- Improved security provided by high-visibility turfed zones.

Recreational Benefits Include:

- A low-cost surface for outdoor sports and leisure activities.
- Enhanced physical health of participants.
- A unique low-cost cushion against personal impact injuries.

Aesthetic Benefits Include:

- Enhanced beauty and attractiveness.
- Improved mental health, with a positive therapeutic impact and social harmony.
- Improved work productivity.
- Complimentary relationship with the ecosystem of flowers, shrubs, and trees.
- An overall better quality-of-life, especially in densely populated urban areas.

Continued on page 8

Trees and Government

A law has now been passed in the country of Greece specifying that no one may cut down a pine tree without permission from a government Forest Inspector, even if that tree is growing on their own property. Certainly trees are great, but the question can certainly be raised as to whether this is in fact excessive government intrusion.

The Amazing Grass Plant

Continued from page 7

References

1. Beard, J.B and R.L. Green. 1994. The role of turfgrasses in environmental protection and their benefits to humans. *J. Environ. Qual.,* 23(3):452–460.
2. Beard, J.B. 1994. Environmental protection and beneficial contributions of golf course turfs. Science and Golf II, Proc. 2nd World Scientific Congress of Golf. *E&FN Spon,* London, England, UK. 2:399–408.

JB COMMENTS

Failure to Use Chemical Soil Test Findings

It is amazing how often I am called in for a technical assistance visitation to a turfgrass facility that is experiencing problems and/or even failure of the turf. Typically, in these situations there are multiple causes for the problem. One of these may involve the turfgrass nutritional strategy. It is not uncommon for the turf facility manager to have chemical soil tests analyses conducted for the problem area. Yet the individual does not implement changes in the fertilization program to correct the indicated individual nutrient deficiencies. The most common occurrences are deficiencies of potassium (K), magnesium (Mg), iron (Fe), and manganese (Mn). In contrast, there are situations where excessive levels of either copper (Cu) and/or zinc (Zn) are indicated, which are red flags that all applications of these two nutrients should cease in order to prevent potentially serious root zone toxicity problems.

Even though chemical soil tests are in hand, too many turf facility managers fail to implement the needed corrections. Why? Is it the failure to read and/or comprehend the soil test results, or is it a lack of confidence that the chemical soil tests are meaningful in the decision-making process to develop a fertilization program? My guess is the latter.

Perhaps some confusion is created by inadequate interpretation of chemical soil test analyses by the laboratory involved. It is important that all chemical soil test values be interpreted by a professional knowledgeable in turfgrass nutrition. A summary interpretive report should be included with the actual soil chemical analysis. This hopefully will aid the turf facility manager in implementing adjustments in the fertilization program, as well as providing confidence as to the importance of implementing the findings.

ASK DR. BEARD

Q *The new cultivar planted onto a putting green is quite hard, with a high ball bounce that is causing complaints from the golfers. What is wrong?*

A I assume that the old greens on the golf course were constructed by what is termed push-up greens using nearby soil. Typically, such root zones have higher clay and lower sand contents. As a consequence, these greens are less hard, with a low ball bounce, which can be accentuated by excessive applications of water and/or an underlying thatch accumulation.

Typically, new putting greens constructed with a USGA specification high-sand root zone tend to be harder, with a higher ball bounce during the initial 2 to 3 years. Once an underlying root biomass and a modest surface mat accumulation form and are fully decomposed through intermixing of topdressing, the green will become softer, with fewer complaints from golfers. The decomposition of both the thatch/mat and the underlying root biomass is accelerated if cultural practices are followed that stimulate the rate of development of a living soil, which has active microbial, fungal, and insect populations that maximize organic matter decomposition.

In your case, the contrasting situation between the new green and the older putting greens on the golf course creates distinct differential playing conditions among the greens. To summarize, it is not the turfgrass cultivar that is creating the so-called hard greens, but most probably it results from the underlying high-sand content root zone, which requires time to form a living, biologically active root zone which is less hard.

Ask Dr. Beard: TURFAX, c/o Ann Arbor Press
121 S. Main St., P.O. Box 310
Chelsea, MI 48118
Email: turfax@aol.com