TURFGRASS TRENDS

HERBICIDE RESEARCH

Spring-Applied Pre-emergent Herbicides Can Impact Nitrogen Uptake

By Benjamin Wherley

One area where caution has often been advised is selecting the proper pre-emergent herbicide for newly established or heavily trafficked turfgrass. This is because numerous studies have shown that some pre-emergent herbicides may inhibit or delay rooting in these situations (Johnson, 1976; Bingham and Schmidt, 1983). However, often little regard is given to selecting the best-suited product for established turfgrass.

Although soil mobility of pre-emergent herbicides is generally low, pre-emergence herbicides may move downward in soil following application under certain conditions such as high soil moisture or low organic matter content, which inhibits not only seedling growth, but also root initiation from rhizomes in established stands of turfgrass (Fishel and Coats, 1993). Root mass reductions have been reported for established cool-season species Kentucky bluegrass and tall fescue following application of the dinitroanaline herbicide prodiamine (Hummel et al., 1990; Han et al., 1995).

Established warm-season turf stands may be particularly vulnerable to spring root inhibition from pre-emergent herbicides in areas where seasonal growth and dormancy cycles occur. Turfgrass researcher Joe DiPaola et al. (1982) observed that warm-season turfgrasses undergo significant dieback of old roots and replacement by new roots arising from existing rhizomes or stolons during the spring transition period, which typically coincides with the presence of pre-emergent herbicides.

These newly formed roots play a vital role in nitrogen acquisition during spring greenup (Wherley, 2007). And while spring nitrogen applications are not advised for two to three weeks following bermudagrass green-up (Beard, 2002), pre-emergence herbicide-induced root inhibition may persist well beyond this time frame.

The questions we wanted to address with this research were:

- What are the effects of commonly used pre-emergent herbicides on spring root regrowth and development in established bermudagrass?
- Do these changes influence the efficiency at which nitrogen is acquired following spring fertilizer applications?

This study was conducted at the University of Florida's G.C. Horn Turfgrass

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Spring root dieback in common bermudagrass. Note that the old root system has turned brown and a new root system is developing.

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Field Laboratory. A 3-year-old native, sand-based stand of Tifdwarf bermudagrass (*Cynodon dactylon* Pers. X C. *transvaalensis* Burt-Davy) was selected for the study because it had never been treated with pre-emergent herbicides. The plots were maintained at 0.5 inch mowing height throughout the study period. Soil at the site had a pH of 6.4 and organic matter content of the upper 8 inches of soil was 1.04 percent.

Treatment plots were arranged in a completely randomized design with three replications. On Feb. 16, 2009, granular formulations of either dithiopyr [3,5 pyridinedicarbothioic acid, 2-(difluoromethyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-S,S-dimethyl ester] applied at 0.37 pounds of active ingredient per acre, prodiamine [N3,N3-Di-n-propyl-2,4-dinitro-6-(trifluoromethyl)-mphenylenediamine] applied at 1 pound of active ingredient per acre, or oxadiazon [2-tert-butyl-4-(2,4 dichloro-5-isopropoxyphenyl)-2-1,3,4-oxadiazoline-5-one] applied at 2 pounds of active ingredient per acre were applied to plots and watered in. At the time herbicides were applied, plots were in the early stages of greenup, although new root growth was not yet evident.

Tifdwarf plots previously treated with various pre-emergent herbicides were injected with ^{15}N-labeled nitrogen fertilizer.

Periodically over the three months (four, eight and 13 weeks) following herbicide treatment, a 4-inch diameter (12.6-square-inch surface area) times 12-inch deep core was removed from each plot using a cup cutter and washed to evaluate root development. Despite the unusually cold spring, all plots had acceptable surface visual quality, with no apparent differences between treatments throughout the study. However, significant differences in root development became apparent within four to eight weeks after herbicide application, primarily within the upper 10 centimeters (cm).

Prodiamine, a dinitroanaline herbicide, reduced root mass and caused root tip swelling, particularly from new roots initiating from stolons and shallow rhizomes. However, it did not appear to have an effect on root initiation from rhizomes that were positioned deeper (greater than 2 cm) in the soil. This may indicate that stoloniferous species such as St. Augustinegrass or centipedegrass could be even more prone to root injury from springtime dinitroanaline applications than rhizomatous species like bermudagrass or zoysiagrass.

Oxadiazon application resulted in no evidence of a loss in root mass relative to untreated controls. Although dithiopyr reportedly acts similarly to dinitroanaline herbicides, it too had minimal impacts on root development during the course of the study.

On these same sampling dates, 4-inch diameter x 12-inch deep polyvinylchloride tubes were installed into treatment plots. A double-labeled ammonium nitrate solution was introduced into the soil in these tubes at a depth of 0.25 inches. The amount of nitrogen of the injection was equivalent to 1 pound of nitrogen per 1,000 square feet.

Twenty-four hours after injection, the tubes were removed and the soil immediately rinsed from plant tissues. The plant tissues were then oven-dried for 72 hours, finely ground using a ball mill, and analyzed using ratio mass spectrometry to determine the total ^{15}N that had been acquired by turf over the 24-hour period. Because the predominant form of nitrogen in the environment (greater than 99 percent) is the ^{14}N isotope, the stable isotope ^{15}N serves as a useful tracer for determining rates of nitrogen

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uptake, transformation, or fate within plants and soil.

Although new root development was significantly reduced by prodiamine application, we could not detect significant differences in nitrogen uptake on any sampling dates between prodiamine-treated, dithiopyr-treated or untreated plants. Greater nitrogen uptake was detected in oxadiazon-treated plants compared to other herbicide treatments on week eight, likely resulting from the increased root development.

It's likely these results could vary by location, environmental conditions and soil. However, our data indicate that while not necessarily apparent through observations of surface quality, certain spring-applied preemergent herbicides have the potential to influence new root initiation within established warm-season turfgrass stands.

In particular, superintendents who would like to manage bermudagrass through the spring transition period with the healthiest root system may want to reconsider the use of prodiamine in their early-spring herbicide programs.

From a broader environmental standpoint, these data reveal a couple interesting observations about the bermudagrass system. First, despite the abnormally cold spring temperatures during this study, a newly developing root system and low rates of shoot growth, nearly half of the nitrogen supplied to plants was taken up within 24 hours of application. This demonstrates a remarkable capacity for bermudagrass to rapidly acquire moderate quantities of nitrogen fertilizer during the spring transition period, well before rapid shoot growth is occurring.

Secondly, that herbicide-induced reductions in root growth by prodiamine didn't translate to significantly decreased nitrogen uptake appears to highlight the importance of the thatch/mat layer of turfgrass for intercepting nitrogen before it leaches deeper into the soil profile.

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Greater nitrogen uptake was detected in oxadiazon-treated plants compared to other herbicide treatments.

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NTEP Changing the Ground Rules With Its Trial Guidelines

By Curt Harler, Managing Editor

For years, the National Turfgrass Evaluation Program (NTEP) trials have been the standard reference for turfgrass performance. Starting this year, golf course superintendents will see some major changes coming to the long-established guidelines for the program.

The NTEP (www.ntep.org) trials were set up to develop and coordinate uniform evaluation varieties and to look at promising selections in the United States and Canada. Results often are used to determine if a cultivar is well adapted to a local area or particular use on a golf course.

"Recently, NTEP has experienced a reduced number of entries," says Kevin Morris, executive director of the program headquartered in Beltsville, Md. In addition, many of the cultivars being released these

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