Use of Prodiamine as a Preemergence Herbicide to Control Annual Bluegrass in Roughs

Knowing the period of prolific Poa annua *germination is crucial to properly timing preemergence applications.*

by PETER H. DERNOEDEN, Ph.D.

ANNUAL bluegrass is a puzzling weed with diverse annual (*P. annua* ssp. *annua*) and perennial (*P. annua* ssp. *reptans*) biotypes. Several chemical strategies involving pre- and postemergence herbicides and plant growth regulators can reduce annual bluegrass (Beard et al., 1978; Callahan and McDonald, 1992; Dernoeden and Turner, 1988; Goss et al., 1980; Kageyama et al., 1989; and Hall and Carey, 1991). Long-term or complete control of the weed, however, is seldom achieved (Branham, 1991; Christians, 1996). Cultural methods, such as increasing mowing height, collecting clippings when seedheads appear, improving drainage and fertility, alleviating soil compaction, applications of iron and magnesium, and flaming reduce the competitiveness of annual bluegrass (Beard et al., 1978; Bell et al., 1997; Desjardins et al., 1997; Watschke et al., 1995). Among preemergence herbicides, multiple applications of bensulide (i.e., Betasan, LescoSan, etc.) and tricalcium arsenate have been reported to consistently reduce annual bluegrass in cool-season turf (Callahan and McDonald, 1992; Goss et al., 1980). Late-summer applications of preemergence herbicides to areas in play on golf courses, however, are discouraged in the Mid-Atlantic region. The use of these herbicides in late summer conflicts with overseeding operations and can be potentially phytotoxic because of generally high air temperatures. Also, persisting herbicide residues in soil could interfere with successful overseeding should large turf areas be killed during winter due to ice cover, crown hydration, desiccation, disease, or other factors.

Annual bluegrass produces large amounts of seed, and heavily colonized areas in golf course roughs and out-of-bounds areas provide a large potential reservoir of seed. The use of a preemergence herbicide in rough areas not adjacent to fairways, greens, and tees would be less risky, assuming turf density was good in late summer. A cursory Maryland study suggested that prodiamine (Barricade 65DG®) was an effective preemergence annual bluegrass herbicide (Dernoeden and Krouse, 1994). The time that annual bluegrass seed germinates in the Mid-Atlantic and most other regions, however, has not been well documented.

Annual bluegrass seedling emergence was monitored adjacent to a putting green at Woodmont Country Club in Rockville, Md., between September 1, 1994, and May 2, 1995, by Robert Larsen, a student then attending the University of Maryland. Mr. Larsen first observed annual bluegrass seedlings on September 21, 1994, in 1.5-inch diameter spots created by a nonselective herbicide. No germination occurred after December 14, but he did observe some seedlings emerging between April 12 and 26, 1995. Although the main germination period of annual bluegrass in the Mid-Atlantic region is likely to begin in late summer, the best timing for an application of a preemergence herbicide for this weed in the region has not been established. Hence, the objectives of this study were to determine the proper timing and rates of prodiamine for preemergence annual bluegrass control in Kentucky bluegrass maintained under golf course rough conditions.

Methods

Treatments were applied to a mature stand of "Kenblue" Kentucky bluegrass at the University of Maryland Turfgrass Research and Education Facility in Silver Spring, Md. For several years the test site was uniformly infested each spring with *P. annua*, but virtually all of the annual bluegrass died during each summer. Because of its apple-green color, prolific seedhead production in May, and inability to survive summer, the biotype at the site was considered to be *P. annua* ssp. *annua*. There also was a heavy smooth crabgrass (*Digitaria ischaemum*) infestation at the site when treatments were applied each fall. The soil was a Chillum silt loam with a pH of 6.2 and 2.3 percent organic matter. Turf was mowed to a height of 2.0 to 2.5 inches and was fertilized with 2.0 lb. N/1000 sq. ft. per year. The 1995 and 1996 studies were conducted on separate, but adjacent sites.

Three rates of prodiamine were applied on three dates in 1995 and 1996 (Tables 1 and 2). The site was irrigated within 24 hours of each application with at least 0.20 inch of water. Prodiamine was applied in 50 gallons of water per acre with a CO_2-pressurized backpack sprayer equipped with an 8004E flat-fan nozzle. Plots were 5.0 by 5.0 feet and were arranged in a randomized complete block with four replications. Percentage of plot area covered by annual bluegrass or smooth crabgrass was assessed visually on a 0-to-100% linear scale where 0 = no weeds and 100 = entire plot area covered by weeds. Rating for annual bluegrass cover was facilitated by the presence of seedheads between mid-May and early June. Subjectively, annual bluegrass cover ≤ 5.0% was considered to be commercially acceptable control for a golf course rough. Data were subjected to statistical analysis and the results of this study were reported previously (Dernoeden, 1998).

1996 Results

Large numbers of annual bluegrass seedlings were first noted emerging at the site on October 3, 1995. The annual bluegrass coverage trends evident on November 27, 1995, remained relatively unchanged on subsequent rating dates, including the final rating on May 24, 1996 (Table 1). All rates applied on either August 11 or September 14 significantly reduced annual bluegrass and produced statistically similar levels of control. Complete control was provided only by 1.0 lb. ai/A applied September 14. None of the

treatments applied October 13, however, reduced annual bluegrass significantly when compared with untreated control plots. Using a subjective annual bluegrass cover threshold of 5.0%, the following prodiamine treatments provided for commercially acceptable control for golf course roughs: 0.32 lb. ai/A applied September 14 and 0.65 or 1.0 lb. ai/A applied on August 11 and September 14.

Smooth crabgrass was highly invasive and weed cover was rated on August 20, 1996 (Table 1). Ratings showed that 0.65 lb. ai/A prodiamine applied on October 13 and 1.0 lb. ai/A applied on September 14 or October 13, 1995, provided an excellent level (1 to 6% crabgrass cover) of season-long smooth crabgrass control in 1996. These findings were similar to those reported previously for November applications of prodiamine 65DG in Maryland (Dernoeden, 1993).

1997 Results

Treatments were initiated later in 1996, and prodiamine was applied at two-week intervals to better pinpoint the application window for the herbicide and germination time of annual bluegrass. Annual bluegrass seedlings were first observed in the test site on September 30, 1996. Except for the 0.32 lb. ai/A rate applied on September 30, 1996, all treatments provided a similar level (0 to 8% cover) of annual bluegrass control. The only treatments not within the 5% cover threshold were the 0.32 and 0.65 lb. ai/A rates applied on September 30. On all 1997 rating dates, annual bluegrass control was better with the higher prodiamine rate applied September 30. These data suggested that the high rate may have had some early postemergence activity on annual bluegrass. During the summer there was very little rainfall and only a small amount of irrigation water was applied, and the turf eventually became drought dormant. As a result, smooth crabgrass levels were very low and all treatments significantly reduced crabgrass cover.

Discussion

Annual bluegrass seed germinates during cool, moist periods in late summer and fall, but in some regions seed may germinate in the spring (Beard et al., 1978). According to Dr. Bruce Branham (1991), annual bluegrass germinates so profusely in the spring and fall in Michigan that three annual applications of preemergence herbicides are needed to effectively control the weed. In Tennessee, the annual subspecies germinates from mid-November to early January (Callahan and McDonald, 1992).

Poa annua's *prolific seed production provides a large reservoir of seed in rough and outlying areas that can easily be tracked to fairways, tees, and greens.*

Observations and data from this study indicated that the major germination period of annual bluegrass in central Maryland was from late September to early December. The view that germination occurs after mid-September is supported, in part, by the relatively poor level of control provided by 0.32 lb. ai/A prodiamine applied September 30, 1996, relative to that obtained with the August 29 and September 16 applications in 1996.

There was little change in annual bluegrass cover ratings between November 27, 1995, and April 3, 1996, indicating that most of the annual bluegrass emerged by late November in 1995 (Table 1). Annual bluegrass seed may have germinated at the site in April, but seedling emergence was not noted. Field observation indicated that the rapid increases in annual bluegrass cover ratings during April and May in both years was largely due to aggressive tillering of overwintering annual bluegrass in the spring.

Hence, as reported in Tennessee (Callahan and McDonald, 1992), the annual biotype appears to have one major germination period between late summer and early winter in central Maryland. As previously noted, however, there may be a brief spring germination period in April. Results from this study also showed that annual bluegrass could be controlled effectively with as little as 0.32 lb. ai/A prodiamine 65DG applied during the first two weeks of September. This time and rate may only be appropriate for the central Mid-Atlantic region in a non-disturbed (i.e., no core cultivation, verticutting, etc.) turf maintained at a mowing height above 2.0 inches.

It also is important to note that only the sprayable, 65DG formulation of prodiamine was evaluated. Granular forms of prodiamine may not perform as well as the 65DG. For example, numerous granular forms of prodiamine have been tested for several years at the University of Maryland for preemergence smooth crabgrass control. These studies clearly have shown that there is a great variation in crabgrass control performance among the many granular forms of prodiamine available in the marketplace.

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Table 1
Influence of rate and time of application of prodiamine (Barricade 65DG®) on preemergence control of annual bluegrass and smooth crabgrass in "Kenblue" Kentucky bluegrass, 1995-1996

Prodiamine		% Plot Area Covered				
		1995	1996			
Rate	Date Applied	Annual Bluegrass				Smooth Crabgrass
(lb. ai/A)	(1995)	27 Nov.	3 April	1 May	24 May	20 Aug.
0.32	11 Aug.	2 b[2]	3 bcd	4 bc	7 bc	90 a
	14 Sept.	2 b	2 bcd	3 bc	4 bc	46 bc
	13 Oct.	23 a	31 a	33 a	40 a	39 c
0.65	11 Aug.	2 b	3 bcd	3 bc	4 bc	61 b
	14 Sept.	<1 b	1 cd	2 bc	2 c	24 cd
	13 Oct.	19 a	15 abcd	16 abc	18 abc	4 d
1.0	11 Aug.	<1 b	1 cd	1 c	1 c	33 c
	14 Sept.	0 b	0 d	0 c	0 c	6 d
	13 Oct.	22 a	18 abc	21 ab	25 ab	1 d
Untreated	——	16 a	19 ab	34 a	38 a	96 a

[2]Mean separation within columns by Duncan's multiple range test, $P = 0.05$

Table 2
Influence of rate and time of application of prodiamine (Barricade 65DG®) on preemergence control of annual bluegrass and smooth crabgrass in "Kenblue" Kentucky bluegrass, 1996-1997

Prodiamine		% Plot Area Covered				
		1996	1997			
Rate	Date Applied	Annual Bluegrass				Smooth Crabgrass
(lb. ai/A)	(1996)	17 Dec.	28 April	16 May	2 June	5 Sept.
0.32	29 Aug.	2 b[2]	1 c	3 c	3 c	2 b
	16 Sept.	0 b	4 c	4 c	5 c	<1 b
	30 Sept.	4 b	11 b	20 b	17 b	1 b
0.65	29 Aug.	0 b	1 c	2 c	3 c	<1 b
	16 Sept.	0 b	1 c	<1 c	1 c	0 b
	30 Sept.	3 b	6 bc	8 c	8 bc	<1 b
1.0	29 Aug.	0 b	0 c	<1 c	<1 c	0 b
	16 Sept.	0 b	0 c	0 c	0 c	0 b
	30 Sept.	2 b	3 c	4 c	3 c	0 b
Untreated	——	8 a	21 a	33 a	35 a	5 a

[2]Mean separation within columns by Duncan's multiple range test, $P = 0.05$