

Annual Bluegrass Control in a Creeping Bentgrass Fairway Using Cutless 50W, Primo MAXX 1EC and Various Tank-mix Combinations.

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Objective:

To evaluate the plant growth regulators (PGRs), Cutless 50W, Primo MAXX 1EC and various tank-mixes of the two for their ability to control annual bluegrass in a creeping bentgrass fairway when applied monthly from May through October.

Experimental Procedures:

This field study was conducted at the Wm. H. Daniel Turfgrass Research and Diagnostic Center at Purdue University, West Lafayette IN, during 2004. The study area consisted of mixed sward of creeping bentgrass (*Agrostis stolonifera* 'L-93') and annual bluegrass (*Poa annua*) being grown on a Starks-Fincastle silt-loam (fine-silty, mixed, mesic Aeric Ochraqualf) with pH of 7.2. The creeping bentgrass was planted in Aug. 2003 and fully mature prior to treatment applications. The area was mowed at 0.5 inch three times per week with clippings returned, irrigated to prevent stress and fertilized with approximately 3.0 lbs N/1000 ft². Insecticides and fungicides (contacts) were applied on a curative basis as required. All treatments were applied with a pressurized CO₂ (35 psi) sprayer equipped with TeeJet XR 8003 tips calibrated to deliver 2.0 gallons of spray volume per 1000 ft². Treatments were initiated on 15 May, and subsequent treatments applied; 14 June, 9 July, 10 Aug., 17 Sep., and 19 Oct. Plots were 5 x 10 ft and arranged in a randomized complete block with four replications. Irrigation was applied within twelve hours of treatment application via an overhead irrigation system once the plant growth regulators had dried on the leaf surface.

Plots were visually assessed throughout the study for creeping bentgrass color, quality and injury, percentage annual bluegrass present and any injury, dollar spot severity, and surface smoothness disruption due to the presence of creeping bentgrass stolons. Creeping bentgrass color was assessed on a 0-10 scale with 0=brown turf, 10=dark green and 5=acceptable. Creeping bentgrass quality was assessed on a 0-10 scale with 0=poor quality turf, 10=excellent and 5=acceptable. The amount of annual bluegrass present was assessed on a linear 0-100 % scale where 0=no annual bluegrass present and 100 % is total plot coverage due to annual bluegrass. Dollar spot was assessed on a linear 0-100 % scale with 0=no infection centers present and 100 % = plot completely covered. Canopy surface smoothness disruption was assessed on a 0-10 scale with 0=no visible stolons and 10=severe disruption of surface uniformity. All data was subjected to analysis of variance using the SAS system (Statistical Analysis Systems Institute Inc., Cary, N.C.) and mean separation performed using Fisher's protected least significant difference test at the (P<0.05) level.

Results:

Color ratings for the treated plots were significantly different on four of fifteen rating dates throughout the study (Table 1). On 28 May, two weeks after the initial treatment application, all PGR treatments exhibited better color than the untreated control. While Cutless 50W (0.50 lbs ai/A) did improve the color over that of the untreated, the tank-mix of Cutless (0.25 lbs ai/A) + Primo MAXX 1EC and Primo MAXX 1EC alone was significantly higher than Cutless alone at 0.50 lbs ai/A. After a trend of lower color ratings throughout July, the tank-mix of Cutless (0.50 lbs ai/A) and Primo rebounded during August. During the latter part of the growing season, following the mid Sept. treatment application, Cutless (0.50 lbs ai/A), either alone or in the tank-mix, reduced the color compared to the untreated for both Oct. ratings. All treatments, however, rebounded to acceptable levels by early November.

Overall, bentgrass quality responses were very similar to those of the color ratings (Table 2). The high rate of Cutless (0.50 lbs ai/A) + Primo tank-mix had worse quality than the lower rate

Cutless (0.125 lbs ai/A) + Primo tank-mix or Primo alone. The high rate Cutless tank-mix did rebound through June but, by July, it was again exhibiting decreased quality. As with the color data, the mid-Sept. applications containing the high rate of Cutless adversely affected quality and negative effects began to wear off by early November.

Annual bluegrass populations ranged from 14 to 56 % depending upon rating date and PGR applications (Table 3). Populations in the untreated plots followed the expected pattern for seasonal development with higher levels (45-56 %) early in the season, lowest (15 %) in late-summer and high (50 %) populations late in the season. All PGR treatments significantly reduced annual bluegrass cover compared to the untreated plots both early, May, and late in the study, Nov., when populations were highest. Through the summer months it is likely the natural dynamics, and canopy architecture of a mixed sward of creeping bentgrass and annual bluegrass lessened the visual presence due to the natural tendency of the creeping bentgrass to thrive during summer months. Late season trends support the hypothesis that Cutless (0.25 lbs ai/A) alone or tank-mixed may prove to be a viable management option in an annual bluegrass reduction program where quality cannot be sacrificed. These treatments lowered annual bluegrass populations from 50 % in the untreated plots to 28 and 23 % for the Cutless (0.25 lb ai/A) treatments respectively.

Creeping bentgrass and annual bluegrass injury were rated when injury to a particular species was clearly discernable (Table 4). Injury was generally noted June through July. Bentgrass injury on 18 and 25 June was more severe on tank-mix treatments with Cutless at both 0.25 and 0.50 lbs ai/A. On 16 July only, treatments containing Cutless at the high rate (0.5 lb. ai/A) caused injury with the tank-mix causing more severe injury than the high rate alone. Damage to annual bluegrass caused by Cutless (0.50 lbs ai/A) + Primo on 28 May during the spring growth flush of annual bluegrass was markedly higher than all other treatments.

Additional data were recorded on 28 May due to the appearance of creeping bentgrass stolons on the canopy surface (see attached photo for a visual description of the exact phenomenon), which could be considered disruptive to the uniformity of a golf course fairway (Table 4). Treatments containing the high rate of Cutless produced the most severe response. While the remaining treatments also displayed poor surface uniformity, the problem was alleviated from all treatments after several mowings. If this problem were to occur on an actual golf course fairway, it is likely that the surface uniformity could be improved even more quickly through a combination of mowing and turf grooming or vertical mowing. It is possible that this could be a beneficial plant response, since this is clearly increased lateral growth and may enhance divot recovery during this time period. One possible explanation for this phenomenon is that there may be a physiological interaction of the PGR in the plant with this period of rapid spring growth/carbohydrate usage since it only was evident during the spring growth flush. Dollar spot was also observed during the study. No significant differences were observed among treatments with respect to dollar spot severity.

In summary, during this single season study, all PGR treatments significantly affected normal turf growth effects compared to the untreated plots. Both quality and color responses were beneficial and negative depending on PGR product, application rate and rating date. For example Cutless 50W applied at the 0.5 lb ai/A rate, color was enhanced early in the season but negatively affected late in the season. By contrast for the 0.25 lb ai/A rate no difference in quality was observed throughout the study. Additionally, and probably most importantly, all PGRs significantly decreased annual bluegrass populations. Future studies should include further study and refinement of the tank-mix rates for turf quality and color enhancement and longer-term evaluation of these PGRs to see if continued annual bluegrass population reductions continue.

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Figure 1. Annual bluegrass suppression and creeping bentgrass injury



Figure 2. Creeping bentgrass surface uniformity disruption due to stolon growth.

Table 1. Creeping bentgrass color^b as affected by various applications of flurprimidol and trinexapac-ethyl.

Treatment ^a	Rate	21 May	28 May	11 June	18 June	25 June	9 July	16 July	23 July	6 Aug.	20 Aug.	3 Sep.	17 Sep.	1 Oct.	22 Oct.	5 Nov.
	(lbs ai/A)															
Cutless	0.25	7.3	6.5 ab ^c	6.8	6.3	6.3	5.8	5.5	5.8	5.8 ab	7.0	6.8	6.8	5.8 b	6.3 a	6.0
Cutless	0.50	7.0	6.3 b	6.8	6.0	5.8	4.8	5.5	5.3	5.5 b	6.5	6.8	6.0	4.0 c	3.5 b	6.3
Cutless + Primo Maxx	0.125 0.05	6.5	6.5 ab	5.8	5.3	5.0	4.8	5.3	5.3	5.3 b	6.5	5.5	5.8	5.8 b	5.8 a	6.0
Cutless + Primo Maxx	0.25 0.05	6.8	7.3 a	6.3	5.8	5.5	5.5	5.0	5.8	5.5 b	7.3	6.5	6.0	4.3 c	5.5 a	6.8
Cutless + Primo Maxx	0.50 0.05	7.0	6.5 ab	7.3	6.0	5.5	4.3	4.5	6.3	6.3 a	7.5	6.5	6.5	3.0 d	3.3 b	5.8
Primo Maxx	0.10	7.5	7.3 a	7.3	6.3	6.3	6.0	6.3	6.3	5.5 b	6.5	6.0	6.5	6.8 a	6.5 a	6.3
Untreated	---	5.6	4.6 c	6.2	6.8	6.5	5.4	5.7	5.2	5.2 b	6.2	6.0	6.3	6.3 ab	5.6 a	4.9
LSD (0.05)		NS	0.9	NS	NS	NS	NS	NS	NS	0.6	NS	NS	NS	0.7	1.4	NS

^a Treatments were applied on 15 May, 14 June, 9 July, 10 Aug., 17 Sep., and 19 Oct. in 2 gals H₂O/1000 ft².

^b Creeping bentgrass color was rated on a 0-10 scale with 0=brown, 10=dark green and 5=acceptable.

^c Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD t-test (p=0.05).

Table 2. Creeping bentgrass quality^b as affected by various applications of flurprimidol and trinexapac-ethyl.

Treatment ^a	Rate	21 May	28 May	11 June	18 June	25 June	9 July	16 July	23 July	6 Aug.	20 Aug.	3 Sep.	17 Sep.	1 Oct.	22 Oct.	5 Nov.
	(lbs ai/A)															
Cutless	0.25	6.5	5.5 abc ^c	6.0	7.0	6.8	5.8	6.3 ab	5.3	5.3	6.8	6.8	6.3	6.0 bc	5.3 a	6.0
Cutless	0.50	6.8	6.0 abc	6.3	7.0	6.0	5.3	5.3 abc	4.8	5.0	5.5	6.0	6.3	4.0 fe	3.5 bc	4.8
Cutless + Primo Maxx	0.125 0.05	6.0	6.3 ab	5.5	5.8	5.8	5.0	4.8 bc	4.5	4.3	5.8	5.0	5.0	5.5 cd	5.0 ab	5.0
Cutless + Primo Maxx	0.25 0.05	6.0	5.8 abc	5.8	6.0	5.8	5.8	5.3 abc	5.3	5.0	6.8	6.5	6.0	4.8 de	5.0 ab	6.0
Cutless + Primo Maxx	0.50 0.05	6.3	4.8 c	5.8	6.3	6.0	4.5	4.3 c	5.3	5.8	6.8	6.3	6.5	3.0 f	3.3 c	5.5
Primo Maxx	0.10	7.3	6.8 a	6.8	7.0	6.3	6.3	6.5 a	5.5	5.0	6.3	6.0	6.3	7.3 a	5.8 a	6.0
Untreated	---	5.6	5.0 bc	5.8	7.0	6.7	5.8	6.2 ab	4.9	4.7	6.3	6.0	6.3	6.7 ab	5.0 ab	5.4
LSD (0.05)		NS	1.3	NS	NS	NS	NS	1.5	NS	NS	NS	NS	NS	1.2	1.5	NS

^a Treatments were applied on 15 May, 14 June, 9 July, 10 Aug., 17 Sep., and 19 Oct. in 2 gals H₂O/1000 ft².

^b Creeping bentgrass quality was rated on a 0-10 scale with 0=poor, 10=excellent and 5=acceptable.

^c Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD t-test (p=0.05).

Table 3. Percentage annual bluegrass cover as affected by various flurprimidol and trinexapac-ethyl applications.

Treatment ^a	Rate	21 May	28 May	18 June	28 June	9 July	16 July	6 Aug.	20 Aug.	3 Sep.	17 Sep.	5 Nov.
	(lbs ai/A)	----- (%) ^b -----										
Cutless	0.25	37.5 abc ^c	40.0 b	36.3	41.3	31.3	20.0	23.8	24.3	23.8	14.8	22.5 b
Cutless	0.50	32.5 bc	38.8 b	43.8	42.5	33.8	28.8	25.0	24.3	28.8	17.3	25.0 b
Cutless + Primo Maxx	0.125 0.05	41.3 ab	36.3 b	55.0	46.3	43.8	37.5	30.0	33.8	36.3	26.0	31.3 b
Cutless + Primo Maxx	0.25 0.05	33.8 bc	31.3 b	38.8	42.5	33.8	26.3	30.0	26.3	26.8	20.5	27.5 b
Cutless + Primo Maxx	0.50 0.05	32.5 bc	31.3 b	35.0	40.0	32.5	27.5	22.5	20.0	21.3	18.3	21.3 b
Primo Maxx	0.10	31.3 c	32.5 b	36.3	35.0	28.8	27.5	21.3	25.0	25.0	14.3	35.0 b
Untreated	---	45.0 a	56.3 a	37.9	38.8	36.2	29.2	25.4	31.7	25.4	15.4	50.0 a
LSD (0.05)		9.5	12.3	NS	NS	NS	NS	NS	NS	NS	NS	13.9

^a Treatments were applied on 15 May, 14 June, 9 July, 10 Aug., 17 Sep., and 19 Oct. with 2 gals H₂O/1000 ft².

^b Cover ratings were based on a 0-100 linear scale where 100 is complete plot coverage and 0 is none.

^c Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD t-test (p=0.05).

Table 4. Creeping bentgrass and annual bluegrass injury, canopy surface disruption and dollar spot severity as affected by various flurprimidol and trinexapac-ethyl applications.

Treatment ^a	Rate	Bentgrass injury ^b				Annual bluegrass injury				Canopy stolons ^c	Dollar spot ^d ¶
		18 June	25 June	9 July	16 July	28 May	25 June	9 July	16 July	28 May	23 July
	(lbs ai/A)	(0-10)				(0-10)				(0-10)	(% affected turf)
Cutless	0.25	0.8 cd ^e	0.3 c	0.0	0.5 bc	0.0 c	0.3	1.3 bc	1.5 bc	5.0 b	2.3
Cutless	0.50	1.8 bc	0.8 bc	0.5	1.0 b	0.5 bc	1.0	2.3 ab	2.8 abc	5.7 ab	6.3
Cutless + Primo Maxx	0.125 0.05	0.0 d	0.3 c	0.0	0.3 bc	0.0 c	1.5	1.0 bc	3.0 ab	3.0 cd	3.8
Cutless + Primo Maxx	0.25 0.05	3.5 a	2.0 a	0.0	0.5 bc	1.5 b	1.5	1.3 bc	3.0 ab	4.5 bc	3.5
Cutless + Primo Maxx	0.50 0.05	3.0 ab	1.5 ab	0.8	2.5 a	6.5 a	1.3	3.3 a	4.0 a	6.7 a	4.0
Primo Maxx	0.10	0.3 cd	0.5 bc	0.0	0.0 c	1.5 b	2.3	0.0 c	0.5 c	3.0 cd	4.8
Untreated	---	0.1 cd	0.0 c	0.0	0.0 c	0.0 c	0.0	0.4 bc	0.7 bc	1.5 d	4.2
LSD (0.05)		1.7	1.2	NS	0.8	1.3	NS	1.9	2.3	1.7	NS

^a Treatments were applied on 15 May, 14 June, 9 July, 10 Aug., 17 Sep., and 19 Oct. with 2 gals H₂O/1000 ft².

^b Creeping bentgrass and annual bluegrass injury ratings were based on a 0-10 scale with 0=no injury and 10= completely brown, dead turf.

^c Canopy surface disruption due to bentgrass stolons ratings were based on a 0-10 scale with 0=no stolons visible and 10=severe disruption.

^d Dollar spot ratings were based on a 0-100 linear scale where 100 is complete dollar spot coverage

^e Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD t-test (p=0.05)