

Evaluation of Ethephon (Proxy) and Trinexapac-ethyl (Primo MAXX) Combinations for Suppression of Annual Bluegrass Seedheads on a Golf Course Putting Green

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Objective:

To evaluate the effectiveness of three plant growth regulators for their ability to suppress annual bluegrass seedheads on a golf course putting green containing a mature mixed stand of annual bluegrass and creeping bentgrass.

Experimental Procedures:

All treatments were applied with a pressurized CO₂ (30 psi) sprayer equipped to deliver 1.0 gallon of spray volume per 1000 sq ft. Where specified, four treatments were initiated on 27 March, 2004 which co-incident with the date nearest the second mowing of the new growing season. The remaining treatments were initiated on 2 April. The dates, rates and actual application timings are all footnoted in the data tables. The study area was conducted on #6 putting green, a par-4 golf hole located at the Lafayette Municipal Golf Course in Lafayette, IN. This putting green had approximately 45 to 60 % annual bluegrass that was assumed to be primarily the annual biotype. The turf on this green was located in full sun and is cultivated on a native soil rootzone that had been regularly sand topdressed for several decades. Turf was maintained under typical municipal golf course practices which include daily triplex mowing at 0.150 inches and annual fertilization with approximately 3.0 lbs. of N/1000 sq ft. throughout the growing season. This site was selected because of its relatively uniform annual bluegrass population and long-term history of annual bluegrass. Plots were 5 ft x 5 ft, and arranged in a randomized complete block with four replications. In the absence of rainfall the plots were only irrigated to prevent stress.

Several environmental indicators like percentage turfgrass green-up, annual bluegrass boot stage and timing of forsythia bloom. (Table 1) were recorded in order to provide key indicators for golf course managers to determine product application timings.

Plots were rated for the presence of seedheads, turfgrass quality, and turf injury. Percent of plot area covered by seedheads was assessed on a linear 0 to 100 % scale where 0 = no seedheads observed, and 100 = entire plot area covered by seedheads. Turfgrass quality was assessed on a 0 to 10 scale where 0 equals brown or dead turf and 10 equals optimal greenness, density and uniformity. Turf injury was rated on a 0-5 scale where 0 = no injury and 5 = complete chlorosis. No injury was observed by any treatment during this study and therefore the data is not presented. Air and soil temperatures (0.25 and 2 inch depths) were continuously monitored throughout the study using logging temperature probes (Onset Corp.) adjacent to the putting green. Unfortunately the Lafayette Municipal course experienced a severe flood from the Wabash River during the second week of June which completely covered the environmental monitoring equipment. Therefore, the environmental data contained in this report are from the West Lafayette airport.

Table 1. Key plant indicators observed during the study period.

Turfgrass	50 % green-up	24 March
	75% green-up	26 March
	100% green-up	1 April
Annual bluegrass	75% boot	16 April
Forsythia	Bud extension	24 March
	50% bloom	28 March
	75% bloom	29 March
	100% bloom	30 March

Results:

At initial application of all treatments the percentage of the plots containing annual bluegrass seedheads was rather low, (< 5 %), and remained that way until 16 April (Table 2). Over the next three weeks as air and soil temperatures increased (Table 3), the presence of seedheads increased. Compared to the untreated turf which had 24 % of the plot area covered by seedheads on 30 April, most treated plots had ≥ 13 % seedheads which would certainly be noticeable to golfers. The Proxy + Primo Maxx combinations applied at the 2nd mowing, the Proxy + Primo Maxx combination applied at 5.0 oz of Proxy one week after the 2nd mowing and repeated three weeks later, and the Embark T/O application resulted in superior annual bluegrass seedhead suppression on 30 Apr. Seedheads in the untreated plots increased dramatically to, 39 % and 55% on 7 and 14 May, respectively. Seedheads present at this amount would severely disrupt ball roll on the putting green. On these two rating dates, there was no consistent seedhead suppression by any PGR or PGR combination. By, 21 May, seedheads decreased to 11 % of the plot in the untreated, but a second wave of seedheads, > 36%, was recorded on 28 May. This could possibly be explained by variation in annual bluegrass biotypes (e.g. some plants naturally flowered later) or fluctuating environmental conditions during this week of May. On the three worst seedhead rating dates, 7, 14 and 28 May when the untreated plots possessed ≥ 36 % seedheads, no single treatment consistently reduced seedheads compared to the untreated plots. However, all treatments except Proxy + Primo Maxx (3.33 + 0.83 oz) applied three times and Embark T/O, effectively suppressed seedhead production on two of the three rating dates. Seedhead suppression during this period was lowered from 19-39 % compared to the untreated plots which had 36 – 55 % of the plot area covered with seedheads.

Compared to Embark T/O applied on 27 March, which has historically been widely regarded in the industry as the standard for annual bluegrass seedhead suppression, no single Proxy + Primo Maxx treatment provided superior control until 14 May (Table 1). On that date the Proxy + Primo Maxx (3.0 + 0.125) treatment applied 1 week after the 2nd mowing and repeated 1 WAT decreased annual bluegrass seedheads from 38 % to 16 %. By 21 May, numerous other Proxy + Primo Maxx combinations also provided superior seedhead suppression compared to Embark T/O. One possible reason for this response may have been that the Embark T/O was a single treatment application, whereas the Proxy + Primo Maxx treatments involved multiple applications which probably extended seedhead suppression.

Turfgrass quality and color were visually assessed throughout the study. No discoloration was observed from any treatment during this experiment (data not shown). Thus, in this study under these environmental conditions all treatments were deemed “safe” for use on a municipal golf course putting green. However, previous reports have indicated mild chlorosis associated with certain environmental conditions during spring green-up and the manufacturer’s product labels should be consulted prior to using these products on various bentgrass cultivars.

As expected, turfgrass quality generally increased as the study progressed (Table 3). This is attributed to more favorable growing conditions and an overall greener appearance as the turf grew more actively. The worst date for untreated turf quality was on 14 May. This date had highest seedhead ratings (55 %) which severely disrupted surface uniformity and was the reason for the poor quality rating. As with seedhead suppression ratings, no single treatment provided superior quality throughout the study. The most consistent treatment for turf quality was Proxy + Primo Maxx (3.33 + 0.083) applied three times, which provided superior quality compared to the untreated plots on four of the six rating dates. Additionally, Proxy + Primo Maxx (3.0 + 0.125) provided superior quality on three of six rating dates, indicating its promise for improving turf quality.

In summary, no treatment consistently reduced annual bluegrass seedheads throughout this study. Several treatments, although erratic in their response showed significant benefit for reducing seedheads and improving visual turf quality during the peak seedhead production period from 7 to 28 May. On the worst seedhead rating date, 14 May, several treatments decreased percentage of the plot covered by seedheads from 55% to approximately 20 %. This would be much more tolerable from an aesthetic standpoint and in terms of ball roll or playability. These treatments included; Proxy + Primo Maxx at both the 3.0 and 5.0 oz Proxy rates applied at the 2nd mowing and repeated 4 weeks after initial treatment, and Proxy Primo at both the 3.0 and 5.0 oz rates 1 week after the 2nd mowing and repeated one week after initial application. Lastly three applications of Proxy (3.33 oz) + Primo (0.083 oz) applied three times on two week intervals starting at the 2nd mowing improved turfgrass quality.

Future research needs to continue to identify optimum application timings and rates of these PGRs to better suppress seedheads on putting greens. Thus, as has been well documented in the scientific literature, annual bluegrass continues to be a tenacious weed problem on putting green turf. An effective seedhead suppression program will likely require application(s) of a PGR or PGR combination that provides 6 to 8 weeks of suppression in order to limit seedhead production of all annual bluegrass biotypes present and account for variable environmental conditions from golf green micro-climate to micro-climate and year to year differences. Additionally, employing proper cultural practices to favor the desired turfgrass species throughout the growing season are essential in order to effectively reduce annual bluegrass populations.

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Table 2. Visual seedhead ratings of a mixed creeping bentgrass/annual bluegrass native soil putting green as affected by various plant growth regulator application rates and timings.

Treatment	Rate oz /1000 ft ²	Application Timing ^a	Seedhead rating						
			16 April	30 April	7 May	14 May	21 May	28 May	4 June
Proxy + Primo Maxx	3.0 0.125	2 nd mowing + 4 weeks	2 bc ^c	15 b	26 abcd	21 bc	5 bcd	23 bc	6 b
Proxy + Primo Maxx	5.0 0.125	2 nd mowing + 4 weeks	2 bc	13 b	27 abc	19 bc	5 bcd	15 c	3 b
Proxy Primo Maxx	3.0 0.125	1 wk after 2 nd mowing + 3 weeks	3 ab	16 ab	15 bcd	35 abc	5 bcd	16 c	10 ab
Proxy Primo Maxx	5.0 0.125	1 wk after 2 nd mowing + 3 weeks	4 a	14 b	30 ab	31 bc	6 bcd	18 c	3 b
Proxy Primo Maxx	3.0 0.125	1 wk after 2 nd mowing + 2 weeks	3 ab	18 ab	18 bcd	34 bc	11 ab	24 bc	21 a
Proxy Primo Maxx	5.0 0.125	1 wk after 2 nd mowing + 2 weeks	3 ab	18 ab	16 bcd	33 bc	10 abc	28 abc	9 ab
Proxy Primo Maxx	3.0 0.125	1 wk after 2 nd mowing + 1 week	1 c	16 ab	11 cd	16 c	5 cd	21 bc	9 ab
Proxy Primo Maxx	5.0 0.125	1 wk after 2 nd mowing + 1 week	2 bc	16 ab	9 d	18 bc	10 abc	28 abc	10 ab
Proxy Primo Maxx	3.33 0.083	2 nd mowing + 2 weeks + 2 weeks	2 bc	19 ab	23 abcd	19 bc	2 d	16 c	6 b
Embark T/O	40 oz/A	2 nd mowing	2 bc	14 b	21 bcd	38 ab	13 a	41 a	15 ab
Untreated	---	---	2 bc	24 a	39 a	55 a	11 ab	36 ab	16 ab

^a Treatments initiated at “2nd mowing” were applied on 27 March, 2004. All subsequent treatments were based off this date. The “+ 1 week”, “+2 weeks”, “+ 3 weeks”, and “+4 weeks” were applied on 2, 9, 16 and 23 April respectively. All treatments were applied in 1.0 gal 1000 ft² spray carrier volume.

^b Visual seedhead ratings were based on a 0-100 linear scale where 100 is turf canopy completely covered by annual bluegrass seedheads and zero is none.

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

Table 3. Visual turfgrass quality^b ratings of a mixed creeping bentgrass/annual bluegrass native soil putting green as affected by various plant growth regulator application rates and timings.

Treatment	Rate oz /1000 ft ²	Application Timing ^a	24 April	7 May	14 May	21 May	28 May	4 June
Proxy + Primo Maxx	3.0 0.125	2 nd mowing + 4 weeks	5.0 c ^c	5.8 bc	5.6 bc	6.0 bc	7.1 abc	7.5 ab
Proxy + Primo Maxx	5.0 0.125	2 nd mowing + 4 weeks	5.0 c	5.3 cd	5.5 bc	6.0 bc	7.3 ab	8.0 a
Proxy Primo Maxx	3.0 0.125	1 wk after 2 nd mowing + 3 weeks	5.8 ab	6.0 ab	6.0 ab	6.3 abc	7.4 ab	6.9 b
Proxy Primo Maxx	5.0 0.125	1 wk after 2 nd mowing + 3 weeks	5.3 bc	5.5 bcd	6.0 ab	7.0 a	7.3 ab	7.5 ab
Proxy Primo Maxx	3.0 0.125	1 wk after 2 nd mowing + 2 weeks	5.3 bc	5.5 bcd	5.5 bc	5.8 bc	7.0 abc	7.0 b
Proxy Primo Maxx	5.0 0.125	1 wk after 2 nd mowing + 2 weeks	5.8 ab	6.0 ab	6.1 ab	6.3 abc	6.9 bc	7.1 ab
Proxy Primo Maxx	3.0 0.125	1 wk after 2 nd mowing + 1 week	5.3 bc	5.9 abc	6.0 ab	6.5 ab	7.6 a	7.6 ab
Proxy Primo Maxx	5.0 0.125	1 wk after 2 nd mowing + 1 week	5.5 abc	6.0 ab	6.0 ab	5.5 c	6.5 c	7.0 b
Proxy Primo Maxx	3.33 0.083	2 nd mowing + 2 weeks + 2 weeks	6.0 a	6.5 a	6.4 a	7.0 a	7.4 ab	7.3 ab
Embark T/O	40 oz/A	2 nd mowing	5.8 ab	5.4 bcd	5.3 cd	6.0 bc	6.5 c	6.9 b
Untreated	---	---	5.0 c	5.0 d	4.7 d	5.8 bc	6.7 bc	6.8 b

^a Treatments initiated at “2nd mowing” were applied on 27 March, 2004. All subsequent treatments were based off this date. The “+ 1 week”, “+2 weeks”, “+ 3 weeks”, and “+4 weeks” were applied on 2, 9, 16 and 23 April respectively. All treatments were applied in 1.0 gal 1000 ft² spray carrier volume.

^b Visual quality was based on a 0-10 scale where 0 equals brown dead turf, and 10 equals optimum greenness, density and uniformity.

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

Table 4. Maximum and minimum air and soil temperatures throughout the study, West Lafayette, IN 2004.

Date	Air		Soil 4" depth		Soil 4" under grass	
	Max	Min	Max	Min	Max	Min
27-Mar	69	55	64	53	58	52
28-Mar	75	55	65	55	59	54
29-Mar	62	47	65	51	58	53
30-Mar	53	41	55	48	54	51
31-Mar	51	38	56	45	51	48
1-Apr	49	34	52	41	49	45
2-Apr	55	33	59	38	50	43
3-Apr	63	32	61	39	50	43
4-Apr	48	34	58	41	49	43
5-Apr	54	26	63	37	51	41
6-Apr	67	38	62	42	52	44
7-Apr	70	43	69	48	55	47
8-Apr	59	42	64	51	53	50
9-Apr	59	31	66	44	54	46
10-Apr	59	37	66	48	54	48
11-Apr	54	35	67	47	54	48
12-Apr	49	34	53	44	50	46
13-Apr	47	33	51	41	47	44
14-Apr	66	28	65	38	52	42
15-Apr	72	43	68	46	54	46
16-Apr	79	55	73	54	58	50
17-Apr	83	62	79	59	62	55
18-Apr	84	64	77	62	63	58
19-Apr	80	56	76	65	63	59
20-Apr	65	49	64	57	60	56
21-Apr	69	51	67	58	60	57
22-Apr	53	45	56	51	58	54
23-Apr	66	45	70	50	59	52
24-Apr	63	43	61	50	57	53
25-Apr	67	52	65	55	59	55
26-Apr	63	42	67	48	57	53
27-Apr	53	36	65	46	55	51
28-Apr	75	41	69	49	56	50
29-Apr	76	58	72	57	59	54
30-Apr	75	59	75	59	61	56
1-May	53	43	65	51	60	54
2-May	54	42	63	48	56	51
3-May	54	35	62	45	56	51
4-May	61	40	64	47	55	51
5-May	73	46	78	51	61	53
6-May	85	57	81	58	64	56
7-May	72	53	70	61	62	59
8-May	85	51	82	54	65	56
9-May	84	63	83	64	67	61

Date	Air		Soil 4" depth		Soil 4" under grass	
	Max	Min	Max	Min	Max	Min
10-May	83	66	82	68	67	63
11-May	81	64	80	66	69	64
12-May	83	66	82	65	69	65
13-May	75	65	74	68	67	65
14-May	73	54	70	62	67	65
15-May	58	50	66	57	64	61
16-May	71	44	76	53	65	59
17-May	81	59	80	60	67	62
18-May	79	60	80	66	68	64
19-May	79	56	79	62	68	64
20-May	79	68	75	67	69	66
21-May	86	71	82	69	72	67
22-May	83	71	86	69	72	69
23-May	74	69	72	68	70	68
24-May	76	58	79	62	70	66
25-May	72	61	74	65	69	66
26-May	72	55	80	61	69	65
27-May	81	59	77	65	70	65
28-May	68	51	80	61	70	65
29-May	79	46	84	57	69	62
30-May	80	64	75	67	68	65
31-May	71	62	73	66	68	66
1-Jun	76	55	79	59	69	64
2-Jun	69	57	77	63	66	64
3-Jun	72	48	81	57	68	62
4-Jun	77	47	86	59	70	61