

# **CONTROL OF ANNUAL BLUEGRASS SEEDHEADS ON A GOLF COURSE PUTTING GREEN USING PLANT GROWTH REGULATOR PRODUCTS AND GROWING DEGREE DAY MODELS, 2019**

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This study was conducted at the Joseph Valentine Turfgrass Research Center in University Park, PA on annual bluegrass maintained as a golf putting green. Mowing was performed 5 times per week at a height of 0.100 in. Soil rootzone was a modified sandy loam with a pH of 7.2 and 1.4% organic matter. Individual plots measured 3 ft x 6 ft and were arranged as a randomized complete block design with four replications. Treatments were applied with a CO<sup>2</sup>-pressurized backpack sprayer at 40 PSI with a single TeeJet AI9508 EVS nozzle and calibrated to deliver 2.0 gallons of water per 1000 ft<sup>2</sup>. All treatments were initially applied according to a growing degree day model and reapplied at 2 or 3-week intervals. Embark and Primo + Proxy treatments were initiated based on GDD models with a base temperature of 22 (GDD 22) and 32F (GDD 32), respectively. All application dates are listed in the tables. Percent seedheads was visually assessed on a 0 to 100 percent scale where 0 = no seedheads present and 100 = entire plot area covered with seedheads. Turf quality was visually rated using a 1 to 9 scale where 1 = entire plot area dead and 9 = optimum density and uniformity. Color was visually assessed on a 1 to 9 scale where 1 = entire plot brown or dead and 9 = optimum dark green color. Injury was visually assessed on a 0 to 5 scale where 0 = no injury observed, 2 = maximum level of acceptable injury and 5 = entire area brown or dead. All data were subjected to analysis of variance and means separated at  $P \leq 0.05$  according to Fisher's Protected least significant difference test

Seedheads were first observed at the site in late April 2019. Seedhead pressure continued to increase until 13 May when peak pressure was reached with the nontreated plots having 89% seedhead coverage (Table 1.). Seedhead pressure then declined within all treatments with the nontreated plots having 14% seedheads by 3 Jun. Embark provided only moderate reductions in seedheads during peak pressure (13 May) regardless of rate and timing. Except at the earliest GDD (200) application timing, Primo + Proxy, applied on a 2-week interval, resulting in the greatest seedhead suppression on all rating dates. When applied on a 3-week interval, only plots treated at 500 GDD provided the greatest seedhead suppression on all rating dates. These results indicate that applications earlier than 250 GDD (32) may be less effective when compared to applications initiated at GDD (32) between 250 and 500. Additionally, 21-day application intervals may be less effective than applications made 2 weeks apart. Injury to the annual bluegrass was observed within Embark-treated plots on the first rating, but injury was considered acceptable ( $\leq 2.0$ ) (Table 2.) No significant differences in turfgrass quality were observed during the trial (Table 3.). Significant differences were observed in turfgrass color during the trial (Table 4.) with seedhead load being the primary factor in reducing color ratings.

Table 1. Percent *Poa annua* seedheads on a putting green following the application of plant growth regulators, 2019.

Treatment and rate per 1000ft <sup>2</sup>		App Code <sup>y</sup>	Percent seedhead <sup>z</sup>					
			29 Apr	6 May	13 May	20 May	27 May	3 Jun
1	Embark 2SC 680 GDD (22) 0.07 fl oz.....	AB	15.5 bc <sup>x</sup>	48.8 b	76.3 b	27.5 c	11.0 d	8.0 b
2	Embark 2SC 800 GDD (22) 0.07 fl oz.....	DE	13.0 bcd	21.3 d	21.3 fg	8.0 d	5.0 de	4.5 cde
3	Embark 2SC 680 GDD (22) 0.07 fl oz.....	AC	10.8 d	57.5 a	31.3 ef	14.3 cd	5.3 de	4.5 cde
4	Embark 2SC 800 GDD (22) 0.07 fl oz.....	DF	16.8 b	41.3 c	63.8 c	52.5 ab	27.8 b	7.8 bc
5	Primo MAXX 200 GDD (32) 0.125 fl oz	AB						
	Proxy 200 GDD (32) 5.0 fl oz.....	AB	2.5 e	5.8 ef	67.5 bc	43.8 b	18.8 c	6.0 bcd
6	Primo MAXX 200 GDD (32) 0.125 fl oz	AC						
	Proxy 200 GDD (32) 5.0 fl oz.....	AC	3.8 e	11.3 e	23.8 fg	4.8 d	3.0 e	1.5 e
7	Nontreated .....	-	25.3 a	62.5 a	88.8 a	65.0 a	39.5 a	13.8 a
8	Primo MAXX 250 GDD (32) 0.125 fl oz	DE						
	Proxy 250 GDD (32) 5.0 fl oz.....	DE	3.5 e	5.0 ef	18.8 gh	2.5 d	1.8 e	1.3 e
9	Primo MAXX 250 GDD (32) 0.125 fl oz	DF						
	Proxy 250 GDD (32) 5.0 fl oz.....	DF	12.5 cd	35.8 c	43.8 d	15.5 cd	5.0 de	2.8 de
10	Primo MAXX 350 GDD (32) 0.125 fl oz	GH						
	Proxy 350 GDD (32) 5.0 fl oz.....	GH	2.5 e	5.3 ef	15.5 gh	2.5 d	2.3 e	2.0 e
11	Primo MAXX 350 GDD (32) 0.125 fl oz	GI						
	Proxy 350 GDD (32) 5.0 fl oz.....	GI	2.3 e	3.3 f	40.0 de	2.8 d	2.0 e	1.8 e
12	Primo MAXX 500 GDD (32) 0.125 fl oz	JK						
	Proxy 500 GDD (32) 5.0 fl oz.....	JK	2.3 e	3.5 f	7.8 h	2.3 d	1.5 e	1.5 e
13	Primo MAXX 500 GDD (32) 0.125 fl oz	JL						
	Proxy 500 GDD (32) 5.0 fl oz.....	JL	2.8 e	6.3 ef	13.5 gh	3.5 d	2.0 e	1.8 e

<sup>z</sup> Percent seedhead was visually assessed on a 0 to 100 percent scale where 0 = no seedheads present and 100 = entire plot area covered in seedheads.

<sup>y</sup> Treatments were applied on the following dates: A = 30 Mar, B = 12 Apr, C = 19 Apr, D = 5 Apr, E = 19 Apr, F = 9 May, G = 9 Apr, H = 23 Apr, I = 30 May, J = 17 Apr, K = 1 May, and L = 9 May.

<sup>x</sup> Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$  according to the Fisher's Protected least significant difference.

Table 2. Turfgrass Injury on a *Poa annua* putting green following the application of plant growth regulators, 2019.

Treatment and rate per 1000ft <sup>2</sup>		App Code <sup>y</sup>	Injury <sup>z</sup>					
			29 Apr	6 May	13 May	20 May	27 May	3 Jun
1	Embark 2SC 680 GDD (22) 0.07 fl oz.....	AB	1.3 b <sup>x</sup>	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
2	Embark 2SC 800 GDD (22) 0.07 fl oz.....	DE	1.8 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
3	Embark 2SC 680 GDD (22) 0.07 fl oz.....	AC	1.0 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
4	Embark 2SC 800 GDD (22) 0.07 fl oz.....	DF	2.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
5	Primo MAXX 200 GDD (32) 0.125 fl oz	AB						
	Proxy 200 GDD (32) 5.0 fl oz.....	AB	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
6	Primo MAXX 200 GDD (32) 0.125 fl oz	AC						
	Proxy 200 GDD (32) 5.0 fl oz.....	AC	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
7	Nontreated .....	-	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
8	Primo MAXX 250 GDD (32) 0.125 fl oz	DE						
	Proxy 250 GDD (32) 5.0 fl oz.....	DE	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
9	Primo MAXX 250 GDD (32) 0.125 fl oz	DF						
	Proxy 250 GDD (32) 5.0 fl oz.....	DF	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
10	Primo MAXX 350 GDD (32) 0.125 fl oz	GH						
	Proxy 350 GDD (32) 5.0 fl oz.....	GH	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
11	Primo MAXX 350 GDD (32) 0.125 fl oz	GI						
	Proxy 350 GDD (32) 5.0 fl oz.....	GI	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
12	Primo MAXX 500 GDD (32) 0.125 fl oz	JK						
	Proxy 500 GDD (32) 5.0 fl oz.....	JK	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
13	Primo MAXX 500 GDD (32) 0.125 fl oz	JL						
	Proxy 500 GDD (32) 5.0 fl oz.....	JL	0.0 c	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a

<sup>z</sup> Injury was visually assessed on a 0 to 5 scale where 0 = no injury observed, 2 = maximum level of acceptable injury for a putting green and 5 = entire area brown or dead.

<sup>y</sup> Treatments were applied on the following dates: A = 30 Mar, B = 12 Apr, C = 19 Apr, D = 5 Apr, E = 19 Apr, F = 9 May, G = 9 Apr, H = 23 Apr, I = 30 May, J = 17 Apr, K = 1 May, and L = 9 May.

<sup>x</sup> Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$  according to the Fisher's Protected least significant difference.

Table 3. Turfgrass quality on a *Poa annua* putting green following the application of plant growth regulators, 2019.

Treatment and rate per 1000ft <sup>2</sup>		App Code <sup>y</sup>	Quality <sup>z</sup>					
			29 Apr	6 May	13 May	20 May	27 May	3 Jun
1	Embark 2SC 680 GDD (22) 0.07 fl oz.....	AB	8.0 a <sup>x</sup>	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
2	Embark 2SC 800 GDD (22) 0.07 fl oz.....	DE	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
3	Embark 2SC 680 GDD (22) 0.07 fl oz.....	AC	8.0 a	8.0 a	7.5 a	7.5 a	8.0 a	8.0 a
4	Embark 2SC 800 GDD (22) 0.07 fl oz.....	DF	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
5	Primo MAXX 200 GDD (32) 0.125 fl oz	AB						
	Proxy 200 GDD (32) 5.0 fl oz.....	AB	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
6	Primo MAXX 200 GDD (32) 0.125 fl oz	AC						
	Proxy 200 GDD (32) 5.0 fl oz.....	AC	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
7	Nontreated .....	-	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
8	Primo MAXX 250 GDD (32) 0.125 fl oz	DE						
	Proxy 250 GDD (32) 5.0 fl oz.....	DE	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
9	Primo MAXX 250 GDD (32) 0.125 fl oz	DF						
	Proxy 250 GDD (32) 5.0 fl oz.....	DF	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
10	Primo MAXX 350 GDD (32) 0.125 fl oz	GH						
	Proxy 350 GDD (32) 5.0 fl oz.....	GH	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
11	Primo MAXX 350 GDD (32) 0.125 fl oz	GI						
	Proxy 350 GDD (32) 5.0 fl oz.....	GI	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
12	Primo MAXX 500 GDD (32) 0.125 fl oz	JK						
	Proxy 500 GDD (32) 5.0 fl oz.....	JK	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
13	Primo MAXX 500 GDD (32) 0.125 fl oz	JL						
	Proxy 500 GDD (32) 5.0 fl oz.....	JL	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a

<sup>z</sup> Quality was visually assessed on a 1 to 9 scale where 1 = entire plot brown or dead and 9 = optimum uniformity and density.

<sup>y</sup> Treatments were applied on the following dates: A = 30 Mar, B = 12 Apr, C = 19 Apr, D = 5 Apr, E = 19 Apr, F = 9 May, G = 9 Apr, H = 23 Apr, I = 30 May, J = 17 Apr, K = 1 May, and L = 9 May.

<sup>x</sup> Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$  according to the Fisher's Protected least significant difference.

Table 4. Turfgrass color on a *Poa annua* putting green following the application of plant growth regulators, 2019.

Treatment and rate per 1000ft <sup>2</sup>		App Code <sup>y</sup>	Color <sup>z</sup>					
			29 Apr	6 May	13 May	20 May	27 May	3 Jun
1	Embark 2SC 680 GDD (22) 0.07 fl oz.....	AB	6.8 bc <sup>x</sup>	7.3 b	6.3 c	6.3 c	7.0 c	7.8 ab
2	Embark 2SC 800 GDD (22) 0.07 fl oz.....	DE	6.3 d	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
3	Embark 2SC 680 GDD (22) 0.07 fl oz.....	AC	7.0 b	7.0 b	7.3 b	7.3 b	7.5 b	7.5 ab
4	Embark 2SC 800 GDD (22) 0.07 fl oz.....	DF	6.5 cd	7.8 a	6.0 c	6.0 c	7.0 c	8.0 a
5	Primo MAXX 200 GDD (32) 0.125 fl oz	AB						
	Proxy 200 GDD (32) 5.0 fl oz.....	AB	8.0 a	8.0 a	6.0 c	6.0 c	7.0 c	7.3 b
6	Primo MAXX 200 GDD (32) 0.125 fl oz	AC						
	Proxy 200 GDD (32) 5.0 fl oz.....	AC	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
7	Nontreated .....	-	8.0 a	6.0 c	6.0 c	6.0 c	6.0 d	6.3 c
8	Primo MAXX 250 GDD (32) 0.125 fl oz	DE						
	Proxy 250 GDD (32) 5.0 fl oz.....	DE	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
9	Primo MAXX 250 GDD (32) 0.125 fl oz	DF						
	Proxy 250 GDD (32) 5.0 fl oz.....	DF	8.0 a	7.3 b	6.5 c	6.5 c	7.3 bc	7.8 ab
10	Primo MAXX 350 GDD (32) 0.125 fl oz	GH						
	Proxy 350 GDD (32) 5.0 fl oz.....	GH	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
11	Primo MAXX 350 GDD (32) 0.125 fl oz	GI						
	Proxy 350 GDD (32) 5.0 fl oz.....	GI	8.0 a	8.0 a	7.3 b	7.3 b	7.3 bc	7.8 ab
12	Primo MAXX 500 GDD (32) 0.125 fl oz	JK						
	Proxy 500 GDD (32) 5.0 fl oz.....	JK	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
13	Primo MAXX 500 GDD (32) 0.125 fl oz	JL						
	Proxy 500 GDD (32) 5.0 fl oz.....	JL	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a

<sup>z</sup> Color was visually assessed on a 1 to 9 scale where 1 = entire plot brown or dead and 9 = optimum dark green color.

<sup>y</sup> Treatments were applied on the following dates: A = 30 Mar, B = 12 Apr, C = 19 Apr, D = 5 Apr, E = 19 Apr, F = 9 May, G = 9 Apr, H = 23 Apr, I = 30 May, J = 17 Apr, K = 1 May, and L = 9 May.

<sup>x</sup> Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$  according to the Fisher's Protected least significant difference.