

Pre- and Postemergence Annual Weed Control Study - 1996

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Herbicides from AgrEvo, DowElanco, Gowan, Rohm and Haas Company, and Sandoz were screened for efficacy as preemergence, early post-, and postemergence products for annual weed control in turfgrass. The study was conducted at the Iowa State University Horticulture Station north of Ames, Iowa. The experimental plot was an area of 'Nassau' Kentucky bluegrass established in 1994. The soil was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.5% organic matter, a pH of 6.2, 30 ppm P, and 133 ppm K.

The experiment was arranged in a randomized complete block design. Individual plots were 5 x 5 ft with three replications and no barrier rows between replications. The assignment of treatments to plots was randomized.

There were a total of 46 treatments including two untreated control plots per replication (Table 1). Three experimental formulations and Pendimethalin, Team and Team/Gallery in combination with fertilizers were screened for DowElanco. NAF 191 was applied in split applications at 1.0 lb a.i./A, NAF 192 in a single application and split applications at 1.5 lb a.i./A, and NAF 193 in single applications at 2.0 lb a.i./A. Pendimethalin 0.86GR + fertilizer and Team 0.87GR + fertilizer were applied in split applications at 1.0 and 1.5 lb a.i./A. and in single applications at 1.5 and 2.0 lb a.i./A. Team/Gallery (Spring Valley) 1.09GR + fertilizer was applied in split applications at 2.04 lb a.i./A and in single applications at 2.720 lb a.i./A. The initial treatments were made preemergently before crabgrass germination and the sequential applications were made when the crabgrass was in the 1-3 tiller growth stage.

Betasan and Tupersan from the Gowan Company were applied as preemergence herbicides. Betasan 4LF was applied at 2 gal product/A and Tupersan 50WP at 20 lb product/A.

The Rohm and Haas products were applied in split applications of herbicide + fertilizer combinations. Each plot received the same amount of nitrogen when initial and sequential applications were made. Methylene urea fertilizer (39-0-0) was the fertilizer component of all formulations and also was used as the fertilizer 'blank' used to equalize the amount of applied N. Dimension 1EC was applied in single applications at 0.25 and 0.38 lb a.i./A and in split applications at 0.125 and 0.250 lb a.i./A. Three Dimension + fertilizer formulations (AD 442, AD 444, & AD 445) that contain different amounts of Dithiopyr and Dimension 1EC were used. AD 442 was applied in split applications at 0.060 lb a.i./A, AD 444 at 0.125 lb a.i./A in single and split applications, and AD 445 at 0.250 lb a.i./A in a single application. Barricade 65WG (Prodiamine) at 0.650 lb a.i./A, Pendimethalin 60WDG at 1.50 lb a.i./A in single applications, and a fertilized control were included for comparisons. Sequential applications were made 51 days after the initial application.

Barricade 65WG from Sandoz was applied as a preemergence herbicide at 0.32, 0.48, 0.65 and 0.50 lb a.i./A. The 0.50 lb treated plots received a sequential treatment 60 days after the initial treatment at a lower rate (0.25 lb a.i./A).

Acclaim Extra 68.5EW, Acclaim 120EC, and Preclaim 370.6EC were applied as early postemergence products at 0.060, 0.120, and 2.060 lb a.i./A, respectively, when the crabgrass was in the 1-3 leaf stage. These materials from AgrEvo also were applied postemergently at 0.090, 0.180, 3.090 lb a.i./A, respectively, when the crabgrass was tillering.

Dimension 1EC was applied at 0.250 lb a.i./A as a preemergence product and in split applications at 0.125 lb a.i./A and at 0.250 lb a.i./A in a single postemergence application. Dimension 1EC also was applied postemergently at 0.25 lb a.i./A with Trimec Plus at 3 fl oz product/1000 ft² and with Preclaim at 3.09 lb a.i./A. Preclaim and Trimec Plus were applied alone at these same rates when the crabgrass was tillering.

Liquid formulations were applied using a carbon dioxide backpack sprayer equipped with #8006 nozzles at 25-30 psi. The granular materials were applied using 'shaker dispensers'.

Preemergence treatments (treatments 1-32 and 39-40) were made on May 3 before crabgrass germination (Table 1). A pre-treatment survey of the plot confirmed that turf quality was uniform. The materials were 'watered in' with the irrigation system. On June 12, crabgrass plants were detected in the untreated control plots. The sequential application of granular treatments 22-32 was made on June 25 (51 days after initial application). The liquid formulations for treatments 22-32 and the early postemergence products (treatments 33-35) were applied on June 26 when the crabgrass was in the 1-3 leaf stage with no tillering. The sequential application of treatment 4 was made 60 days after the initial application on July 3. Postemergent applications (treatments 6, 8, 10, 12, 14, 15, 18, 36-38, and 40-45) were made on July 15 when the crabgrass was beginning to tiller.

The turf was examined for visual quality throughout the study. Data were taken May 9, May 22, June 13, June 26, July 3, July 22, and August 13. Turf quality was assessed using a 9 to 1 scale: 9 = best quality, 6 = lowest acceptable quality, and 1 = poorest quality (Table 2). Kentucky bluegrass phytotoxicity was evaluated following herbicide applications using a 9 to 1 scale: 9 = no damage, 5 = uniform tip burning, 3 = severe burning & discoloration, and 1 = dead turf. Phytotoxicity data were taken July 10 following application of the early postemergence materials (Table 3). Crabgrass control was measured by counting the number of crabgrass plants in each plot on August 13 (Table 4). Crabgrass reductions were calculated by comparing crabgrass counts among the treated plots as compared with the untreated controls (treatments 1 and 46).

All data were analyzed using the Statistical Analysis System (SAS) version 6.09 and the Analysis of Variance (ANOVA) procedure. Fisher's Least Significant Difference (LSD) test was used to compare means among the treatments.

Turf quality was equal in all treated and untreated plots in May and the first significant differences were detected on July 3 after the sequential applications for treatments 22-32 (Table 2). In these plots quality was significantly better than in the other treated and the untreated turf. By July 22, the quality improved in some plots receiving postemergence applications of herbicide + fertilizer formulations (treatments 6, 8, 15, and 18).

Mean turf quality was above the lowest acceptable rating (a '6') for all treatments including the untreated controls (Table 2). The best mean turf quality was achieved in Kentucky bluegrass treated with Pendimethalin 60WDG + fertilizer (treatment 23), Dimension 1EC + fertilizer (treatments 26 and 27), and the 'AD' experimental Dimension + fertilizer formulations (treatments 28-31).

The only bluegrass phytotoxicity was detected July 10 in plots treated with the early postemergence herbicides on June 26 (treatments 33, 34, and 35). The bluegrass had severe tip burning and was discolored (Table 3). By July 22, the turf had recovered somewhat and was given either the lowest acceptable quality rating or lower (5's and 6's). The temperatures during this period were quite high and there was only minimal rainfall. These factors probably contributed to the impact of the herbicides on the bluegrass. Turf quality in these plots did not improve by August 13.

Most herbicides significantly reduced the number of crabgrass plants when compared with the untreated controls and eighteen of the products provided $\geq 90\%$ reductions (Table 3). Pre- and postemergence applications of some herbicides resulted in better crabgrass control than single applications (treatments 7 and 15).

Table 1. Materials, rates and timing of application for materials used in the 1996 Preemergence & Postemergence Annual Grass Control Study.

Materials	Rate lb a.i./A. (initial)	Amount of fertilizer lb/1000 ft ² (initial)	Rate lb a.i./A (sequential)	Amount of fertilizer lb/1000 ft ² (sequential)	Timing of applications
1. Untreated control	NA	none	NA	none	NA
2. Barricade 65WG	0.320	none	NA	none	PRE
3. Barricade 65WG	0.480	none	NA	none	PRE
4. Barricade 65WG	0.500	none	0.250	none	PRE & POST
5. Barricade 65WG	0.650	none	NA	none	PRE
6. NAF-191 0.57GR + fert	1.000	NA	1.000	NA	PRE & POST
7. NAF-192 0.86GR + fert	1.500	NA	NA	NA	PRE
8. NAF-192 0.86GR + fert	1.500	NA	1.500	NA	PRE & POST
9. NAF-193 1.15GR + fert	2.000	NA	NA	NA	PRE
10. Pendimethalin 0.86GR + fert	1.000	NA	1.000	NA	PRE & POST
11. Pendimethalin 0.86GR + fert	1.500	NA	NA	NA	PRE
12. Pendimethalin 0.86GR + fert	1.500	NA	1.500	NA	PRE & POST
13. Pendimethalin 0.86GR + fert	2.000	NA	NA	NA	PRE
14. Team 0.87GR + fertilizer	1.000	NA	1.000	NA	PRE & POST
15. Team 0.87GR + fertilizer	1.500	NA	1.500	NA	PRE & POST
16. Team 0.87GR + fertilizer	1.500	NA	NA	NA	PRE
17. Team 0.87GR + fertilizer	2.000	NA	NA	NA	PRE
18. Team 1.09GR & Gallery + fert	2.040	NA	2.040	NA	PRE & POST
19. Team 1.09GR & Gallery + fert	2.720	NA	NA	NA	PRE
20. Tupersan 50WP	20.0 lb/A	NA	NA	NA	PRE
21. Betasan 4LF	2.0 gal/A	NA	NA	NA	PRE
22. Barricade 65WG	0.650	4.0	none	4.0	PRE & POST
23. Pendimethalin 60WDG	1.500	4.0	none	4.0	PRE & POST
24. Dimension 1EC(& fertilizer)	0.250	4.0	none	4.0	PRE & POST
25. Dimension 1EC(& fertilizer)	0.380	4.0	none	4.0	PRE & POST
26. Dimension 1EC(& fertilizer)	0.125	4.0	0.125	4.0	PRE & POST
27. Dimension 1EC(& fertilizer)	0.250	4.0	0.250	4.0	PRE & POST
28. AD444 Dimension 0.072FG + fert	0.125	4.0	none	4.0	PRE & POST
29. AD445 Dimension 0.164FG + fert	0.250	3.5	none	3.5	PRE & POST
30. AD442 Dimension 0.035FG + fert	0.060	4.0	0.060	4.0	PRE & POST
31. AD444 Dimension 0.072FG + fert	0.125	4.0	0.125	4.0	PRE & POST
32. Fertilized control	NA	4.0	NA	4.0	NA
33. Acclaim Extra 68.5EW	0.060	none	NA	none	EARLY POST
34. Acclaim 120EC	0.120	none	NA	none	EARLY POST
35. Preclaim 370.6EC	2.060	none	NA	none	EARLY POST
36. Acclaim Extra 68.5Ew	0.090	none	NA	none	POST
37. Acclaim 120EC	0.180	none	NA	none	POST
38. Preclaim 370.6EC	3.090	none	NA	none	POST
39. Dimension 1EC	0.250	none	NA	none	PRE
40. Dimension 1EC	0.125	none	NA	none	PRE & POST
41. Dimension 1EC	0.250	none	NA	none	POST
42. Dimension 1EC	0.250				
+ Trimec Plus	+ 3 fl oz	none	NA	none	POST
43. Trimec Plus	3 fl oz	none	NA	none	POST
44. Dimension 1EC	0.250	none	NA	none	POST
+ Preclaim	+ 3.090				

45. Preclaim	3.090	none	NA	none	POST
46. Untreated control	NA	none	NA	none	NA

Treatments 1-32 and 39-40 were applied on May 3, trts 22-32 sequential on June 25, trt 4 sequential on July 3, and trts postemergence on 6, 8, 10, 12, 14, 15, 18, 36-38, and 40-45 on July 16.

Table 2. Visual quality¹ of Kentucky bluegrass treated with various herbicide formulations in the 1996 Preemergence & Postemergence Annual Grass Study.

Materials		May 9	May 22	June 13	June 26	July 3	July 22	August 13	Mean quality
1.	Untreated control	9	9	8	8	7	6	6	8
2.	Barricade 65WG	9	9	8	8	7	6	5	8
3.	Barricade 65WG	9	9	8	8	7	7	6	8
4.	Barricade 65WG	9	9	8	8	7	7	6	8
5.	Barricade 65WG	9	9	8	8	7	7	7	8
6.	NAF-191 0.57GR + fert	9	9	9	8	7	8	7	8
7.	NAF-192 0.86GR + fert	9	9	9	8	7	6	6	8
8.	NAF-192 0.86GR + fert	9	9	9	8	7	8	7	8
9.	NAF-193 1.15GR + fert	9	9	8	8	7	7	6	8
10.	Pendimethalin 0.86GR + fert	9	9	8	8	7	7	6	8
11.	Pendimethalin 0.86GR + fert	9	9	9	8	7	6	6	8
12.	Pendimethalin 0.86GR + fert	9	9	8	8	7	6	7	8
13.	Pendimethalin 0.86GR + fert	9	9	9	8	7	7	6	8
14.	Team 0.87GR + fert	9	9	8	8	7	7	6	8
15.	Team 0.87GR + fert	9	9	9	8	7	8	7	8
16.	Team 0.87GR + fert	9	9	8	8	7	6	6	8
17.	Team 0.87GR + fert	9	9	8	8	7	7	6	8
18.	Team 1.09GR & Gallery + fert	9	9	8	8	7	8	6	8
19.	Team 1.09GR & Gallery + fert	9	9	8	8	7	6	6	8
20.	Tupersan 50WP	9	9	8	8	7	6	6	8
21.	Betasan 4LF	9	9	8	8	7	7	6	8
22.	Barricade 65WG (& fert)	9	9	9	8	9	8	8	8
23.	Pendimethalin 60WDG (& fert)	9	9	9	8	9	8	8	9
24.	Dimension 1EC (& fert)	9	9	9	8	9	7	7	8
25.	Dimension 1EC (& fert)	9	9	9	8	9	8	7	8
26.	Dimension 1EC (& fert)	9	9	9	8	9	9	7	9
27.	Dimension 1EC (& fert)	9	9	9	8	9	9	7	9
28.	AD444 0.072FG + fert	9	9	9	8	9	9	7	9
29.	AD445 0.164FG + fert	9	9	9	8	9	9	8	9
30.	AD442 0.035FG + fert	9	9	9	8	9	9	8	9
31.	AD444 0.072FG + fert	9	9	9	8	9	9	8	9
32.	Fertilized control	9	9	9	8	9	8	7	8
33.	Acclaim Extra 68.5EW	9	9	8	8	6	5	5	7
34.	Acclaim 120EC	9	9	8	8	6	6	6	7
35.	Preclaim 370.6EC	9	9	8	8	6	6	5	7
36.	Acclaim Extra 68.5EW	9	9	8	8	7	6	6	7
37.	Acclaim 120EC	9	9	8	8	7	5	5	7
38.	Preclaim 370.6EC	9	9	8	8	7	6	6	7
39.	Dimension 1EC	9	9	8	8	7	7	6	8
40.	Dimension 1EC	9	9	8	8	7	5	5	7
41.	Dimension 1EC	9	9	8	8	6	6	5	7
42.	Dimension 1EC + Trimec Plus	9	9	8	8	7	5	6	7
43.	Trimec Plus	9	9	8	8	7	7	6	8
44.	Dimension 1EC + Preclaim	9	9	8	8	7	6	5	7
45.	Preclaim	9	9	8	8	7	6	6	8
46.	Untreated control	9	9	8	8	7	6	6	8
	LSD _{0.05}	NS	NS	1	NS	1	1	1	0.3

¹ Visual quality was assessed using a 9 to 1 scale: 9 = best quality, 6 = lowest acceptable quality, and 1 = poorest quality.

NS = means are not significantly different at the 0.05 level.

Treatments 1-32 and 39-40 were applied on May 3, trts 22-32 sequential on June 25, trt 4 sequential on July 3, and trts postemergence on 6, 8, 10, 12, 14, 15, 18, 36-38, and 40-45 on July 16.

Table 3. Kentucky bluegrass phytotoxicity¹ in the 1996 Preemergence & Postemergence Annual Grass Study.

Materials	Rate (lb a.i./A) initial / sequential	Timing of application	Phytotoxicity on July 10
1. Untreated control	NA	NA	9
2. Barricade 65WG	0.320 / NA	PRE	9
3. Barricade 65WG	0.480 / NA	PRE	9
4. Barricade 65WG	0.500 / 0.250	PRE & POST	9
5. Barricade 65WG	0.650 / NA	PRE	9
6. NAF-191 0.57GR + fertilizer	1.000 / 1.000	PRE & POST	9
7. NAF-192 0.86GR + fertilizer	1.500 / NA	PRE	9
8. NAF-192 0.86GR + fertilizer	1.500 / 1.500	PRE & POST	9
9. NAF-193 1.15GR + fertilizer	2.000 / NA	PRE	9
10. Pendimethalin 0.86GR + fertilizer	1.000 / 1.000	PRE & POST	9
11. Pendimethalin 0.86GR + fertilizer	1.500 / NA	PRE	9
12. Pendimethalin 0.86GR + fertilizer	1.500 / 1.500	PRE & POST	9
13. Pendimethalin 0.86GR + fertilizer	2.000 / NA	PRE	9
14. Team 0.87GR + fertilizer	1.000 / 1.000	PRE & POST	9
15. Team 0.87GR + fertilizer	1.500 / 1.500	PRE & POST	9
16. Team 0.87GR + fertilizer	1.500 / NA	PRE	9
17. Team 0.87GR + fertilizer	2.000 / NA	PRE	9
18. Team 1.09GR & Gallery + fertilizer	2.040 / 2.040	PRE & POST	9
19. Team 1.09GR & Gallery + fertilizer	2.720 / NA	PRE	9
20. Tupersan 50WP	20.0 lb/A / NA	PRE	9
21. Betasan 4LF	2.0 gal/A / NA	PRE	9
22. Barricade 65WG (& fertilizer)	0.650 & fert	PRE & POST	9
23. Pendimethalin 60WDG (& fertilizer)	1.500 & fert	PRE & POST	9
24. Dimension 1EC (& fertilizer)	0.250 & fert	PRE & POST	9
25. Dimension 1EC (& fertilizer)	0.380 & fert	PRE & POST	9
26. Dimension 1EC (& fertilizer)	0.125 / 0.125	PRE & POST	9
27. Dimension 1EC (& fertilizer)	0.250 / 0.250	PRE & POST	9
28. AD444 0.072FG + fertilizer	0.125 / fert	PRE & POST	9
29. AD445 0.164FG + fertilizer	0.250 / fert	PRE & POST	9
30. AD442 0.035FG + fertilizer	0.060 / 0.060	PRE & POST	9
31. AD444 0.072FG + fertilizer	0.125 / 0.125	PRE & POST	9
32. Fertilized control	fert / fert	PRE & POST	9
33. Acclaim Extra 68.5EW	0.060 / NA	EARLY POST	3
34. Acclaim 120EC	0.120 / NA	EARLY POST	3
35. Preclaim 370.6EC	2.060 / NA	EARLY POST	3
36. Acclaim Extra 68.5EW	0.090 / NA	POST	9
37. Acclaim 120EC	0.180 / NA	POST	9
38. Preclaim 370.6EC	3.090 / NA	POST	9
39. Dimension 1EC	0.250 / NA	PRE	9
40. Dimension 1EC	0.125 / 0.125	PRE & POST	9
41. Dimension 1EC	0.250 / NA	POST	9
42. Dimension 1EC + Trimec Plus	0.250 + 3 fl oz / NA	POST	9
43. Trimec Plus	3 fl oz / NA	POST	9
44. Dimension 1EC + Preclaim	0.250 + 3.090 / NA	POST	9
45. Preclaim	3.090 / NA	POST	9
46. Untreated control	NA	NA	9

LSD_{0.05}NS²

¹ Kentucky bluegrass phytotoxicity was determined following herbicide applications using a 9 to 1 scale: 9 = no damage, 5 = tip burning, 3 = severe burning & discoloration, and 1 = dead turf.

Treatments 1-32 and 39-40 were applied on May 3, trts 22-32 sequential on June 25, trt 4 sequential on July 3, and trts postemergence on 6, 8, 10, 12, 14, 15, 18, 36-38, and 40-45 on July 16.

²NS = LSD test is not valid for these data because there is no error among the replications.

Table 4. Number of crabgrass plants and percentage reductions¹ in crabgrass numbers in Kentucky bluegrass in the 1996 Preemergence & Postemergence Annual Grass Study on August 13.

Materials		Rate (lb a.i./A) initial / sequential	Timing of application	Number of crabgrass plants per plot	Percent reduction in crabgrass plants per plot ¹
1.	Untreated control	NA	NA	83	0
2.	Barricade 65WG	0.320 / NA	PRE	6	94
3.	Barricade 65WG	0.480 / NA	PRE	6	95
4.	Barricade 65WG	0.500 / 0.250	PRE & POST	0	100
5.	Barricade 65WG	0.650 / NA	PRE	2	98
6.	NAF-191 0.57GR + fert	1.000 / 1.000	PRE & POST	66	38
7.	NAF-192 0.86GR + fert	1.500 / NA	PRE	92	13
8.	NAF-192 0.86GR + fert	1.500 / 1.500	PRE & POST	24	77
9.	NAF-193 1.15GR + fert	2.000 / NA	PRE	15	86
10.	Pendimethalin 0.86GR + fert	1.000 / 1.000	PRE & POST	33	69
11.	Pendimethalin 0.86GR + fert	1.500 / NA	PRE	37	65
12.	Pendimethalin 0.86GR + fert	1.500 / 1.500	PRE & POST	67	37
13.	Pendimethalin 0.86GR + fert	2.000 / NA	PRE	32	70
14.	Team 0.87GR + fert	1.000 / 1.000	PRE & POST	39	64
15.	Team 0.87GR + fert	1.500 / 1.500	PRE & POST	22	80
16.	Team 0.87GR + fert	1.500 / NA	PRE	70	34
17.	Team 0.87GR + fert	2.000 / NA	PRE	16	85
18.	Team 1.09GR & Gallery + fert	2.040 / 2.040	PRE & POST	36	66
19.	Team 1.09GR & Gallery + fert	2.720 / NA	PRE	45	58
20.	Tupersan 50WP	20.0 lb/A / NA	PRE	110	0
21.	Betasan 4LF	2.0 gal/A / NA	PRE	5	96
22.	Barricade 65WG (& fert)	0.650 & fert	PRE & POST	1	99
23.	Pendimethalin 60WDG (& fert)	1.500 & fert	PRE & POST	31	71
24.	Dimension 1EC (& fert)	0.250 & fert	PRE & POST	26	75
25.	Dimension 1EC (& fert)	0.380 & fert	PRE & POST	3	97
26.	Dimension 1EC (& fert)	0.125 / 0.125	PRE & POST	3	97
27.	Dimension 1EC (& fert)	0.250 / 0.250	PRE & POST	0	100
28.	AD444 0.072FG + fert	0.125 / fert	PRE & POST	18	83
29.	AD445 0.164FG + fert	0.250 / fert	PRE & POST	5	96
30.	AD442 0.035FG + fert	0.060 / 0.060	PRE & POST	1	99
31.	AD444 0.072FG + fert	0.125 / 0.125	PRE & POST	1	99
32.	Fertilized control	fert / fert	PRE & POST	58	45
33.	Acclaim Extra 68.5EW	0.060 / NA	EARLY POST	33	69
34.	Acclaim 120EC	0.120 / NA	EARLY POST	43	59
35.	Preclaim 370.6EC	2.060 / NA	EARLY POST	1	99
36.	Acclaim Extra 68.5EW	0.090 / NA	POST	8	92
37.	Acclaim 120EC	0.180 / NA	POST	5	95
38.	Preclaim 370.6EC	3.090 / NA	POST	2	98
39.	Dimension 1EC	0.250 / NA	PRE	29	72
40.	Dimension 1EC	0.125 / 0.125	PRE & POST	94	11
41.	Dimension 1EC	0.250 / NA	POST	40	62
42.	Dimension 1EC + Trimec Plus	0.250+3 fl oz/NA	POST	0	100
43.	Trimec Plus	3 fl oz / NA	POST	85	19
44.	Dimension 1EC + Preclaim	0.250+3.090/NA	POST	1	99
45.	Preclaim	3.090 / NA	POST	44	58
46.	Untreated control	NA	NA	128	0
	LSD _{0.05}			46	43

¹ Percent reduction in crabgrass counts were calculated as the mean number of crabgrass plants per plot compared with the mean number in the untreated controls (treatments 1 and 46).
Treatments 1-32 and 39-40 were applied on May 3, trts 22-32 sequential on June 25, trt 4 sequential on July 3, and trts postemergence on 6, 8, 10, 12, 14, 15, 18, 36-38, and 40-45 on July 16.