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Sequential Postemergence/Preemergence Treatments for Crabgrass Control in Bermudagrass Turf[1]

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Abstract

Crabgrass (*Digitaria* spp.) was controlled in common bermudagrass [*Cynodon dactylon* (L.) Pers.] with postemergence (POST) and preemergence (PRE) herbicides on a tropical island of Guam. The recommended label rates of PRE herbicides oxadiazon at 3.4 kg/ha (3.0 lb/A), pendimethalin at 3.4 kg/ha (3.0 lb/A), and dithiopyr at 0.6 kg/ha (0.5 lb/A) were applied initially and one-half recommended rates were applied to one-half of the plots 8 weeks later. MSMA was applied as the POST herbicide treatment in 1, 2, or 3 applications. The first MSMA treatment was applied in sequence with the PRE herbicides and followed by either 1 or 2 additional MSMA applications at 1 or 1 and 2 weeks after the initial MSMA application. Two weekly applications of MSMA assured complete control of existing crabgrass. Single applications of pendimethalin, oxadiazon, and dithiopyr at full rates assured ≥90% control for a period of 20 to 26 weeks during the rainy season and for 6 to 12 weeks during the dry season. There was no advantage of the second PRE treatments at a reduced rate. On fairways where crabgrass infestation was 95%, an application of MSMA resulted in severe turf discoloration lasting 5–6 weeks.

Index words: weed control, turf injury, *Digitaria* spp., *Cynodon dactylon* (L.) Pers.

Herbicides used in this study: dithiopyr (Dimension EC), S,S-dimethyl 2-(difluoromethyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-3,5-pyridinedicarbothioate; oxadiazon (Ronstar 2G), 3-[2,4-dichloro-5-(1 methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one; pendimethalin (Pre M 3.3 EC), –(1-ethylpropyl)-3,4-dimethyl-2,6-dinitroaniline, MSMA (monosodium acid methanearsonate).

Significance for the Nursery Industry

Post-emergence and pre-emergence herbicides are used to control weeds in home lawns, golf courses, athletic fields and other recreational areas. In the humid tropics a crabgrass control program must start with post-emergence herbicides. Crabgrass plants must be eliminated and then controlled by application of pre-emergence herbicides to prevent future germination. Weed control program is far more effective when herbicide applications start in the rainy season rather than in the dry season.

Introduction

Crabgrass (*Digitaria* spp.) is considered the most problematic weed in recreational turf on the island of Guam. Constantly warm temperatures averaging 29C (84F) during the day and 23C (73F) at night in addition to 250 cm (100 in) of annual rainfall promote its vigorous growth. If crabgrass is not controlled adequately it can overwhelm turf within 12 to 18 months. Because in the tropics crabgrass has a 12-month growing period and seeds are produced constantly, maintenance of adequate weed control may require multiple herbicide applications. Programs for crabgrass control were developed mostly for temperate climates and usually start with PRE herbicides applications following the natural elimination of matured weeds by winter kill. In the tropics crabgrass must be eliminated with effective POST herbicide treatments and followed by application of PRE herbicides to prevent germination. Little crabgrass control research has been conducted in tropical climates, therefore only limited information exists for herbicide selection, rates, and frequency of application.

MSMA is a widely used POST herbicide for crabgrass control in both temperate and warm climates (1, 2, 5, 8, 9). In the tropics its labeled rate does not always provide adequate control (10). Among numerous PRE herbicides, pendimethalin, oxadiazon, and dithiopyr were reported effective in controlling crabgrass in bermudagrass (6, 7). There is also evidence that when these herbicides were applied in the spring at the full rates and then re-applied in the summer at reduced rates, weed control was adequate throughout the entire growing season (3, 4). The present study was conducted to determine a) the number of POST treatments required to eliminate mature crabgrass from bermudagrass turf, b) the longevity of control when PRE herbicides were applied once at a full rates, and c) the efficacy of a second PRE application at a reduced rate.

Materials and Methods

Two crabgrass control studies were conducted on two common bermudagrass fairways at the Andersen Air Force Base Golf Course on the island of Guam (13° N latitude). On these fairways crabgrass had not been controlled for several years and its ground coverage exceeded 95%. Prior to the application of the treatments, the turfgrass in the fairways was mowed twice a week with clippings returned. The soil on both fairways was similar, a Pulantat clay (clayey, montmorillonitic, isohyperthermic, shallow Udic Haplustalfs) with pH 7.2, 4% organic matter, 29% sand, 5% silt and 66% clay. Turfgrass on fairways was fertilized twice a year with 50 kg/ha N, 11 kg/ha P, and 27.5 kg/ha K (45N, 10P, 25K lb/A). The experiment at the first location was initiated on October 1, 1996, and at the second location on February 13, 1997.

The label recommended rate of oxadiazon at 3.4 kg/ha (3.0 lb/A), pendimethalin at 3.4 kg/ha (3.0 lb/A), and dithiopyr at 0.6 kg/ha (0.5 lb/A) were applied as PRE treat-

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Table 1. The effect of sequential postemergence and preemergence herbicides on crabgrass control in rainy season on Guam at Location I.

Treatment[z]										
POST	Rate		PRE	Rate		Crabgrass control (wk)[y]				
	kg/ha	lb/A		kg/ha	lb/A	4	8	12	20	26
Untreated			Untreated			0	0	0	0	0
MSMA	2.2	2.0	Oxadiazon	3.4	3.0	69	50	42	34	35
MSMA	2.2	2.0	Oxadiazon	3.4+1.7	3.0+1.5	65	52	45	36	40
MSMA	2.2+2.2	2.0+2.0	Oxadiazon	3.4	3.0	100	98	90	90	88
MSMA	2.2+2.2	2.0+2.0	Oxadiazon	3.4+1.7	3.0+1.5	100	100	95	95	90
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Oxadiazon	3.4	3.0	100	100	95	90	90
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Oxadiazon	3.4+1.7	3.0+1.5	100	100	96	96	92
MSMA	2.2	2.0	Pendimethalin	3.4	3.0	55	52	46	34	30
MSMA	2.2	2.0	Pendimethalin	3.4+1.7	3.0+1.5	50	58	40	35	35
MSMA	2.2+2.2	2.0+2.0	Pendimethalin	3.4	3.0	98	97	94	92	92
MSMA	2.2+2.2	2.0+2.0	Pendimethalin	3.4+1.7	3.0+1.5	100	96	95	95	95
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Pendimethalin	3.4	3.0	100	100	100	94	93
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Pendimethalin	3.4+1.7	3.0+1.5	100	100	95	95	92
MSMA	2.2	2.0	Dithiopyr	0.6	0.5	58	54	40	34	31
MSMA	2.2	2.0	Dithiopyr	0.6+0.3	0.5+0.25	55	52	40	30	30
MSMA	2.2+2.2	2.0+2.0	Dithiopyr	0.6	0.5	97	98	95	90	88
MSMA	2.2+2.2	2.0+2.0	Dithiopyr	0.6+0.3	0.5+0.25	98	98	98	90	90
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Dithiopyr	0.6	0.5	100	100	100	94	95
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Dithiopyr	0.6+0.3	0.5+0.25	100	100	100	95	95
$LSD_{0.05}$[x]						10	11	13	12	10

[z]POST and PRE were applied initially on October 1, 1996. POST was reapplied to certain plots in weekly intervals. Turfgrass plots treated with a second half rate PRE application were eight weeks after the initial application.

[y]Ratings were made at 4, 8, 12, 20, and 26 weeks after the initial treatment, and are presented as percent (%) of untreated check.

[x]Means were separated using Fischer's protected LSD procedure.

ments. MSMA at 2.2 kg/ha (2.0 lb/A) was applied as a POST treatment on the same date. Two-thirds of the plots received a second MSMA application and one-third of the plots received a second and third application of MSMA at weekly intervals. One-half of the plots received PRE treatments at one-half rate, 8 weeks after the initiation of the study. All herbicides except oxadiazon were applied in 375 kg/ha (40 gal/A) of water by a carbon dioxide-powered boom sprayer with 110 02 VS nozzles (R&D Sprayers Inc. Model AS, Opelousas, LA) designed for use on small plots. Oxadiazon was applied in a granular form using a hand shaker. Turfgrass plots were not irrigated. On Guam evapotranspiration of bermudagrass turf averaged 0.5 cm (0.20 in) of water per day. During the initial 8 weeks of the first study, precipitation averaged 1.1 cm (0.44 in) per day with rain showers occurring daily, often 2 to 3 times a day. During the initial 8 weeks of the second study, precipitation averaged 0.2 cm (0.08 in) per day and turf showed frequent water stress symptoms. Air temperature in both studies ranged from 21C (70F) to 24C (75F) at night and 26C (79F) to 30C (86F) in the daylight. During both studies turf was mowed twice weekly at a height of 2.5 cm (1 in). Visual estimates of turfgrass quality were made weekly after the first MSMA treatment until the turfgrass recovered. Visual quality ratings were based on leaf discoloration, turf density and uniformity, where 1 = brown dead turf and 10 = complete green uniform turf. Crabgrass control ratings started four weeks after the first herbicides application and were made bi-weekly through 14 weeks and then at 20 and 26 weeks after the initial treatment. Weed control ratings were based on 0–100, where 0 = no control, and 100 = complete control.

The experimental design for both studies was a randomized complete block with four replications. Plot size was 1.5 × 3.0 m (5 × 10 ft). The analysis of variance (ANOVA) was conducted using the general linear model procedure. All data are separated by LSD at P = 0.05.

Results and Discussion

Crabgrass control. Regardless of when the initial herbicide application was made in rainy or dry season, a single POST application of MSMA at 2.2 kg/ha (2.0 lb/A) coupled with a single application of oxadiazon at 3.4 kg/ha (3.0 lb/A), pendimethalin at 3.4 kg/ha (3.0 lb/A), and dithiopyr at 0.6 kg/ha (0.5 lb/A) was insufficient to provide acceptable crabgrass controls with initial ratings mostly below 70% (Tables 1 and 2). Within 4 weeks crabgrass had recovered and resumed vigorous growth. In contrast, complete crabgrass control was obtained in plots treated initially with MSMA and PRE herbicides followed by the second MSMA application one week later. There was no advantage in crabgrass control resulted from the third application of MSMA.

The efficacy of PRE herbicides depended on the application timing and were different for rainy season at location I, with rainfall of 206 cm (81 in) from July to December, and dry season at location II, with rainfall of 46 cm (18 in) from January to June (Tables 1 and 2). During the rainy season, after elimination of the matured crabgrass using MSMA, single applications of pendimethalin, oxadiazon, and dithiopyr at full rates assured ≥90% control for a 20- to 26-week period. The repeated one-half recommended rate of PRE herbicides at week 8 was not needed. The control was similar whether the PRE herbicides were applied once or twice provided MSMA was applied in two applications. During the dry season pendimethalin and oxadiazon assured ≥90% control for six weeks and dithiopyr for 12 weeks when

Table 2. The effect of sequential postemergence and preemergence herbicides on crabgrass control in dry season on Guam at Location II.

Treatment[z]										
POST	Rate		PRE	Rate		Crabgrass control (wk)[y]				
	kg/ha	lb/A		kg/ha	lb/A	4	8	12	20	26
Untreated						0	0	0	0	0
MSMA	2.2	2.0	Oxadiazon	3.4	3.0	72	53	40	32	34
MSMA	2.2	2.0	Oxadiazon	3.4+1.7	3.0+1.5	69	56	50	41	42
MSMA	2.2+2.2	2.0+2.0	Oxadiazon	3.4	3.0	100	75	74	62	60
MSMA	2.2+2.2	2.0+2.0	Oxadiazon	3.4+1.7	3.0+1.5	100	79	87	72	60
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Oxadiazon	3.4	3.0	100	100	85	65	65
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Oxadiazon	3.4+1.7	3.0+1.5	100	98	79	68	65
MSMA	2.2	2.0	Pendimethalin	3.4	3.0	71	52	45	35	34
MSMA	2.2	2.0	Pendimethalin	3.4+1.7	3.0+1.5	66	49	47	36	32
MSMA	2.2+2.2	2.0+2.0	Pendimethalin	3.4	3.0	98	88	80	62	52
MSMA	2.2+2.2	2.0+2.0	Pendimethalin	3.4+1.7	3.0+1.5	100	85	80	60	57
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Pendimethalin	3.4	3.0	100	88	85	80	65
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Pendimethalin	3.4+1.7	3.0+1.5	100	98	90	80	61
MSMA	2.2	2.0	Dithiopyr	0.6	0.5	70	57	45	36	32
MSMA	2.2	2.0	Dithiopyr	0.6+0.3	0.5 +0.25	68	53	45	35	35
MSMA	2.2+2.2	2.0+2.0	Dithiopyr	0.6	0.5	97	90	91	70	63
MSMA	2.2+2.2	2.0+2.0	Dithiopyr	0.6+0.3	0.5+0.25	98	90	93	80	72
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Dithiopyr	0.6	0.5	100	95	82	65	60
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Dithiopyr	0.6+0.3	0.5+0.25	100	98	92	82	75
$LSD_{0.05}$[x]						8	12	14	14	11

[z]POST and PRE were applied initially on February 13, 1997. POST was reapplied to certain plots in weekly intervals. Turfgrass plots treated with a second half rate PRE application were eight weeks after the initial application.

[y]Ratings were made at 4, 8, 12, 20, and 26 weeks after the initial treatment, and are presented as percent (%) of untreated check.

[x]Means were separated using Fischer's protected LSD procedure.

applied once. Only dithiopyr applied a second time at a one-half rate assured considerably better crabgrass control. The positive effect of the second application probably resulted from the postemergence activity of dithiopyr when applied on crabgrass at the 2- to 3-leaf stage.

The differences between location I and location II could result from complex interactions between moisture, light, and herbicide concentration in a soil. The initial application of MSMA controlled crabgrass and caused some temporary injury to bermudagrass. As a result the turf could be easily penetrated by light. In the rainy season when the soil surface was constantly moist, crabgrass seeds were exposed to the light and massively germinated. These favorable weed germination conditions lasted 2–3 weeks, until bermudagrass resumed intensive growth, shaded the soil, and became competitive to crabgrass. During the first several weeks of the study, PRE herbicides were present in the soil at adequate concentration, and effectively controlled germinating seedlings. It is likely that the vast majority of seeds germinated at this time. No differences in crabgrass control resulted from the second PRE application at week 8 could be a consequence of few viable seeds that remained in the soil to germinate. It could also be related to the activity of PRE herbicides still present in the soil. Differences in soil longevity of the three PRE herbicides were probably unimportant as all three performed the same.

In the dry season at location II, MSMA acted similarly as in the rainy season. The open turf allowed for light penetration but germination was probably reduced. In fact, dry winds and less frequent rainfall resulted in a mostly dry soil surface preventing massive seed germination. Since the germinating period was less favorable, not all viable seeds germinated during the PRE herbicides' active windows. In addition, the efficacy of PRE herbicides in the dry season could have been reduced because of impeded soil translocation. Low soil moisture could also decrease efficacy of the second reduced rate application of pendimethalin and oxadiazon. In conclusion, when a sequential POST/PRE crabgrass control program was initiated during a dry season, satisfactory (≥80%) control lasted usually for 12 weeks. When a program was initiated during the rainy season, two full rate applications of MSMA followed by a full application rate of any of the tested PRE herbicides assured ≥88% control for a period of 6 months.

Turf quality. A single application of MSMA resulted in turf showing severe discoloration within two weeks following initial treatments (Tables 3 and 4). This was expected because the crabgrass infestation was 95% and bermudagrass was highly suppressed. Bermudagrass density was too low to evaluate the initial influence of the herbicides on turf quality. Three to four weeks after initial POST treatment, the density of bermudagrass increased rapidly. After week 4, quality ratings reflected mostly an increased bermudagrass density. After 5 to 6 weeks, plots where MSMA was applied once and crabgrass control was poor were less uniform and had lower quality than plots where MSMA was reapplied. Plots where MSMA was applied three times showed lower quality for a week longer than plots where MSMA was applied twice. Since a complete discoloration resulted from MSMA applications, differences between PRE herbicides applied at week 0 were not detected. The second application of oxadiazon and pendimethalin at 1.7 kg/ha (1.5 lb/A) had no influence on turf quality. Dithiopyr at 0.3 kg/ha (0.25 lb/A) reduced turf quality for a period of 1 to 2 weeks in both studies, however in the rainy season differences were insig-

Table 3. The effect of sequential postemergence and preemergence herbicides on quality of bermudagrass turf in crabgrass experiment conducted in rainy season on Guam at Location I.

Treatment[z]														
POST	Rate		PRE	Rate		Turf quality (wk)[y]								
	kg/ha	lb/A		kg/ha	lb/A	1	2	3	4	5	6	8	9	10
Untreated			Untreated			7.5	7.6	7.5	7.7	7.6	7.7	7.5	7.6	7.5
MSMA	2.2	2.0	Oxadiazon	3.4	3.0	1.8	1.0	2.2	4.8	6.2	7.0	6.6	6.5	6.9
MSMA	2.2	2.0	Oxadiazon	3.4+1.7	3.0+1.5	2.0	1.3	2.4	4.8	6.5	7.0	6.4	7.0	7.1
MSMA	2.2+2.2	2.0+2.0	Oxadiazon	3.4	3.0	1.7	1.0	2.2	4.9	6.5	7.1	7.2	7.3	7.7
MSMA	2.2+2.2	2.0+2.0	Oxadiazon	3.4+1.7	3.0+1.5	2.0	1.0	2.4	4.7	6.3	7.2	7.0	7.3	7.4
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Oxadiazon	3.4	3.0	2.0	1.0	2.0	4.7	6.0	7.0	6.9	7.4	7.8
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Oxadiazon	3.4+1.7	3.0+1.5	2.1	1.0	1.8	4.3	6.0	7.0	7.0	7.3	7.7
MSMA	2.2	2.0	Pendimethalin	3.4	3.0	1.7	1.3	2.4	4.6	6.2	7.1	7.0	7.1	7.2
MSMA	2.2	2.0	Pendimethalin	3.4+1.7	3.0+1.5	1.8	1.0	2.4	4.7	6.2	5.7	7.1	7.0	7.1
MSMA	2.2+2.2	2.0+2.0	Pendimethalin	3.4	3.0	1.7	1.0	2.4	4.8	6.3	6.3	6.7	7.0	7.4
MSMA	2.2+2.2	2.0+2.0	Pendimethalin	3.4+1.7	3.0+1.5	1.7	1.0	2.2	4.7	5.8	6.4	6.6	7.3	7.7
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Pendimethalin	3.4	3.0	1.7	1.0	1.8	4.6	5.8	6.3	7.0	7.5	7.4
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Pendimethalin	3.4+1.7	3.0+1.5	1.7	1.0	1.7	4.7	5.8	6.3	7.0	7.3	7.7
MSMA	2.2	2.0	Dithiopyr	0.6	0.5	1.7	1.3	2.2	4.8	6.0	5.8	7.0	7.1	7.1
MSMA	2.2	2.0	Dithiopyr	0.6+0.3	0.5+0.25	1.5	1.3	2.4	4.9	6.3	5.8	7.1	6.2	6.5
MSMA	2.2+2.2	2.0+2.0	Dithiopyr	0.6	0.5	2.0	1.0	2.4	4.9	6.2	6.9	7.0	7.1	7.2
MSMA	2.2+2.2	2.0+2.0	Dithiopyr	0.6+0.3	0.5+0.25	1.8	1.0	2.4	4.8	6.3	6.9	6.7	6.2	6.6
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Dithiopyr	0.6	0.5	1.8	1.0	2.0	4.5	6.2	6.0	7.0	7.3	7.2
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Dithiopyr	0.6+0.3	0.5+0.25	1.8	1.0	1.8	4.7	6.2	6.6	7.1	7.0	7.1
$LSD_{0.05}$[x]						0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.5	0.6

[z]POST and PRE were applied initially on October 1, 1996. POST was reapplied to certain plots in weekly intervals. Turfgrass plots treated with a second half rate PRE application were eight weeks after the initial application.

[y]Turf quality ratings were made in weekly intervals after the initial treatment and were based on a scale of 1 to 10 (where 1 = turf brown, and 10 = dark green dense uniform stand).

[x]Means were separated using Fischer's protected LSD procedure.

Table 4. The effect of sequential postemergence and preemergence herbicides on quality of bermudagrass turf in crabgrass experiment conducted in dry season on Guam at Location II.

Treatment[z]														
POST	Rate		PRE	Rate		Turf quality (wk)[y]								
	kg/ha	lb/A		kg/ha	lb/A	1	2	3	4	5	6	8	9	10
Untreated		Untreated				7.0	6.8	7.0	7.1	6.9	7.1	6.9	7.1	7.0
MSMA	2.2	2.0	Oxadiazon	3.4	3.0	2.0	1.0	1.5	4.1	5.3	5.8	5.9	6.1	5.8
MSMA	2.2	2.0	Oxadiazon	3.4+1.7	3.0+1.5	2.0	1.6	1.6	4.5	4.8	5.7	5.9	5.8	5.9
MSMA	2.2+2.2	2.0+2.0	Oxadiazon	3.4	3.0	2.0	1.0	1.9	4.3	4.8	6.2	6.7	6.9	6.8
MSMA	2.2+2.2	2.0+2.0	Oxadiazon	3.4+1.7	3.0+1.5	1.7	1.0	2.0	4.5	5.3	6.2	6.4	6.9	6.9
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Oxadiazon	3.4	3.0	1.9	1.0	1.9	3.1	5.2	6.1	6.3	6.5	7.2
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Oxadiazon	3.4+1.7	3.0+1.5	1.9	1.0	1.9	3.9	4.8	6.3	6.4	6.5	6.9
MSMA	2.2	2.0	Pendimethalin	3.4	3.0	1.6	1.0	2.0	4.5	4.8	5.6	5.9	5.8	6.2
MSMA	2.2	2.0	Pendimethalin	3.4+1.7	3.0+1.5	1.9	1.0	1.5	4.3	5.3	5.3	6.0	5.8	6.2
MSMA	2.2+2.2	2.0+2.0	Pendimethalin	3.4	3.0	1.8	1.0	2.0	4.6	5.4	5.8	5.7	6.3	7.0
MSMA	2.2+2.2	2.0+2.0	Pendimethalin	3.4+1.7	3.0+1.5	1.6	1.0	1.9	4.5	5.1	5.9	6.2	6.1	7.0
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Pendimethalin	3.4	3.0	1.5	1.0	1.4	3.9	4.5	5.8	6.4	6.3	6.8
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Pendimethalin	3.4+1.7	3.0+1.5	1.5	1.0	1.4	3.7	4.6	5.8	6.4	6.7	6.6
MSMA	2.2	2.0	Dithiopyr	0.6	0.5	1.9	1.5	1.6	4.6	5.3	5.5	6.0	6.2	6.4
MSMA	2.2	2.0	Dithiopyr	0.6+0.3	0.5+0.25	1.7	1.5	1.6	4.6	5.4	5.5	5.9	5.3	5.9
MSMA	2.2+2.2	2.0+2.0	Dithiopyr	0.6	0.5	2.2	1.0	1.6	4.3	5.4	6.2	6.3	6.5	6.3
MSMA	2.2+2.2	2.0+2.0	Dithiopyr	0.6+0.3	0.5+0.25	2.0	1.0	2.0	4.5	5.5	6.3	6.2	5.7	6.0
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Dithiopyr	0.6	0.5	1.9	1.0	1.4	3.8	5.3	5.7	6.4	6.9	6.6
MSMA	2.2+2.2+2.2	2.0+2.0+2.0	Dithiopyr	0.6+0.3	0.5+0.25	1.6	1.0	1.4	3.7	4.6	6.1	6.3	6.1	6.2
$LSD_{0.05}$[x]						0.5	0.4	0.5	0.7	0.7	0.6	0.6	0.6	0.5

[z]POST and PRE were applied initially on February 13, 1997. POST was reapplied to certain plots in weekly intervals. Turfgrass plots treated with a second half rate PRE application were eight weeks after the initial application.

[y]Turf quality ratings were made in weekly intervals after the initial treatment and were based on a scale of 1 to 10 (where 1 = turf brown, and 10 = dark green dense uniform stand).

[x]Means were separated using Fischer's protected LSD procedure.

nificant. In conclusion, elimination of crabgrass from highly infested fairway results in necessity to tolerate severe turf injury lasting 5–6 weeks.

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