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Effect of Core Cultivation on Preemergence Herbicide Activity in Bermudagrass

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Abstract. **A field experiment was initiated to determine herbicidal activity on large crabgrasses (*Digitaria sanguinalis* (L.) Scop.] when core cultivation was performed in a common bermudagrass [*Cynodon dactylon* (L.) Pers.] turf after herbicide application. Core cultivation treatments were made prior to preemergence herbicide application or at 1, 2, 3, or 4 months after the chemicals were applied. Where oxadiazon (4.4 kg·ha^{-1}), bensulide (11.2 kg·ha^{-1}), bensulide + oxadiazon (6.7 + 1.7 kg·ha^{-1}) and benefin (3.4 kg·ha^{-1}) were applied, the timing of core cultivation had no significant influence on preemergence large crabgrass control. DCPA (14.0 kg·ha^{-1}) was ineffective in controlling large crabgrass, regardless of core cultivation parameter. Chemical names used: 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2(3*H*)-one (oxadiazon); *0,0-bis*(1-methylethyl)*S*-[2-[(phenylsulfonyl)amino] ethyl]phosphorodthioate (bensulide); *N*-butyl-*N*-ethyl-2,6-dinitro-4-(trifluoromethyl)benzenamine (benefin); dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate (DCPA).**

Crabgrass is a common summer annual weed that invades turfgrasses throughout the United States. Many studies have shown that preemergence herbicide applications to turf in spring effectively control crabgrass regardless of whether smooth [*Digitaria ischaemum* (Schreb.) Muhl.] or large crabgrass (2, 4, 5, 8, 9).

Core cultivation is used commonly on turfgrass sites in the spring and summer to improve wetting of dry spots, to stimulate root and shoot growth, to alleviate compaction, and to control thatch (7). Core cultivation also has resulted in openings in the turf that favor weed seed germination and development (1, 7). Therefore, coring is usually not performed after preemergence herbicide application to prevent disruption of the herbicide barrier. This restriction greatly limits the usefulness of core cultivation in many turfgrass situations.

Preemergence herbicides must be applied in early spring for effective crabgrass control. When bermudagrass [*Cynodon dactylon* (L.) Pers.] greens are overseeded with cool-season grasses, the optimum time for coring is mid to late spring. This timing results in the best turf transition from the overseeded grass back to bermudagrass. As a result, core cultivation often is eliminated to avoid disrupting the preemergence herbicide barrier. Researchers in Michigan (3) found that core cultivation 4 weeks after herbicide application in an annual bluegrass [*Poa annua* var. reptans (Hauskins)] turf had no influence on the ability of benefin, bensulide, or DCPA to control crabgrass. Effective preemergence goosegrass [*Eleusine indica* (L.) Gaertn.] control also occurred when oxadiazon (3.4 kg·ha^{-1})-treated plots were cored prior to or at 1, 2, or 3 months after herbicide treatment in Georgia (6). Because large crabgrass germinates over a longer period in Georgia and the southeast than in Michigan, an experiment was initiated to determine the effect of core cultivation on the efficacy of preemergence herbicides for large crabgrass control in bermudagrass.

The soil type was a Cecil sandy loam (clayey, Kaolinitic Thermic Typic Hapludult) with 66% sand, 16% silt, 18% clay, and 0.6% organic matter content. Soil pH was 6.0. Treatments were applied to the same plots each year. Large crabgrass seed were applied to the test site at 10 kg·ha^{-1} only during the first week in January to supplement the natural weed population. This seeding was done during the first 2 years of the study but was not needed the last 2 years. The population of large crabgrass in untreated plots was 35% and 42% cover in 1982 and 1983, respectively, and 53% cover in 1984 and 1985 when weed control ratings were made in late August. Herbicides and rates of application are given in Table 1. Bensulide and DCPA were applied as a broadcast spray in 375 liters·ha^{-1} of water. Oxadiazon, benefin, and combination of bensulide plus oxadiazon were applied as granules with a drop-type spreader.

Core cultivation treatments were performed across the herbicide-treated plots just prior to herbicide application or at 1, 2, 3, or 4 months after application. An untreated check also was included. The tines on the coring machine were 1 cm in diameter and spaced 5.1 cm apart. During the cultivation, the tines removed cores that were 7 to 10 cm long. After the cores dried on the soil surface, a vertical mower was used to break up the cores and return the soil to the same plots from which the cores were removed. During vertical mowing, the thatch layer may have been slightly disrupted but did not penetrate the soil surface.

The turf in the test area was fertilized with 50 kg N/ha, 22 kg P/ha, and 42 kg K/ha in April and September of each year. Nitrogen at 50 kg·ha^{-1} also was applied in May, June, July, and August of each year. Rainfall was supplemented with irrigation as needed. The turf was mowed twice each week at a 2- to 3-cm height, and clippings were removed.

Visual ratings of turf cover and large crabgrass control were made in late August of each year. The ratings were based on percent ground cover, where 0 equals no turf or weeds. Because the results were statistically similar (i.e., no year × treatment interaction) for all 4 years, the data are reported as averages over years.

Herbicides were randomly assigned to three blocks. Core cultivation treatments were stripped across all herbicide treatments and

Table 1. Comparison of core cultivation and preemergence herbicide applications on large crabgrass cover in bermudagrass turf.

	Large crabgrass cover (%)[z]						
	Herbicides (kg·ha^{-1})						
Core cultivation comparisons[y]	None	Oxadiazon (2.2)	Oxadiazon (4.4)	Bensulide (11.2)	DCPA (14.0)	Bensulide + oxadiazon (6.7 + 1.7)	Benefin (3.4)
Prior to	34**	4*	6	7	25	6	7
vs. 1 month after	63	9	3	5	30	9	5
Prior to	34	4*	6	7	25	6	7
vs. 2 months after	37	9	8	5	26	4	7
Prior to	34**	4	6	7	25	6	7
vs. 3 months after	55	5	4	8	20	4	5
Prior to	34**	4	6	7	20	6	7
vs. 4 months after	54	7	2	7	24	4	5

[z] Percentage of ratings were made in late August and are averages over 4 years. For all data there was a test of normality to indicate transformation was not needed.
[y] Dates of coring are related to time of herbicide treatment.
*,** Significant comparison at the 0.05 and 0.01 levels, respectively.

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individual plots were 1.5 × 1.5 m. Analysis of variance was done using the General Linear Model procedure in Statistical Analysis System as a strip split-block design. Various post hoc contrasts were hypothesized for a planned comparison of core treatments within each herbicide treatment, including the comparisons of coring done prior to herbicide treatment and coring done at 1, 2, 3, or 4 months after herbicides were applied.

Core cultivation at 1, 2, 3, or 4 months after herbicide application did not affect the efficacy of herbicides applied at recommended rates to control large crabgrass (Table 1). Even though plots treated with oxadiazon at 2.2 $kg \cdot ha^{-1}$ and cored at 1 or 2 months after herbicide treatment had a higher large crabgrass cover than did plots cored prior to herbicide treatment, the difference was small and not agronomically important. This difference did not occur when oxadiazon rate was increased to 4.4 $kg \cdot ha^{-1}$. This observation with oxadiazon agrees with results on goosegrass control study conducted in Georgia (6) and crabgrass control study performed in Michigan (3).

In this study, there were differences in weed cover among the core cultivation treatments where no herbicide was applied. Weed cover was higher in plots that were cored in April (1 month after herbicide treatment date), June (3 months after herbicide treatment date), and July (4 months after herbicide treatment date) than when untreated plots were cored in March (prior to herbicide treatment date). Even though crabgrass cover in plots cored in May was not significantly different from plots cored in March, there was a trend for a higher cover in the later-cored plots. The increased cover of large crabgrass in plots cored in April or later (in nonherbicide treated plots) indicates that large crabgrass seed were present in the cores removed at each coring date.

DCPA was ineffective in controlling large crabgrass, regardless of core cultivation treatment (Table 1). Similar levels of large crabgrass control occurred among all other herbicide-treated plots.

Bermudagrass cover in untreated plots was consistently lower than in herbicide-treated plots (data not shown). Because DCPA did not control large crabgrass effectively, turf cover in DCPA treated plots was not as high as in other herbicide-treated plots.

The results obtained from this experiment indicate that core cultivation may be performed without significantly reducing the activity of oxadiazon, bensulide, bensulide + oxadiazon, and benefin on large crabgrass.

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Annual Bluegrass and Creeping Bentgrass Germination Response to Flurprimidol

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Abstract. **Seed of *Poa annua* var. *reptans* (Hauskins) Timm. (annual bluegrass) and *Agrostis palustris* Huds. 'Penncross' (creeping bentgrass) were treated at planting with flurprimidol at rates of 0.00, 0.28, 0.56, 0.84, 1.12, 1.68, and 2.24 $kg \cdot ha^{-1}$. Data were collected on germination of each species. Flurprimidol rates greater than 0.56 decreased germination for both species. Chemical name used: α-(1-methylethyl-α-[4-(trifluoromethoxy)phenyl]-5-pyrimidine methanol (flurprimidol).**

Poa annua L. (annual bluegrass) invades close-cut, irrigated, intensively managed cool season turfs and within 3 to 5 years may dominate the stand (11). Annual bluegrass may invade desired species, filling voids left by mismanagement, disease, traffic, cultivation, and other stresses (1). Annual bluegrass may reestablish these areas vegetatively (1) or from seed in the soil (7). Control programs are based on the removal of annual bluegrass over a number of years while managing the turf for the desired species, or reestablishment of the desired species after annual bluegrass eradication (2, 5, 8). One management approach would be to employ a plant growth regulator to inhibit selectively the growth of annual bluegrass and encourage the desired species, allowing a gradual transition from annual bluegrass dominance while maintaining turfgrass aesthetic and functional qualities. Flurprimidol reduced annual bluegrass in perennial ryegrass (*Lolium perenne* L.) (2). Flurprimidol applied to annual bluegrass and creeping bentgrass (*Agrostis palustris* Huds.) polystands exhibits selectivity for annual bluegrass growth suppression, indicating a potential for use in the conversion process (10). If the annual bluegrass population in a mixed stand is very high, overseeding with creeping bentgrass is sometimes implemented. Haley and Fermanian (6) found that flurprimidol was active on young seedlings of annual bluegrass and creeping bentgrass, but information on germination response was not reported. The objective of this research was to determine if flurprimidol applications influenced germination of annual bluegrass and creeping bentgrass.

Clay pots 100 mm in diameter were seeded in the greenhouse, where temperatures fluctuated between 10° and 24°C. The growth medium was 5 sandy loam : 3 sand : 1 peatmoss, (by volume). Half the pots were seeded to 'Penncross' creeping bentgrass (lab germination 85%). The remaining pots were seeded to annual bluegrass (lab germination 92%). Both species were seeded at a rate of 25 seeds/pot. Seed of annual bluegrass was obtained by harvesting mature seed heads from a stand of annual bluegrass located at the Hancock Turfgrass Research Center, Michigan State Univ. The harvested seed was assumed to be of the perennial annual bluegrass biotype, due to the high germination (92%) observed immediately after harvest (1).

Immediately following seeding, pots were treated with flurprimidol at rates of 0.00, 0.28, 0.56, 0.84, 1.12, 1.68, and 2.24 $kg \cdot ha^{-1}$. Treatments were applied with a backpack CO_2 sprayer with an 8002E nozzle calibrated to deliver 384 $liters \cdot ha^{-1}$. Pots were irrigated three times daily for 4 min with an automatic misting system. The experiment was conducted on two dates (Oct. 1984 and

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