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Centipedegrass Tolerance to Postemergence Grass Herbicides

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Abstract. **The phytotoxicity of single and sequential treatments of sethoxydim and fluazifop at 0.10, 0.20, and 0.30 kg·ha^{-1}; haloxyfop, xylafop, fenoxaprop, and SC-1084 at 0.07, 0.15, and 0.30 kg·ha^{-1}, on centipedegrass [*Eremochloa ophiuroides* (Munro.) Hack.] was determined. Turf color generally was unaffected by sethoxydim application except for a slight discoloration at 14 days after treatment (DAT) with the high rate. Recovery was evident from all rates of sethoxydim by 28 DAT. Turf density was similar to untreated control at 42 DAT. Single applications of fenoxaprop and SC 1084 at 0.07 kg·ha^{-1} initially caused severe discoloration; however, recovery was evident by 42 DAT. Density also was unaffected at this time. Unacceptable turf color and density were observed with single and sequential applications of fluazifop, haloxyfop, xylafop, and with sequential application of SC 1084 and fenoxaprop. Chemical names used: (2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one (sethoxydim); (±)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxyl]phenoxy]propanoic acid (fluazifop); 2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]-phenoxyl]propanoic acid (haloxyfop); (2-[4-[(6-chloro-2-quinoxalinyl)-oxy]phenoxyl]propanoic acid (xylafop); (±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoic acid (fenoxaprop); and methyl 3-hydroxy-4-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]-pentanoate (SC-1084).**

Centipedegrass is a warm-season, perennial grass often used in the southeastern United States for limited wear areas such as lawns, industrial sites, and along roadsides. Desirable characteristics of centipedegrass include reduced fertilizer requirements, pH range adaptability, and reduced mowing frequency (11). Centipedegrass is established by seeds or vegetatively and due to its slow, stoloniferous growth habit, weeds often invade these areas. Postemergence control of weeds, such as bermudagrass [*Cynodon dactylon* (L.) Pers], crabgrass (*Digitaria* spp.), dallisgrass (*Paspalum dilatatum* Poir.), and goosegrass [*Eleusine indica* (L.) Gaertn.] in centipedegrass is difficult to achieve without injury (11).

Previous studies on the phytotoxicity of postemergence herbicides and their effectiveness in controlling weeds on centipedegrass often have reported unacceptable results (2, 7, 10, 12). The recent introduction of several postemergence herbicides has stimulated interest for investigating their tolerance on centipedegrass. 2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoic acid (sulfometuron) at 0.07, 0.13, 0.14, and 0.25 kg·ha^{-1} has been reported tolerant in centipedegrass (1, 7) and provided control of bahiagrass (*Paspalum notatum* Flugge.) (3). Centipedegrass also has been reported tolerant to single applications of sethoxydim (1, 12). However, Willard and Currey (14) indicated that sethoxydim at 0.25 kg·ha^{-1} reduced centipedegrass carbon exchange rate by 27% at 12 days after application. Crabgrass and goosegrass have been controlled with sethoxydim and other postemergence grass herbicides (4–6, 8, 9, 13). The objective of this study was to determine the phytotoxicity of single and sequential applications of six postemergence herbicides on centipedegrass.

Research was conducted at Clemson, S.C. on an amended Cecil series (clayey, kaolinitic, thermic Typic Hapludults). Soil test results showed medium to high levels of P, K, Mg, and Ca. Soil pH was 5.8, and no lime was added prior to the study. Herbicides were applied in the 3rd week of June 1985, and the experiment then was repeated in August. Herbicides included sethoxydim, fluazifop, haloxyfop, xylafop, fenoxaprop, and SC-1084. Each treatment contained crop oil concentrate (BASF crop oil concentrate, BASF Wyandate Corp., Parsipanny, N.J.) at 2.4 liters·ha^{-1}. Sequential treatments at the same initial rate were applied to the same plots 28 days after the first application.

Treatments were arranged in a randomized complete block design with 0.5 m × 1.0 m plots replicated three times. Herbicide treatments were applied with a CO_2-pressurized backpack sprayer delivering 187 liters·ha^{-1}. Plots were mowed weekly at a height of 5 cm and watered to avoid stress. Nitrogen fertilizer was applied at 0.56 kg·ha^{-1} in mid-April and again in mid-July. Turf color was estimated visually using a 1 to 9 scale, with 1 as complete kill, 6.5 as acceptable, and 9 as best. Stand density was estimated visually using a 0 to 100 scale, with 0 as bare ground and 100 as total turf vegetative coverage.

Data were subjected to analysis of variance (ANOVA) with observations appearing to be distributed over limits not associated with normally distributed data. This possibly suggests that sample variance may not be normally distributed. Therefore, data were transformed and analysis resulted in similar responses as with ANOVA; thus data will be discussed by ANOVA results. Treatment means were separated using least significant differences (LSD) at the 5% level of significance.

Single herbicide application. Similar responses were observed in both the August and June experiments so only the August data will be discussed.

Visual ratings 14 days after treatment (DAT) revealed acceptable color (6.5 and above) only with sethoxydim treatments; however, the medium and high rates of sethoxydim produced lower color ratings than the untreated check (Table 1). Evaluations 28 DAT and 42 DAT indicated this turf recovered from sethoxydim applications when compared to the untreated check. Severe discoloration (<3.0) was observed with haloxyfop and xylafop 28 DAT and with fluazifop, haloxyfop, and xylafop 42 DAT. Recovery of the centipedegrass color was observed 56 DAT with low and high rates of fenoxaprop, and low rate of SC-1084. Comparable color ratings to the untreated check also were obtained with all rates of sethoxydim. Final evaluation 70 DAT indicated sethoxydim (all rates), low and high rates of fenoxaprop, and low rate of SC-1084 were comparable to the untreated check. Turf density observations 70 DAT revealed sethoxydim (all rates), fenoxaprop (low rate), and SC-1084 (low rate) were similar to the untreated check.

Sequential herbicide application. Results from the sequential herbicide studies were similar for June and August experiments; therefore, only data from the August test will be presented. Sethoxydim-treated centipedegrass did not show any discoloration 28 days after sequential application (Table 2). Turf density evaluations 42 days after sequential applications indicated excellent tolerance of centipedegrass to sethoxydim. All other treatments produced severe to moderate discoloration. The 2nd application of sethoxydim did not affect turf color adversely at all evaluation periods. Centipedegrass recovered from a single low-rate application of fenoxaprop and SC-1084 (Table 1). However, sequential treatments produced severe injury, and the grass did not recover from the 2nd treatment through 42 DAT.

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Table 1. Response of centipedegrass to single postemergence herbicide applications.

Herbicide[z]	Rate (kg·ha^{-1})	Turf color[y] 14 DAT[x]	28 DAT	42 DAT	56 DAT	70 DAT	Density (%)[w] 70 DAT
Sethoxydim	0.10	8.0	8.2	8.3	8.3	8.5	87
	0.20	7.7	8.0	8.5	8.5	8.7	90
	0.30	7.3	7.8	8.0	8.3	8.5	82
Fluazifop	0.10	4.8	4.0	3.0	2.8	3.3	37
	0.20	4.0	3.3	2.5	2.2	2.5	17
	0.30	3.7	1.8	1.3	1.3	1.2	5
Haloxyfop	0.07	3.8	2.7	2.2	1.8	1.8	18
	0.15	3.7	2.7	2.0	1.3	1.3	15
	0.30	3.5	1.7	1.0	1.0	1.0	2
Xylafop	0.07	3.7	2.7	2.7	3.0	3.0	35
	0.15	3.7	2.7	2.5	2.3	3.2	37
	0.30	3.5	1.0	1.0	1.0	1.0	3
Fenoxaprop	0.07	5.2	6.0	6.8	7.3	7.3	75
	0.15	4.2	4.7	5.3	5.8	5.8	50
	0.30	4.3	5.2	6.8	7.3	7.5	65
SC-1084	0.07	5.5	5.7	6.7	7.7	8.0	75
	0.15	4.0	3.0	2.2	2.0	2.3	27
	0.30	4.2	3.8	3.3	3.0	3.7	40
Check	---	8.5	8.5	8.2	8.3	8.3	85
LSD (5% level)		0.7	1.3	1.2	1.2	1.2	19

[z]Herbicide treatments applied in Aug. 1985.
[y]Rated visually on a scale of 1 to 9, 9 = best with a minimum homelawn acceptability rating of 6.5.
[x]DAT = days after herbicide treatment.
[w]Rated visually on a scale of 0% to 100% green ground cover.

Table 2. Response of centipedegrass color and density to sequential postemergence herbicide applications.

Herbicide[z]	Rate (kg·ha^{-1}) August	September	Turf color[y] 0 DAT[x]	14 DAT	28 DAT	42 DAT	Turf density (%)[w] 42 DAT
Sethoxydim	0.10	0.10	8.2	8.5	8.5	8.3	88
	0.20	0.20	7.8	7.5	8.0	8.3	85
	0.30	0.30	8.0	7.3	7.8	8.3	85
Fluazifop	0.10	0.10	3.5	2.3	1.5	1.5	8
	0.20	0.20	3.0	2.0	1.3	1.5	8
	0.30	0.30	2.2	1.3	1.0	1.0	5
Haloxyfop	0.07	0.07	2.3	1.7	1.7	1.2	7
	0.15	0.15	2.7	1.3	1.7	1.0	3
	0.30	0.30	1.3	1.0	1.0	1.0	0
Xylafop	0.07	0.07	2.3	1.7	1.5	1.7	8
	0.15	0.15	2.8	2.0	1.7	1.3	5
	0.30	0.30	2.2	1.3	1.0	1.0	3
Fenoxaprop	0.07	0.07	5.8	4.7	4.0	4.8	53
	0.15	0.15	5.0	4.0	3.5	4.2	28
	0.30	0.30	4.3	3.2	2.2	2.8	28
SC-1084	0.07	0.07	5.2	3.0	2.2	2.5	20
	0.15	0.15	3.8	2.7	1.3	1.7	18
	0.30	0.30	3.5	2.5	1.3	1.5	8
Check	---	---	8.5	8.3	8.5	8.5	85
LSD (5% level)			1.4	1.0	1.2	1.2	12

[z]Herbicide treatments applied in Aug. and Sept. 1985.
[y]Rated visually on a scale of 1 to 9, 9 = best with a minimum homelawn acceptability rating of 6.5.
[x]DAT = days after sequential herbicide treatment. Sequential herbicide treatment was 28 days after the first treatment.
[w]Rated visually on a scale of 0% to 100% green ground cover.

In conclusion, single and sequential sethoxydim applications at the high rate did not reduce turf color or density by 70 DAT when compared to the untreated check. Slight discoloration was noted with single sethoxydim application (high rate) at 14 DAT; however, recovery occurred by 28 DAT. Acceptable turf color for the low rate of SC-1084 was noted 40 days after a single treatment but was unacceptable 42 days after the sequential treatment. Inconsistent responses with fenoxaprop indicate that further investigations with fenoxaprop using various rates and application under different environmental conditions are needed before usage on centipedegrass is accepted.

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Postharvest Fruit Conditioning Reduces Chilling Injury in Watermelons

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Abstract. **Symptoms of external chilling injury, primarily brown-staining of the rind, of watermelon [*Citrullus lanatus* (Thunb.) Matsum & Nakai] were reduced by conditioning fruit at 26°C for 4 days before storage at 0° or 7°. No loss of marketable fruit occurred in nonconditioned melons stored at 0° for 4 days, or in conditioned melons stored at 0° for 12 days. Further lengths of 0° storage resulted in chilling injury and increased loss of marketable fruit. The amount of brown-staining intensified during 4- and 8-day holding periods at 21° after removal from storage at 0° for 8 days or longer, but was always less in conditioned fruit. Less chilling injury occurred in fruit stored at 7° than at 0°. No loss of marketable fruit occurred in conditioned melons stored for 8 days at 7° followed by holding at 21° for up to 8 days. A slight fruit loss occurred in nonconditioned melons subjected to the same treatment. 'Charleston Gray' was slightly more susceptible to chilling injury than 'Crimson Sweet' or 'Jubilee', among nonconditioned fruit.**

Watermelons may be stored under a wide range of temperatures after harvest, depending on economics and commercially available refrigeration facilities. The standard reference for commercial storage of watermelons recommends that fruit be stored at 4.5° to 10°C (6), but this recommendation was made almost 20 years ago. Little additional work has been done since then to develop a precise storage temperature recommendation. Determining optimum storage conditions is important to the U.S. domestic industry and to the development of overseas export markets, which require long storage and transit times.

Watermelon is a warm-season vegetable crop reported to be susceptible to external chilling injury at low storage temperatures (3) and sugar loss at high temperatures (2). Assuming that a high sugar content is necessary for optimal flavor, it would be beneficial if watermelons could be stored at low temperature without chilling injury. A high-temperature, prestorage conditioning or curing treatment has been successful in preventing or reducing low-temperature-induced chilling injury in grapefruit (4, 5) and sweet potatoes (7). No study has been conducted on the use of a prestorage conditioning treatment to ameliorate chilling injury in watermelon. Therefore, the objective of this study was to determine the effectiveness of a high-temperature (26°C) conditioning treatment on reducing external chilling injury in low-temperature-stored watermelon fruit from different cultivars. The influences of storage temperature, length of storage, and length of holding at 21° after removal from cold storage on chilling-injury symptom development were determined on the three leading cultivars currently grown in the United States. The rationale for selecting 26° as the prestorage conditioning temperature was based on feasibility and on the results of a preliminary study.

'Charleston Gray', 'Crimson Sweet', and 'Jubilee' watermelons were grown during Spring and early Summer 1985 at the Louisiana State Univ. Hill Farm in Baton Rouge, following cultural practices recommended for commercial production (1). Sound, disease-free fruit (about 9 kg in size, 34–38 days after anthesis) were harvested in mid-July. Immediately after harvest, the fruit were divided randomly and put directly (nonconditioned) into storage rooms at 0°, 7°, 16°, or 21°C; or held at 26° for 4 days (prestorage conditioning) before being put into the 0°, 7°, 16°, or 21° storage rooms. Relative humidity was 85% ± 5% in each room. Fifty fruit from each cultivar were used for each treatment. Both the nonconditioned and conditioned melons were inspected after 4, 8, 12, and 16 days of storage, which is within the range of transit and storage times for domestic and overseas shipments. The fruit were then transferred to 21° to simulate marketing conditions and inspected after holding for 4 and 8 days.

Brown-staining of the rind was the primary symptom of chilling, followed by rind

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Table 1. Main effects and interactions of conditioning treatment, storage temperature, length of storage, cultivar, and length of holding after storage on marketable fruit of watermelon.

Main effects	Marketable fruit[z] (%)
Conditioning treatment	
Conditioned[y]	87
Nonconditioned[x]	73
Significance[w]	*
Storage temperature (°C)	
0°	72
7°	88
16°	100
21°	100
Significance	Q
Length of storage (days)	
4	100
8	92
12	75
16	52
Significance	Q
Cultivar	
Charleston Gray	78
Crimson Sweet	81
Jubilee	80
Significance	NS
Length of holding at 21°C (days)	
0	94
4	77
8	69
Significance	Q
Interactions[v]	*

[z]Fruit with <10% rind surface area affected with brown-staining or pitting were considered marketable. Based on a total of 50 fruit per treatment.
[y]Held for 4 days at 26°C, 85% RH immediately after harvest and then placed in storage.
[x]Immediately put in storage after harvest.
[w]F test significant at 5% (*) level or nonsignificant (NS); Q = quadratic effect.
[v]All two-way interactions were significant at the 5% level. All three-, four-, and five-way interactions were put into the error term.