Controlling Growth of Common Carpetgrass Using Selected Plant Growth Regulators

Edward W. Bush¹, Wayne C. Porter², Dennis P. Shepard³, and James N. McCrimmon⁴

Department of Horticulture, Louisiana State University Agricultural Center, 137 J.C. Miller Hall, Baton Rouge, LA 70803

Additional index words. *Axonopus affinis*, trinexapac-ethyl, mefluidide, sulfometuron, sethoxydim, fluzasulfuron, seedhead height, clipping yield, phytotoxicity, growth retardants

Abstract. Field studies were performed on established carpetgrass (*Axonopus affinis* Chase) in 1994 and 1995 to evaluate plant growth regulators (PGRs) and application rates. Trinexapac-ethyl (0.48 kg·ha⁻¹) improved turf quality and reduced cumulative vegetative growth (CVG) of unmowed and mowed plots by 38% and 46%, respectively, in 1995, and suppressed seedhead height in unmowed turf by >31% 6 weeks after treatment (WAT) both years. Mefluidide (0.14 and 0.28 kg·ha⁻¹) had little effect on carpetgrass. Sulfometuron resulted in unacceptable phytotoxicity (>20%) 2 WAT in 1994 and 18% phytotoxicity in 1995. In 1995, sulfometuron reduced mowed carpetgrass CVG 21%, seedhead number 47%, seedhead height 36%, clipping yield 24%, and reduced the number of mowings required. It also improved unmowed carpetgrass quality at 6 WAT. Sethoxydim (0.11 kg·ha⁻¹) suppressed seedhead formation by 60% and seedhead height by 20%, and caused moderate phytotoxicity (13%) in 1995. Sethoxydim (0.22 kg·ha⁻¹) was unacceptably phytotoxic (38%) in 1994, but only slightly phytotoxic (7%) in 1995, reduced clipping yields (>24%), and increased quality of mowed carpetgrass both years. Fluzasulfuron (0.027 and 0.054 kg·ha⁻¹) phytotoxicity ratings were unacceptable at 2 WAT in 1994, but not in 1995. Fluzasulfuron (0.054 kg·ha⁻¹) reduced seedhead height by 23% to 26% in both years. Early seedhead formation was suppressed >70% when applied 2 WAT in 1994, and 43% when applied 6 WAT in 1995. The effects of the chemicals varied with mowing treatment and evaluation year. Chemical names used: 4-(cyclopropyl-x-hydroxy-methyl-ene)-3,5-dioxo-cyclohexane-carboxylic acid ethyl ester (trinexapac-ethyl); N-2,4-dimethyl-5-[[[(trifluoro-methyl)sulfonyl]amino]phenyl]acetamide] (mefluidide); [methyl 2-[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoate]] (sulfometuron); (2-[1-(ethoxymimino)butyl-5-[(2-ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one) (sethoxydim); 1-(4,6-dimethoxypyrimidin-2-yl)-3-[(3-trifluoromethyl-pyridin-2-yl)sulphonyl] urea (fluzasulfuron).

Common carpetgrass is a low-maintenance lawngrass well adapted to the gulf coast region of the United States (Heath et al., 1985). It is generally used as a low-maintenance home lawn mowed between 3.8 and 7.5 cm in height (McCarty et al., 1992). Numerous seedheads, however, can be an unsightly problem associated with carpetgrass, thus necessitating increased mowing frequency.

The use of plant growth regulators (PGRs) offers an economical means of reducing turfgrass

mowing frequency (Nielsen, 1992). Carpetgrass seedhead formation was suppressed by >40% for up to 6 weeks following sethoxydim applications at 0.17 and 0.22 kg·ha⁻¹ (Fry and Wells, 1990). Sethoxydim applied at 0.05 and

0.11 kg·ha⁻¹ reduced seedhead production by >81% with moderate phytotoxicity (Wells, 1984). As rates increased from 0.28 to 1.12 kg·ha⁻¹, there was a gradual increase in carpetgrass phytotoxicity and a 16% stand reduction, yet growth was reduced 28% 7 WAT. Sequential applications of sethoxydim (0.07 and 0.14 kg·ha⁻¹) effectively extended time between mowings (Fry, 1989), but rates >0.14 kg·ha⁻¹ caused unacceptable phytotoxicity.

Several new PGRs are being used to manage seedhead formation, turfgrass growth, and improve turf quality (Dingwall, 1993). According to the label, trinexapac-ethyl increases turfgrass density, color, and turf quality while reducing mowing frequency (Chemical and Pharmaceutical Publishing Corp., 1994). It suppressed seedhead formation and vegetative growth of unmowed common bermudagrass [*Cynodon dactylon* (L.) Pers.] for 2 weeks when used at 0.4 kg·ha⁻¹, and that of 'Tifway' bermudagrass [*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt-Davy] for 8 weeks when applied at 0.2 kg·ha⁻¹ (Johnson, 1992).

The objective of this study was to compare the efficacy and phytotoxicity of trinexapac-ethyl and fluzasulfuron at selected rates with those of several other commonly used PGRs for seedhead number and height reduction, cumulative vegetative growth (CVG) reduction, and turf quality of unmowed and mowed common carpetgrass.

Materials and Methods

This experiment consisted of two mowing treatments (unmowed and mowed), and 12 PGR treatments, arranged in a split-plot design with four replications (Table 1). Four main carpetgrass plots were established in an Olivier silt loam soil [fine-silty, mixed, thermic Aquic Fragiudalf, pH 6.2, organic matter (OM) 1.1 meq·L⁻¹] located on the Burden Research Plantation in Baton Rouge, La. Duplicate plots were established in 1994 and 1995. Each main plot was divided into two randomly assigned mowing plots. The 12 PGR treatments were randomly assigned to

Table 1. The phytotoxicity² of PGRs on unmowed carpetgrass 2, 4, and 6 weeks after treatment (WAT) in 1994 and 1995.

Treatment	Rate (kg·ha ⁻¹)	1994			1995		
		WAT			WAT		
		2	4	6	2	4	6
Control	---	0 a ³	0 a	0	0 a	0	0
Trinexapac-ethyl	0.160	8 ab	0 a	0	0 a	0	0
	0.320	8 ab	1 a	0	0 a	0	0
	0.480	13 b	8 bc	0	0 a	0	0
Mefluidide	0.140	13 b	3 a	0	4 ab	0	0
	0.280	12 b	1 a	0	4 ab	0	0
					3 ab	0	0
Sulfometuron	0.630	32 de	15 d	0	18 d	0	0
Sethoxydim	0.084	10 b	4 ab	0	5 b	0	0
	0.110	18 bc	4 ab	0	13 cd	0	0
	0.220	38 e	11 cd	0	7 bc	0	0
Fluzasulfuron	0.027	24 cd	1 a	0	5 ab	0	0
	0.054	26 cd	3 a	0	4 ab	0	0

²Turfgrass phytotoxicity ratings were based on a 0 to 100% visual scale, where 0 = green foliage; 20% = unacceptable foliage discoloration, and 100% = complete browning. Data are means for four replications.

³Means separation within columns by Duncan's multiple range test ($P \leq 0.05$).

Received for publication 12 May 1997. Accepted for publication 29 Oct. 1997. Approved for publication by the director of the Louisiana Agricultural Experiment Station as manuscript number 97-28-0371. This research was supported by funds from state and matching funds allocated to the Louisiana State Univ. Agricultural Center. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked advertisement solely to indicate this fact.

¹Assistant Professor; to whom reprint requests should be addressed.

²Professor.

³Former Assistant Professor. Current address: Novartis Crop Protection Inc., 11561 Hemlock Drive, Overland Park, KS 66210.

⁴Assistant Professor.

Table 2. Seedhead number reduction and height of unmowed carpetgrass 2, 3, 4, and 6 weeks after treatment (WAT) with plant growth regulators (PGRs) in 1994 and 1995.

Treatment	Rate (kg·ha ⁻¹)	1994						1995			
		Seedhead reduction ² (%)			Seedhead height (cm)			Seedhead reduction (%)		Seedhead height (cm)	
		WAT			WAT			WAT		WAT	
		2	4	6	2	4	6	3	6	3	6
Control	---	0 a ^y	0 a	0 a	21 a	32 a	31 a	0 a ^y	0 a	46 a	55 a
Trinexapac-ethyl	0.160	31 a-c	34 a-c	30 a-d	16 bc	24 b	24 d-f	61 b	11 a-c	33 bc	49 ab
	0.320	57 c-e	35 a-c	19 ab	15 c	21 bc	24 d-f	70 b	0 a	29 cd	37 ef
	0.480	65 e	37 a-c	29 a-c	14 cd	18 cd	21 f	73 b	0 a	24 c-e	34 f
Mefluidide	0.140	1 a	0 a	0 a	20 a	29 a	30 a-c	58 b	28 b-d	38 ab	51 a
	0.280	0 a	12 ab	16 ab	19 ab	29 a	31 a	15 a	0 a	44 a	50 ab
Sulfometuron	0.630	63 de	18 a-c	47 b-d	11 d	18 cd	24 ef	63 b	47 cd	20 de	35 ef
Sethoxydim	0.084	34 b-d	23 a-c	16 ab	16 bc	23 b	28 a-d	69 b	47 cd	30 bc	53 a
	0.110	69 e	53 bc	58 cd	14 cd	22 b	26 c-e	89 b	60 d	27 c-e	44 bc
	0.220	82 e	65 c	65 d	11 d	20 bc	26 c-e	61 b	48 cd	30 d	40 c-e
Fluazasulfuron	0.027	72 e	45 a-c	12 ab	13 cd	16 d	27 b-e	82 b	44 b-d	24 c-e	42 cd
	0.054	77 e	55 bc	34 a-d	10 d	12 e	24 d-f	84 b	52 cd	18 e	41 c-e

²Seedhead number reduction = (seedhead number within nontreated control/seedhead number within PGR treatment) × 100.

^yMean separation within columns by Duncan's multiple range test ($P \leq 0.05$).

subplots (1.5 × 3.0 m) within each strip.

Mowing strips in all plots were mowed at 5.1 cm with a rotary mower prior to the start of the experiment. In 1994, no fertilizer was applied. In 1995, 87 kg·ha⁻¹ N of a 21N-2.3P-8.2K slow-release fertilizer was applied to the test area 1 July 1995. Plant growth regulator treatments were applied with a CO₂-powered sprayer in 188 L of water per hectare at 240 kPa on 21 July 1994 and 14 July 1995.

Unmowed plots were rated at 2, 4, and 6 WAT for phytotoxicity using a 0 to 100% visual scale where 0 = green foliage, 20% = unacceptable foliage discoloration, and 100% = complete browning. Unmowed carpetgrass seedhead height and number per square meter were recorded at 2, 4, and 6 WAT in 1994, and at 3 and 6 WAT in 1995. Turfgrass quality ratings were taken at 2, 4, and 6 WAT. Ratings were a combination of color, density, uniformity, and vigor for unmowed and mowed plots. A visual scale of 1-9 was utilized in which 1 = discolored, unhealthy turf, 6 = turf acceptable for home lawns, and 9 = dark-green, dense, uniform turf. Turfgrass height in unmowed and mowed plots was measured weekly using a device described by Parish et al. (1994) to determine CVG. Cumulative vegetative growth data were analyzed 2, 4, and 6 WAT. Mowed carpetgrass plots were mowed to the base mowing height of 5.1 cm when grass height exceeded 7.0 cm., and were harvested at base mowing at the termination of the study. Clipping yield was determined in mowing plots following each required mowing by collecting clippings and drying in a forced-air oven at 65 °C for 5 d. Clippings from unmowed plots were harvested at the 5.1-cm base mowing height and dry mass determined at the conclusion of each experiment.

Data were subjected to analysis of variance (ANOVA) and means separated using Duncan's multiple range test ($P \leq 0.05$) (SAS Institute, 1991). Comparisons between PGR treatments and the control were made using orthogonal contrasts. For cumulative vegetative growth data, analysis of variance was performed using the General Linear Model (GLM) procedure in the Statistical Analysis Systems (SAS Institute, 1991).

Results and Discussion

Analysis of variance indicated a significant interaction between year and PGR treatments ($P \leq 0.05$). Therefore, data were analyzed independently for each year. Furthermore, mowed and unmowed carpetgrass responded differently for most measured variables. Therefore, mowing treatments are discussed separately.

Unmowed turfgrass. Trinexapac-ethyl (0.16 and 0.32 kg·ha⁻¹) caused no phytotoxicity in unmowed carpetgrass in either year (Table 1). At 0.48 kg·ha⁻¹ it resulted in yellowing (13%) of leaf blades in 1994, but no phytotoxicity in 1995. Mefluidide caused yellow discoloration of leaf blades, accounting for the increased phytotoxicity 2 WAT in 1994; in 1995, neither mefluidide treatment caused significant phytotoxicity. Our results are consistent with those of Fry and Wells (1990), who reported slight phytotoxicity to carpetgrass by mefluidide (0.30 kg·ha⁻¹) at 3 WAT. Phytotoxicity caused by sulfometuron, sethoxydim (0.22 kg·ha⁻¹), and fluazasulfuron exceeded acceptable levels at 2 WAT (>20%) in 1994, but symptoms dissipated to acceptable levels over the remaining 4 weeks. Fry and Wells (1990) reported that sulfometuron (0.6 kg·ha⁻¹) and sethoxydim (0.22 kg·ha⁻¹)

caused carpetgrass phytotoxicity at 3 WAT, but no symptoms of phytotoxicity were observed at 6 WAT in either year in our study.

All rates of trinexapac-ethyl failed to suppress seedhead number at 6 WAT (Table 2). Mefluidide at 0.14 kg·ha⁻¹ suppressed seedhead number by 28% in 1995, but sulfometuron and sethoxydim (0.11 and 0.22 kg·ha⁻¹) were the only treatments effective 6 WAT in both years. These data confirm previous results that seedhead number declined with increasing sethoxydim rate (Fry and Wells, 1990). Fluazasulfuron suppressed seedhead number by >43% at 6 WAT in both years.

Trinexapac-ethyl (0.32 and 0.48 kg·ha⁻¹), sulfometuron, sethoxydim (0.11 and 0.22 kg·ha⁻¹), and fluazasulfuron (0.054 kg·ha⁻¹) reduced seedhead height at 6 WAT by at least 16% in 1994 and 20% in 1995 (Table 2). Fry and Wells (1990) also reported that sethoxydim suppressed seedhead height and development for up to 6 WAT. Mefluidide treatments did not reduce seedhead height in 1994 or 1995.

Plots treated with trinexapac-ethyl were generally uniform, dark-green, with a dense stand of carpetgrass compared with control plots (Table 3). Numerous seedheads within the unmowed mefluidide plots were objectionable, especially when seedhead lodging occurred. Trinexapac-ethyl, sulfometuron,

Table 3. Turf quality of carpetgrass 6 weeks after application of plant growth regulators (PGRs).

Treatments	Rate (kg·ha ⁻¹)	Turf quality ²			
		Unmowed		Mowed	
		1994	1995	1994	1995
Control	---	3.5 e ^y	3.7 e	6.6 b-d	6.6 c
Trinexapac-ethyl	0.160	4.8 a-c	4.4 cd	6.7 ab	6.9 c
	0.320	5.1 ab	5.0 bc	7.0 a	7.4 ab
	0.480	5.3 a	5.2 ab	7.0 a	7.5 a
Mefluidide	0.140	3.8 de	4.1 de	6.5 cd	6.5 c
	0.280	3.8 de	3.9 e	6.4 de	6.5 c
Sulfometuron	0.630	4.6 a-d	5.6 a	6.1 e	6.6 c
Sethoxydim	0.084	4.0 c-e	4.9 bc	6.8 a-c	6.6 c
	0.110	4.3 b-e	5.3 ab	6.5 cd	6.9 c
	0.220	4.9 a-c	4.9 bc	6.1 e	6.8 c
Fluazasulfuron	0.027	4.8 a-c	5.1 ab	6.5 cd	7.0 bc
	0.054	4.6 b-d	5.2 ab	6.4 de	6.0 c

²Turf quality ratings are based on a 1-9 scale, where 1 = poor-quality turf; 6 = acceptable lawn turf; and 9 = dark-green, uniform turfgrass.

^yMean separation within columns by Duncan's multiple range test ($P \leq 0.05$).

Table 4. The effect of plant growth regulator (PGR) applications on cumulative vegetative growth (cm) of unmowed and mowed carpetgrass 2, 4, and 6 weeks after treatment (WAT) in 1994 and 1995.

Treatment	Rate (kg·ha ⁻¹)	Unmowed						Mowed					
		1994			1995			1994			1995		
		WAT			WAT			WAT			WAT		
		2	4	6	2	4	6	2	4	6	2	4	6
Control	---	3.8	5.6	10.1	9.9	17.3	32.4	4.7	6.9	11.7	12.6	23.0	30.5
Trinexapac-ethyl	0.160	2.1**	3.5**	8.1	4.9**	10.7**	24.1*	3.3**	6.1	9.5*	9.2*	17.2*	22.9*
	0.320	2.4**	3.0**	7.3*	4.7**	12.1*	24.8*	2.5**	4.1**	6.4**	7.2**	17.6*	23.2*
	0.480	1.8**	2.7**	6.8**	3.8**	8.2**	20.0**	1.9**	3.7**	6.3**	5.1**	11.5**	16.7**
Mefluidide	0.140	3.6	5.9	8.6	7.5	12.4*	26.5	2.7**	5.3	9.1*	12.1	23.2	29.6
	0.280	3.0	5.2	9.9	8.6	16.7	27.6	2.8**	6.5	10.6	13.4	25.6	32.6
Sulfometuron	0.630	0.3**	3.8**	8.9	2.2**	11.1*	18.0**	0.4**	4.7*	9.3**	3.2**	15.3**	22.7*
Sethoxydim	0.084	2.1**	4.9	9.4	5.0**	11.2*	22.5*	1.9**	5.6	10.0	7.8**	18.4	25.4
	0.110	1.8**	4.5	8.7	3.2**	11.5*	17.4**	1.5**	6.7	11.1	5.2**	18.6	21.2*
	0.220	0.7**	4.1**	9.4	6.0**	14.4	21.0**	0.7**	4.8*	10.2	7.8**	19.4	21.1*
Fluazasulfuron	0.027	0.5**	3.5**	8.7	3.0**	12.4*	22.8*	0.4**	5.8	9.9	6.2**	20.4	22.9*
	0.054	0.3**	3.6**	7.8*	2.4**	10.5**	20.5**	0.3**	4.9*	7.9**	3.1**	17.7*	20.6*

* **Significantly different from the control at $P \leq 0.05$ and 0.01 , respectively.

Table 5. The effect of plant growth regulator (PGR) application on clipping yield reduction and mowing requirement of mowed carpetgrass 6 weeks after treatment.

Treatments	Rate (kg·ha ⁻¹)	Clipping yield reduction (%) ²		Mowings required ³	
		1994	1995	1994	1995
Control	---	0 a*	0 a	4.8 a	6.0 a
Trinexapac-ethyl	0.160	43 c	18 a-d	3.5 c-e	6.0 a
	0.320	49 c	20 a-d	3.3 de	5.5 ab
	0.480	58 c	38 d	3.0 e	4.5 c
Mefluidide	0.140	4 a	15 a-c	4.0 bc	6.0 a
	0.280	11 ab	5 ab	4.8 a	6.0 a
Sulfometuron	0.630	58 c	24 b-d	3.0 e	4.5 c
Sethoxydim	0.084	36 bc	15 a-c	4.0 bc	6.0 a
	0.110	52 c	28 cd	4.3 ab	5.3 b
	0.220	62 c	25 b-d	3.8 b-d	5.5 ab
Fluazasulfuron	0.027	61 c	10 a-c	3.3 de	5.8 ab
	0.054	61 c	26 b-d	3.8 b-d	4.3 c

²Data represent clipping mass (g) reduction as a percentage of the nontreated control.

³Number of mowings over the 6-week testing period. Carpetgrass was mowed at base height (5.1 cm) when turf height exceeded 7.0 cm.

*Mean separation within columns by Duncan's multiple range test ($P \leq 0.05$).

sethoxymid (0.22 kg·ha⁻¹), and fluazasulfuron improved turf quality in both years. Sethoxymid reportedly suppresses bahiagrass (Willard and Curry, 1986) and carpetgrass seedhead formation (Fry and Wells, 1990) without reducing turf quality. Seedhead growth suppression contributed to increased turfgrass quality of unmowed carpetgrass 6 WAT in 1994 and 1995. Leaf blade and seedhead lodging created shading in unmowed plots, reducing turf density and quality.

Trinexapac-ethyl at 0.32 and 0.48 kg·ha⁻¹ rates reduced CVG of unmowed carpetgrass by at least 28% in 1994 and 24% in 1995 (Table 4). Responses to mefluidide applications were inconsistent over time and maintenance treatment, with little CVG reduction. Sulfometuron, however, reduced CVG in unmowed plots by 44% and in mowed plots by 26% in 1995. Reduction of CVG by sethoxymid was inconsistent in 1994, but in 1995 all rates had reduced CVG by at least 31% 6 WAT. Fluazasulfuron (0.054 kg·ha⁻¹) reduced CVG of unmowed turfgrass by 23% in 1994 and 37% in 1995.

Clipping yield reductions were nonsignificant both years for unmowed PGR treatments (data not shown).

Mowed turf. Mowed plots treated with trinexapac-ethyl (0.32 and 0.48 kg·ha⁻¹)

maintained higher turf quality ratings 6 WAT than did control plots or plots treated with sethoxymid (0.11 and 0.22 kg·ha⁻¹), sulfometuron, and fluazasulfuron (0.054 kg·ha⁻¹) in both years (Table 3). Turfgrass quality within mowed control plots was better than that in the best unmowed PGR treatment both years.

Trinexapac at 0.16 kg·ha⁻¹ reduced CVG of mowed carpetgrass 25%, 6 WAT in 1995 (Table 4); applications of 0.32 and 0.48 kg·ha⁻¹ reduced CVG by at least 45% in 1994, and 24% in 1995. The effects of sethoxymid were inconsistent, but in 1995 the two higher rates reduced CVG by at least 31%, 6 WAT. Fluazasulfuron (0.054 kg·ha⁻¹) reduced CVG of mowed turfgrass by 33% in 1994 and 1995.

Trinexapac-ethyl (0.48 kg·ha⁻¹) reduced clipping yields 38% and 58% on mowed turf plots in 1994 and 1995, respectively (Table 5). Mefluidide did not significantly influence clipping yields. Sulfometuron and sethoxymid (0.11 and 0.22 kg·ha⁻¹) decreased clipping yield by >23% in 1994 and >51% in 1995, and fluazasulfuron (0.054 kg·ha⁻¹) reduced yields by 26% in 1994 and 61% in 1995. The greatest clipping yield reductions 6 WAT were attained using trinexapac-ethyl (0.48 kg·ha⁻¹), sulfometuron or sethoxymid (0.11 and 0.22 kg·ha⁻¹), and fluazasulfuron.

Sulfometuron and the highest rate of trinexapac-ethyl (0.48 kg·ha⁻¹) reduced mowing frequency by at least 1.5 mowings over a 6-week period in both years (Table 5). Mefluidide, with the exception of the low rate in 1994, did not decrease mowing frequency. Sethoxymid (0.22 kg·ha⁻¹) reduced mowing frequency in 1994 by one mowing. The higher rate of fluazasulfuron reduced mowing frequency by 1.7 times in 1995.

Trinexapac-ethyl (0.32 and 0.48 kg·ha⁻¹) was comparable to sethoxymid (0.22 kg·ha⁻¹) and sulfometuron (0.63 kg·ha⁻¹) for retarding growth of common carpetgrass. Additional research is needed to determine the optimum rate of fluazasulfuron. Different environmental conditions and fertility levels may have caused the disparity between the results obtained in 1994 vs. 1995.

Literature Cited

- Chemical and Pharmaceutical Publ. Corp. 1994. Turf and ornamental chemical reference. 3rd ed.
- Dingwall, J.G. 1993. Key chemical inputs to new herbicides: Intermediates, processes, and mechanistic investigations. *Pest. Sci.* 41:259-267.
- Fry, J.D. 1989. Sequential sethoxymid applications for season-long carpetgrass seedhead suppression, p. 33-35. In: *The 1988 Turfgrass Research Report: Louisiana Agr. Expt. Sta./Dept. of Horticulture*.
- Fry, J.D. and D.W. Wells. 1990. Carpetgrass seedhead suppression with plant growth regulators. *HortScience* 25:1257-1259.
- Heath, M.E., R.F. Barnes, and D.S. Metcalfe. 1985. *Forages: The science of grassland agriculture*, Iowa State Univ. Press.
- Johnson, B.J. 1992. Response of bermudagrass (*Cynodon* spp.) to CGA 163935. *Weed Technol.* 6:577-582.
- McCarty, L.B., R.J. Black, and K.C. Ruppert. 1992. *Florida lawn handbook*. Florida Coop. Ext. Bul. SP 45.
- Nielsen, S. 1992. Pricing challenges. *Grounds Maintenance* 11:12-16.
- Parish, R., E.W. Bush, and D.P. Shepard. 1994. A simplified turfgrass height-measuring device. *HortTechnology* 4:49-50.
- SAS Institute. 1991. *SAS users guide*. SAS Inst., Cary, N.C.
- Wells, D.W. 1984. Carpetgrass response to plant growth regulators. Progress report: Louisiana Agr. Expt. Sta.
- Willard, T.R. and W.L. Currey. 1986. Herbicide programs for bahiagrass management on Florida highway rights-of-way. *Proc. Southern Weed Sci. Soc.* 39:149.