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Mowing Height and Nitrogen Rate Affect Turf Quality and Vegetative Growth of Common Carpetgrass

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Abstract. **Common carpetgrass (*Axonopus affinis* Chase), mowed at 3.8 or 7.6 cm and fertilized with at least 98 kg·ha^{-1} N, maintained acceptable lawngrass quality during the 1993 and 1994 growing seasons. Cumulative vegetative growth (CVG) quality and coverage were increased in mowed plots fertilized with 98, 147, or 196 kg·ha^{-1} N. Unsightly seedheads were a problem in nonmowed plots 3 weeks after the start of the experiment, but did not appear in the mowed plots. Our results indicate that mowing common carpetgrass at 3.8 or 7.6 cm and fertilizing with 98, 147, or 196 kg·ha^{-1} N will provide acceptable turfgrass quality.**

Common carpetgrass is a low-maintenance lawngrass well adapted to the southeastern coastal plains of the United States. Abandoned pasture lands are invaded by common carpetgrass because of its ability to thrive in infertile sandy soils (Heath et al., 1985). Carpetgrass is ubiquitous in low-fertility pasture soils (Stephens, 1942). Nitrogen recommendations for carpetgrass range from 39 to 78 kg·ha^{-1} N annually (McCarty et al., 1992), but no published data are available as to the nutritional requirements of common carpetgrass in a lawn. High N levels in common carpetgrass pastures reportedly reduce grass density. Common carpetgrass was eliminated within 1 year from pasture plots fertilized with 28 or 48 kg·ha^{-1} N (Gartner, 1969).

In contrast with Gartner's (1969) report, Blaser and Stokes (1942) observed a 7-fold increase in common carpetgrass yield when a complete fertilizer was applied to a pasture soil deficient in N, P, K, and Ca. Nitrogen deficiency symptoms in tropical carpetgrass [*Axonopus compressus* (Swartz) Beauv.] reduced inflorescence development, root growth, and dry-matter production under hydroponic conditions (Foong et al., 1982). No published information is known on the optimum mowing heights and frequencies for common carpetgrass. Previous research indicated that heavy grazing of common carpetgrass pastures was required to reduce weed competition (Wolters, 1975). This suggests that mowing practices may affect turfgrass quality.

The objective of this research was to determine the effects of mowing height and N rate on growth of common carpetgrass.

Materials and Methods

This experiment was a 3 × 5 factorial arranged in a randomized complete-block design with three independent mowing treatments (unmowed, 3.8 cm, and 7.6 cm) and five fertilizer treatments (0, 49, 98, 147, and 196 kg·ha^{-1} N each year) over a 2-year period. A naturalized common carpetgrass plot at the Burden Research Plantation, Baton Rouge, La., was sectioned into four blocks on 15 June 1993. Each block was randomly divided into three mowing columns. Each mowing column was divided transversely into five rows, to which N treatments were assigned. Analysis of variance (ANOVA) for mowing treatments and year was performed separately for cumulative vegetative growth (CVG) using the general linear model procedure (SAS Institute, 1991). Means were separated using Duncan's new multiple range test (DNMR) at the $P \leq 0.05$ level.

Ammonium nitrate (34–0–0) treatments were topdressed over grass plots in four split applications of 0, 12.3, 24.5, or 49 kg·ha^{-1} N on 15 June, 15 July, 23 Aug., and 20 Sept. 1993 and on 17 June, 17 July, 17 Aug., and 16 Sept. 1994. Turfgrass height was measured weekly using a device described by Parish et al. (1994). An individual grass plot was mowed when the average of three sub-sample measurements exceeded 33% of the base mowing height. Weekly turfgrass height measurements were used to determine CVG. Turfgrass quality ratings were taken on 15 June, 18 Aug., and 19 Sept. 1993; and 17 June, 24 Aug., and 19 Sept. 1994. Ratings were measured on a scale from 1 to 9 defined as follows: <5.0 = unacceptable; 5.0 = acceptable utility turfgrass quality; 6.0 = acceptable lawn turfgrass quality; >6.5 = excellent lawn turfgrass quality. Annual bluegrass (*Poa annua* L.) encroachment was measured on 29 Feb. 1994 by visually estimating the percentage of the area covered by the weed. Weather data were recorded over the 2-year experimental period (data not shown).

Results and Discussion

Analysis of variance indicated a significant interaction between mowing height and year for most parameters measured ($P \leq 0.05$). Therefore, N fertility data are presented by mowing height within each year and will be discussed separately. Also, data are presented by each mowing height.

Cumulative vegetative growth. Interaction of mowing height × N rate was evident in both years (Table 1) as applications of N increased growth only in mowed plots, with maximum effect at the highest rates. Mowing alone increased CVG in 1994, but reduced it in 1993. Mowing plus N application was generally more effective than mowing alone, especially at higher application rates.

Annual CVG in nonmowed plots ranged from 27 to 29.5 cm in 1993 and from 27 to 30 cm in 1994, but N had no significant effect in either year (Table 1). Response to N in mowed plots was linear in both years, resulting in significant interaction. The increase was 11% at 49 kg and 25% at 196 kg·ha^{-1} N in 1993. The

Table 1. Effects of N fertilizer rate and mowing height on cumulative vegetative growth (CVG) of common carpetgrass in 1993 and 1994.

	1993			1994		
N rate (kg·ha^{-1})	Nonmowed	3.8 cm	7.6 cm	Nonmowed	3.8 cm	7.6 cm
	cm			cm		
0	27.4 a[z]	25.4 c	25.9 d	30.0 a	35.1 d	36.3 c
49	28.7 a	28.7 b	26.4 cd	28.2 a	39.6 c	44.7 c
98	29.5 a	32.0 a	28.2 bc	27.7 a	43.4 bc	50.0 b
147	29.5 a	34.0 a	31.5 b	28.2 a	46.5 ab	52.6 ab
196	29.2 a	34.3 a	36.1 a	30.2 a	48.5 a	52.1 a
Linear	NS	**	**	NS	**	**
Nonlinear	NS	NS	NS	NS	NS	NS
Interaction: Mowing × N rate		**			**	

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

NS, *, **Nonsignificant or significant at $P \leq 0.05$, 0.01, respectively.

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two highest rates increased CVG >10% over the lowest rate. In 1994, application of 49, 98, 147, and 196 kg·ha^{-1} N increased CVG 11%, 19%, 25%, and 28%, respectively, compared with the control.

In 1993, fertilization of plots mowed at 7.6 cm increased CVG in a linear fashion. The CVG 147 and 196 kg·ha^{-1} N rates increased CVG at least 16% relative to the CVG of turf receiving 49 kg·ha^{-1} N in 1993. In 1994 fertilization with 98, 147, and 196 kg·ha^{-1} N increased CVG 10% to 15% over that in plots receiving 49 kg·ha^{-1} N, and >20% relative to the control. At higher N rates, mowing plus N applied was generally more effective than mowing alone, especially in 1994.

Turf quality. The interaction of mowing height and N rate was significant for some sampling dates (Table 2). On 23 Aug. and 20 Sept. 1993 there were significant linear increases in quality with increasing N rates regardless of mowing, but on 20 Sept. the effect was nonlinear in the nonmowed plots. Application of N reduced turfgrass quality in nonmowed plots on 17 June 1994, but had no effect on 16 Sept. Quality ratings were unacceptable (<5.9) both years.

Carpetgrass quality for turf mowed at 3.8 cm in 1993 increased in a linear fashion as N rates increased from 0 to 196 kg·ha^{-1} N (Table 2). On 23 Aug. 1993 quality at 147 and 196 kg·ha^{-1} N was greater than that of turf receiving 49 and 98 kg·ha^{-1} N. There were no significant effects on 17 June 1994, but on 16 Sept. quality increased linearly with N rate. There was concern that low-temperature damage might result from active growth associated with high N levels during winter months, but none was observed. Winters 1993 and 1994 were considered mild to moderate with annual low temperatures of –3.5 and –4.0 °C, respectively. Deacclimation of grasses during the winter months has been reported in the U.S. Gulf Coast region for warm-season grasses (Johnston and Dickens, 1977).

On 23 Aug. and 20 Sept. 1993 there were linear increases in quality ratings within plots mowed at 7.6 cm (Table 2). Plots receiving 147 and 196 kg·ha^{-1} N were rated 1.5 to 2.0 points higher than the control. There were no significant effects of N application on 17 June, but on 16 Sept. 1994 turf quality increased linearly with rate.

Turf coverage and mowing. Nitrogen rate did not effect coverage in nonmowed plots, increased it at 3.8-cm mowing height, and had no effect on turf mowed at 7.6 cm. Turf coverage in nonmowed plots was <40% (Table 3). There was a significant linear increase in turf coverage with N fertilization at 3.8 cm for 1993, but not at 7.6 cm.

The number of mowings required was consistently higher in plots mowed at 3.8 cm than in those at 7.6 cm, as expected. Application of N increased the number of mowings linearly at both heights and years (Table 4). Interaction was significant in both years.

Annual bluegrass. On 29 Feb. 1994 a natural infestation of annual bluegrass covered <12% of nonmowed plots, possibly because the tall canopy prevented light penetration,

Table 2. Effects of N fertilization and mowing height on quality of common carpetgrass turfgrass in 1993 and 1994.

	23 Aug. 1993			20 Sept. 1993		
N rate (kg·ha^{-1})	Nonmowed	3.8 cm	7.6 cm	Nonmowed	3.8 cm	7.6 cm
0	4.0 c[z]	5.0 c	4.8 c	5.0 b	6.3 b	5.8 d
49	4.8 b	5.8 b	5.5 abc	5.0 b	6.3 b	6.5 c
98	5.0 b	6.0 b	5.5 abc	5.0 b	6.8 b	6.8 bc
147	5.3 ab	7.0 a	6.0 ab	4.8 b	6.8 b	7.3 ab
196	5.8 a	7.0 a	6.3 a	5.8 a	7.5 a	7.8 a
Linear	**	**	**	*	**	**
Nonlinear	NS	NS	NS	*	NS	NS
	17 June 1994			16 Sept. 1994		
0	3.8 a	5.6 a	4.9 a	5.5 a	5.6 c	5.4 c
49	3.8 a	6.0 a	5.0 a	5.1 a	6.4 b	5.8 bc
98	2.6 a	5.9 a	4.8 a	5.3 a	6.5 b	6.0 b
147	2.5 a	6.0 a	5.1 a	4.9 a	7.0 a	6.5 a
Linear	**	NS	NS	NS	**	**
Nonlinear	NS	NS	NS	NS	NS	NS
Interaction: Mowing × N rate		**			**	

[z]Mean separation within columns by Duncan's multiple range test ($P \leq 0.05$). Turfgrass quality ratings: <5.0 = unacceptable; 5.0 = acceptable utility quality; 6.0 = acceptable lawngrass quality; >6.5 = excellent lawngrass quality.

NS, *, **Nonsignificant or significant at $P \leq 0.05$, 0.01, respectively.

Table 3. Effects of N fertilizer rate and mowing on coverage of common carpetgrass turfgrass in 1993 and 1994.

	9 Mar. 1994			24 Dec. 1994		
N rate (kg·ha^{-1})	Nonmowed	3.8 cm	7.6 cm	Nonmowed	3.8 cm	7.6 cm
	Turfgrass Coverage (%)					
0	29 a[z]	88 b	84 a	18 b	85 a	85 a
49	26 a	91 ab	84 a	35 a	90 a	88 a
98	18 a	91 ab	86 a	38 a	90 a	85 a
147	16 a	96 a	85 a	18 b	95 a	86 a
196	11 a	95 a	89 a	25 ab	90 a	88 a
Linear	NS	**	NS	NS	NS	NS
Nonlinear	NS	NS	NS	NS	NS	NS
Interaction: Mowing × N rate		**			**	

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

NS, *, **Nonsignificant or significant at $P \leq 0.05$, 0.01, respectively.

Table 4. Effect of nitrogen rate and mowing height in common carpetgrass on number of mowings/year.

	1993		1994	
N rate (kg·ha^{-1})	3.8 cm	7.6 cm	3.8 cm	7.6 cm
	Mowings/year			
0	9.3 b[z]	5.0 b	14.0 b	9.0 b
49	10.5 a	5.5 b	16.0 a	10.5 ab
98	12.0 a	5.8 b	16.0 a	11.0 a
147	12.5 a	6.0 b	17.0 a	11.5 a
196	12.8 a	7.5 a	17.0 a	12.0 a
Linear	**	**	**	**
Nonlinear	NS	NS	NS	NS
Interaction: Mowing × N rate		**		**

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

NS, *, **Nonsignificant or significant at $P \leq 0.05$, 0.01, respectively.

Table 5. Natural occurrence of annual bluegrass on 29 Feb. 1994 as influenced by N fertilizer rates and mowing height.

N rate (kg·ha^{-1})	Nonmowed	3.8 cm	7.6 cm
	Weed coverage (%)		
0	6 a[z]	15 c	5 b
49	9 a	26 bc	9 ab
98	9 a	23 bc	4 b
147	11 a	41 ab	9 ab
196	9 a	49 a	16 a
Linear	NS	**	NS
Nonlinear	NS	NS	NS
Interaction: Mowing × N rate		**	

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

NS, *, **Nonsignificant or significant at $P \leq 0.05$, 0.01, respectively.

which is critical for germination . There was no significant N application effect on annual bluegrass in these plots (Table 5).

Plots mowed at 3.8 cm were heavily infested with annual bluegrass in 1994, and infestation increased in a linear fashion as N rate increased. The lower mowing height, coupled with adequate moisture and fertility, was apparently conducive to bluegrass establishment (Dest and Allinson, 1981). Weeds covered 41% of plots when N was applied at 147 $kg \cdot ha^{-1}$ and 49% of the plots at 196 $kg \cdot ha^{-1}$ N. Brede (1992) noticed an increase in bermudagrass [(*Cynodon dactylon* (L.) Pers.] within tall fescue (*Festuca arundinacea* Schreb.) mowed low (1.9 cm) and heavily fertilized with N (244 $kg \cdot ha^{-1}$). In our experiment, all mowed (3.8 cm) plots recovered from annual bluegrass infestations by 15 Mar. 1994 following early spring growth. Use of a preemergence herbicide could reduce weed populations when turf is mowed low (Dernoedon et al., 1993).

There was no linear relationship associated with N rates and annual bluegrass for carpetgrass mowed at 7.6 cm (Table 5). On 29 Feb. 1994, annual bluegrass populations within such plots fertilized with 196 $kg \cdot ha^{-1}$ N were significantly greater than in control plots. Common carpetgrass recovered from annual bluegrass infestation with no permanent damage by 15 Mar. 1994. No other weed competition was observed. Dernoeden et al. (1993) indicated that mowing tall fescue high (8.8 cm) was the best management strategy for controlling smooth crabgrass (*Digitaria ischaemum* Schreb.). We observed that plots that were not mowed or mowed at 7.6 cm had generally lower weed populations, regardless of the N rate, than did the 3.8-cm treatment.

There was minimal benefit to fertilizing nonmowed plots. As nitrogen rates increased from 0 to 196 $kg \cdot ha^{-1}$, quality and mowing frequency increased in three of four cases within mowed plots. Mowing common carpetgrass at either 3.8 or 7.6 cm with N fertilization would provide acceptable quality for carpetgrass use as a lawn turfgrass. Further research is needed to determine the effect of high N applications on low-temperature tolerance and thatch accumulation of common carpetgrass.

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