Effects of Clippings and Fertilizers on Warm-Season Turfgrasses

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ABSTRACT

Six warm-season turfgrasses were established on a clay-loam soil to determine the effects of clippings and nitrogen (N) fertilizers on growth and appearance. Ammonium sulfate produced higher clipping yields and tissue N content than Milorganite. Using 0.5 lb. N from ammonium sulfate per 1000 sq. ft. was as effective as 1.0 lb. N from Milorganite per 1000 sq. ft. Recycling clippings increased growth without a reduction in tissue N content or general appearance. Compared with other grasses, 'Prairie' buffalograss and bermudagrass cultivars generally had greater tissue N levels and growth. The growth and quality of 'Georgia Common' centipedegrass declined during the second year of the study. General appearance ratings for 'Emerald' zoysiagrass declined during the second year at higher N rates supplied by ammonium sulfate.

KEYWORDS: mulching mower, Milorganite

Continued population growth, urbanization, and environmental awareness are creating interest in environmentally friendly landscape management practices. Using organic fertilizers and mulching mowers to recycle nutrients may contribute to environmentally sound management practices.

Organic nitrogen (N) carriers are processed from metropolitan sewage sludges and animal residues (Beard, 1973 and Turgeon, 1980). Use of slow-release forms of N reduces thatch accumulation and provides for more uniform growth compared to synthetic sources (Meinhold et al., 1973). English et al. (1974) found leachates to be low in ammonium and nitrate forms of N when the organic fertilizer, Milorganite, was compared to urea and ammonium nitrate. Barrios et al. (1979) found that N from Milorganite generally produced turfgrass of higher quality than equivalent rates of N from synthetic sources in sandy soils.

Turfgrass clippings are also a potentially significant source of organic nutrients (Anonymous, 1989). Recycling clippings may provide up to 25% of the fertilizer needs of a lawn. Grass clippings returned to the turf canopy decompose quickly compared to stem and crown tissues (Beard, 1976) and nutrient recycling can begin within 14 days (Johnson et al., 1987; Soper et al., 1988).

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This study was done to determine the interactive effects of grass clippings and N applications on the growth and appearance of six warm-season turfgrasses.

MATERIALS AND METHODS

Turfgrass species and cultivars used in this project were: 'Common' bermudagrass [*Cynodon dactylon* (L.) Pers.], 'Tifway' bermudagrass [*Cynodon transvaalensis* Burt-Davies x *Cynodon dactylon* (L.) Pers.], 'Georgia Common' centipedegrass [*Eremochloa ophiuroides* (Munro) Hack.], 'Raleigh' St. augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntze.], 'Emerald' zoysiagrass [Z. *japonica* x Z. *tenufolia*], and 'Prairie' buffalograss [*Buchloe dactyloides* (Nutt.) Engelm.].

The soil used on the East Texas State University Farm was classified as a clay-loam with 8.1 pH and 4% organic matter. The soil was high in phosphorus, potassium, calcium, magnesium, zinc, iron, and copper. Manganese, sodium, sulfur and boron were low. No preplant fertilizers or soil amendments were incorporated.

The experimental design was a randomized split-plot with three replications and with cultivars as main plots. All main plots measured 10.0 ft. by 12.5 ft. and were established by laying sod in May and June of 1990, except buffalograss plots which were established in July, 1990.

Each main plot was subdivided into five subplots measuring 2.5 ft. by 10 ft. for the following fertilizer treatments (expressed in lbs. of actual N per 1000 sq. ft.): control (no fertilizer), milorganite at 0.5 lb., ammonium sulfate at 0.5 lb., milorganite at 1.0 lb., and ammonium sulfate at 1.0 lb. Fertilization treatments were applied by hand on 11 July, 6 August, 14 September, and 12 October in 1990 and on 10 May, 15 June, 28 July, and 19 August in 1991. The fertilizer subplots were further subdivided into 2.5 by 5.0 ft. plots to accommodate mowing treatments using either a traditional bagging mower or a recycling (mulching) mower.

All plots were mowed weekly during the growing season and irrigated as necessary. Once per year, about 2 weeks after a fertilizer application, clipping yields were determined and visual evaluations were conducted. On 15 August, 1990 and 2 July, 1991, hand clippers were used to remove all clippings above the 2-inch height inside a 14-inch diameter template. Clippings were oven-dried at 70° Celsius for about 72 hours and dry weight was measured. Dried samples from the 1991 clipping harvest were analyzed for N content following digestion procedures of Isaac and Johnson (1976) and distillation and titration procedures of Bremner (1965).

On 2 September, 1990 and 6 August, 1991, each plot was visually evaluated by two to four raters. General appearance values were based on turfgrass color, density, vertical shoot growth, and uniformity. Each plot was assigned a value between 1 and 5, with 5 being best and 3 minimally acceptable.

Data were analyzed by analysis of variance and means were separated by the Duncan's multiple range test. Buffalograss data were analyzed separately because of a lack of randomization among the other main plots due to late sod availability and establishment.

RESULTS AND DISCUSSION

When data were pooled, all main effects except year significantly affected clipping

When data were pooled, all main effects except year significantly affected clipping yield (Table 1). The only significant interaction affecting clipping yield was the cultivar by year interaction.

Table 1. Analysis of variance data (main effects and significant interactions) for clipping yield (dry weight) of turfgrasses.

Source	df	SS	F	P
Fertilizer	4	1091.62	43.02	0.0001
Mowing trmt.	1	113.34	17.87	0.0001
Cultivar	4	404.80	15.95	0.0001
Year	1	9.72	1.53	0.2172
Rep	2	57.92	4.56	0.0115
C x Y	4	105.58	4.16	0.0029
Error	198	1256.04		

Ammonium sulfate (AS) at 1.0 lb. of actual N per 1,000 sq. ft. per growing month (1.0 AS) produced the most growth as indicated by clipping yield (Table 2). The same rate of N supplied by Milorganite (1.0 M) produced less clipping yields than the 1.0 AS treatment, but was similar to 0.5 lb. of N per 1,000 sq. ft. supplied by ammonium sulfate (0.5 AS). The 0.5 Milorganite (0.5M) fertilization treatment produced the lowest clipping yield of any of the treatments receiving fertilizer application. The control treatment (receiving no supplemental fertilization) produced the lowest clipping yield and exhibited poorest growth.

The grass did not use N as readily when supplied by Milorganite. This is possibly because the organic source of N from Milorganite was not as readily available to the root system, as suggested by Beard (1973) and Turgeon (1980).

The lack of a significant fertilizer X year interaction suggests that the slow-release rate of N from Milorganite did not have a carry-over effect influencing clipping yields during the second year of this study (Table 1). These results are in conflict with those reported by Barrios et al. (1979).

Recycling clippings produced higher clipping yields across both years compared to the traditional bagging mower (Table 2). This is possibly a result of added N from the recycled clippings that became available to the grass plant. Tifway bermudagrass produced significantly higher clipping yields than any other cultivar, while Common bermudagrass, Georgia Common centipedegrass, and Raleigh St. augustinegrass produced similar, but significantly lower clipping yields (Table 2). Emerald zoysiagrass produced the lowest clipping yield of all five turfgrasses. The growth response of these cultivars in comparison to one another follows established trends previously reported by Beard (1973), Turgeon (1980), and Johnson et al. (1986).

Table 2. Treatment main effects on clipping yield (dry weight), general appearance rating, and tissue N content of turfgrasses.

Main Effect	Clipping yield†	General appearance‡	Tissue N§
	g		%
Fertilizer			
Control	3.2d¶	2.8d	1.3e
0.5 lb.-Milorganite	4.3c	3.7c	1.5d
0.5 lb.-Am. Sulfate	5.7b	4.1b	1.7c
1.0 lb.-Milorganite	5.3b	4.2b	1.9b
1.0 lb.-Am. Sulfate	8.9a	4.5a	2.7a
Mowing Treatment			
Clippings removed	4.9b	3.9a	1.8a
Clippings recycled	6.1a	3.8a	1.8a
Cultivar			
'Common' bermuda	5.5b	3.7bc	2.0a
'Tifway' bermuda	7.6a	3.9b	2.0a
'Georgia Common' centipede	5.1b	4.2a	1.7b
'Raleigh' St. augustine	5.2b	3.9b	1.4c
'Emerald' zoysia	4.0c	3.6c	1.9a
Year			
1990	5.3a	4.0a	—
1991	5.7a	3.7b	—

† Clippings above the two-inch height collected within a fourteen-inch diameter template. 1 g = 0.0022 lb.

‡ Rated on a 1-5 scale with 5=best, 1=poorest, and 3=minimal acceptance. Color, vertical shoot growth, density and uniformity were considered in overall rating. Values are means of two to four evaluators.

§ Percent tissue nitrogen was determined by Kjeldahl procedure.

¶ Means separations within columns and main effects by Duncan's multiple range test. Means followed by the same letter are not significantly different at the .05 level.

The only significant interaction affecting clipping yield was cultivar X year (Table 1). Figure 1 shows that all clipping yields tended to increased the second year of the study except for centipedegrass. Although centipedegrass may be sensitive to higher rates of N, the clipping yield from all centipedegrass plots regardless of fertilizer treatment was lower during the second year of this project as indicated by a nonsignificant fertilizer X cultivar X year interaction, and the actual means (data not shown). A contributing factor to lower clipping yield of centipede during the second year could be due to its poor adaptability to high soil pH conditions as suggested by Beard (1973) and Turgeon (1980).

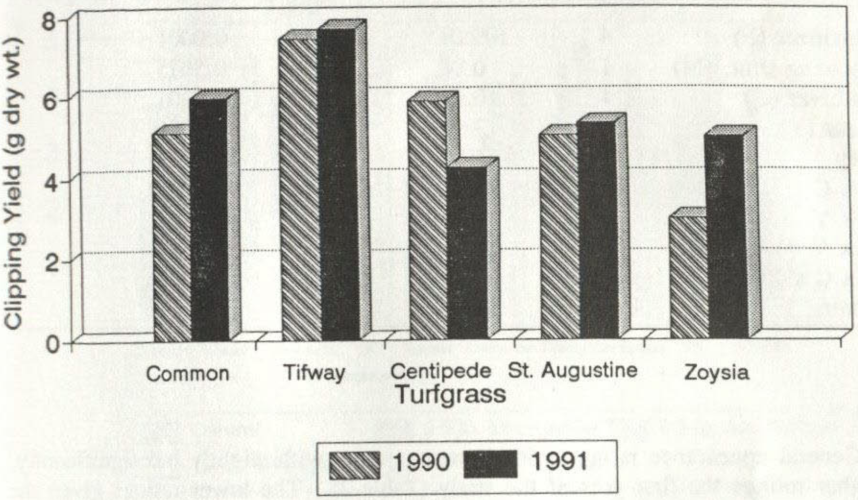

Figure 1. Interactive effects of cultivar x year on clipping yields of turfgrasses. (1 g = 0.0022 lb.)

All main effect treatments, except mowing, significantly affected turfgrass general appearance (Table 3). All interactions, except those with mowing treatments as a factor, also affected general appearance ratings.

The control fertilizer treatment resulted in the poorest (2.8) general appearance rating (Table 2), and was considered unacceptable by the evaluators because a rating of 3.0 was established as minimal acceptability. This treatment had the slowest rate of vertical shoot growth and the least green color. The 1.0 AS fertilizer treatment produced the highest rating, as a result of the vertical shoot growth and greenest color. The 1.0 M and 0.5 AS treatments produced similar general appearance ratings, while 0.5 M produced the poorest acceptable appearance, of any fertilized plot.

Mowing treatments had no significant influence on general appearance (Table 2). Georgia Common centipedegrass received the highest general appearance rating, followed by Raleigh St. augustinegrass, Tifway bermudagrass and Common bermudagrass. Emerald zoysiagrass rated the poorest, although not significantly different than Common bermudagrass.

Table 3. Analysis of variance data (main effects and significant interactions) for general appearance rating of turfgrasses.

Source	df	SS	F	P
Fertilizer (F)	4	109.01	108.35	0.0001
Mowing trmt. (M)	1	0.08	0.33	0.5675
Cultivar (C)	4	10.84	10.77	0.0001
Year (Y)	1	3.96	15.75	0.0001
Rep	2	1.89	3.75	0.0251
F x C	16	10.84	2.69	0.0007
F x Y	4	4.19	4.16	0.0029
C x Y	4	4.45	4.42	0.0019
F x C x Y	16	22.76	5.65	0.0001
Error	198	49.80		

General appearance rating varied between years, with slightly but significantly, higher ratings the first year of the study (Table 2). The lower ratings given the second year of this study is primarily attributable to a slight decline in general appearance of centipedegrass and zoysiagrass (Figure 2). Although clipping yields were not adversely affected, declines in general appearance ratings for these two cultivars the second year occurred at the higher fertilization rates as indicated by the significant fertilizer X cultivar X year interaction (Figure 3). Although 1.0 AS resulted in the highest general appearance ratings for all cultivars the first year, both Emerald zoysiagrass and, to a lesser extent, Georgia Common centipedegrass failed to respond to this N source and rate the second year.

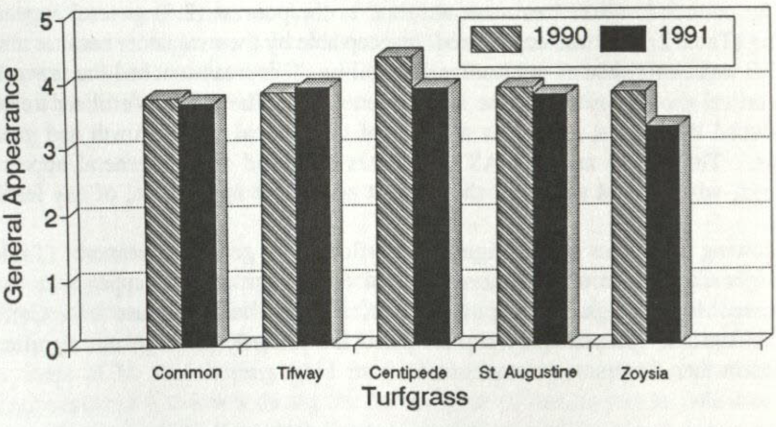

Figure 2. Interactive effects of cultivar x year on general appearance ratings of turfgrasses.

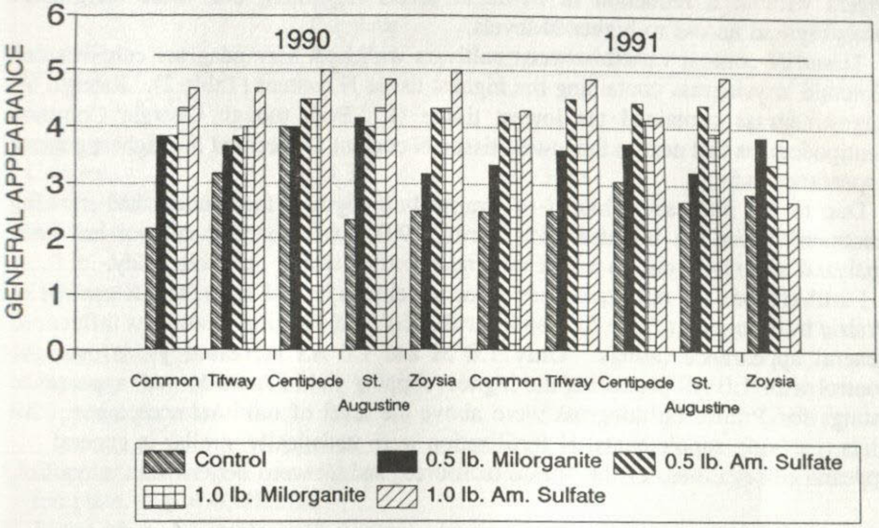

Figure 3. Interactive effects of fertilizer x cultivar x year on general appearance ratings of turfgrasses.

The first year, the general appearance ratings for Emerald zoysiagrass increased with each increase in fertilization rate (Figure 3). However, the second year, any increase in fertilization rate above the 0.5 M treatment either failed to improve or significantly reduced appearance ratings. At equivalent N rates, Milorganite produced higher general appearance ratings for Emerald zoysiagrass than AS.

Only the main effects of fertilizer and cultivar affected tissue N content (1991 data only) (Table 4). No interactions were significant. The control (no fertilization) resulted in lowest tissue N content (Table 2). Each succeeding increase in N rate increased tissue N content. Ammonium sulfate was more effective than Milorganite in increasing tissue N, with 1.0 AS resulting in the highest level.

Table 4. Analysis of variance data for tissue N content of turfgrasses, 1991.

Source	df	ss	F	P
Fertilizer	4	326861.69	121.87	0.0001
Mowing Trmt.	1	114.41	0.17	0.6805
Cultivar	4	81901.96	30.54	0.0001
Rep	2	1710.76	1.28	0.2838
Error	98	65711.24		

Although mowing treatments had no effect on tissue N content (Table 2), clipping yields were increased when clippings were recycled. Recycling clippings increased yields without a reduction in tissue N levels suggesting that these turfgrasses probably had access to higher N levels.

Tissue N content varied between cultivars with both bermudagrass cultivars and Emerald zoysiagrass containing the highest tissue N content (Table 2). Raleigh St. augustinegrass contained the lowest tissue N. Even though Georgia Common centipedegrass had next to the lowest tissue N content, it received the highest general appearance ratings.

Due to the late establishment of Prairie buffalograss, fertilization and mowing treatments were not initiated until Spring 1991. Data on this cultivar has been analyzed separately due to a lack of randomization within the main study.

Fertilizer was the only treatment affecting clipping yield and tissue N content of Prairie buffalograss (Table 5). Both fertilization and mowing treatments influenced general appearance ratings. Only 1.0 M and 1.0 AS increased yields over the control with 1.0 AS producing the highest clipping yield (Table 6). All appearance ratings for Prairie buffalograss were above the level of minimal acceptance. All plots receiving supplemental N fertilization were statistically similar in general appearance regardless of the N rate or source, and all were better than the control.

Table 5. Analysis of variance data for clipping yield (dry weight), general appearance rating, and tissue N content of 'Prairie' Buffalograss, 1991.

Source	df	SS	F	P
Clipping Yield				
Total	29	373.09		
Fertilizer	4	299.55	21.22	0.0001
Mowing	1	2.64	0.75	0.3985
Rep	2	0.58	0.08	0.9209
Error	18	63.53		
General Appearance				
Total	29	2.33		
Fertilizer	4	1.67	18.57	0.0001
Mowing	1	0.10	4.56	0.0468
Rep	2	0.07	1.47	0.2573
Error	18	0.40		
Tissue N				
Total	29	48411.5		
Fertilizer	4	45713.3	100.81	0.0001
Mowing	1	73.6	0.65	0.4308
Rep	2	163.4	0.72	0.4999
Error	18	2040.6		

Table 6. Treatment main effects on clipping yield (dry weight), general appearance rating, and tissue N content of 'Prairie' Buffalograss, 1991.

Main Effect	Clipping yield†	General appearance‡	Tissue N§
	g		%
Fertilizer			
Control	5.3c¶	3.4b	1.6d
0.5 lb.-Milorganite	5.3c	4.0a	1.8c
0.5 lb.-Amm. Sulfate	6.2c	4.0a	1.8c
1.0 lb.-Milorganite	10.3b	3.9a	2.2b
1.0 lb.-Amm. Sulfate	13.2a	4.0a	2.7a
Mowing Treatment			
Clippings removed	7.7a	3.8b	2.0a
Clippings recycled	8.3a	3.9a	2.0a

† Clippings above the two-inch height collected within a fourteen-inch diameter template. 1 g = 0.0022 lb.

‡ Rated on a 1-5 scale with 5=best, 1=poorest, and 3=minimal acceptance. Color, vertical shoot growth, density and uniformity were considered in overall rating. Values are means of two to four evaluators.

§ Percent tissue N was determined by Kjeldahl procedure.

¶ Means separations within columns and main effects by Duncan's multiple range test. Means followed by the same letter are not significantly different at the .05 level.

Supplemental N fertilization increased tissue N concentration (Table 6). The 0.5 M and 0.5 AS treatments produced similar N content but 1.0 AS was superior to the 1.0 M treatment.

Although non-significant, recycling clippings tended to increase clipping yield. Recycling clippings slightly increased general appearance ratings but had no effect on tissue N content (Table 6).

CONCLUSIONS

Milorganite at rates providing 0.5 to 1.0 lb. of N per 1,000 sq. ft. per growing month maintained acceptable turfgrass quality. Higher rates of N from an organic source would probably be required to produce results similar to a synthetic source. The use of mulching (recycling) mowers improved turfgrass growth compared to bagging mowers, and would reduce the amount of supplemental fertilizer required.

Centipedegrass exhibited the best overall general appearance ratings, while Tifway bermudagrass was the most vigorous. Prairie buffalograss did not show a decline in general appearance ratings even at the lowest level of supplemental fertilization.

REFERENCES

Anonymous. 1989. Grass clippings add nutrients to tarheel lawns, decrease burden on landfills. North Carolina Turfgrass News 7:36.

Barrios, E. P., L. G. Jones, and K. Koonce. 1979. The relationship between some N fertilizer sources, rates, application frequencies, and quality of Tifgreen bermudagrass. J. Amer. Soc. Hort. Sci. 104:84-88.

Beard, J. B. 1973. Turfgrass Science and Culture. Prentice-Hall. Englewood Cliffs, NJ.

Beard, J. B.. 1976. Clipping disposal in relation to rotary lawn mowers and the effect on thatch. J. Sports Turf Res. Inst. 52:85-91.

Bremner, J. M. 1965. Inorganic forms of N. p. 1179-1206 In C. A. Black (ed.) methods of soil analysis. American Society of Agronomy, Madison, WI.

English, K. R., R. H. Miller, and P. R. Henderlong. 1974. Nitrogen loss through "USGA Golf Green" type soil column related to source and frequency of application. Agron. Abstracts 66:98.

Isaac, R. A. and W. C. Johnson. 1976. Determination of total N in plant tissue using a block digester. Jour. Assoc. Off. Anal. Chem. 59:98-100.

Johnson, B. J., R. N. Carrow, and R. E. Burns. 1986. Effect of mower types and fertilizer treatments on quality of bermudagrass turf. Agron. Abstracts 94:135.

Meinhold, V. H., R. L. Duble, R. W. Weaver, and E. C. Holt. 1973. Thatch accumulation in bermudagrass turf in relation to management. Agron. J. 65:833-835.

Soper, D. Z., J. H. Dunn, D. D. Minner, and D. A. Sleper. 1988. Effects of clipping disposal, N, and growth retardants on thatch and tiller density in zoysiagrass. Crop Sci. 28:325-328.

Turgeon, A.J. 1980. Turfgrass Management. Prentice-Hall, Englewood Cliffs, NJ.