Influence of Fertility and Mowing Height on Performance of Established Centipedegrass

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Abstract. Centipedegrass [*Eremochloa ophiuroides* (Munro) Hack.] is widely grown throughout the southeastern United States as a low-maintenance turfgrass; however, limited peer-reviewed research is available on “best” cultural practices for established centipedegrass. This research was conducted to examine the long-term effects of mowing height and fertility regimens providing various rates and application times of soil-applied granular Fe and N on centipedegrass quality and surface coverage. Soil type was a Cecil sandy loam (clayey, kaolinitic, thermic Typic Hapludult) with a pH of 5.5. A mowing height of 3.8 cm was equal to or better than the 1.9 cm mowing height throughout the study. The rate of N fertilization played an important role in achieving optimal turfgrass quality and coverage with the two highest rates (97.6 and 195.2 kg·ha⁻¹ N), generally providing similar results when applied as split applications in May and August and mowed at 3.8 cm. These treatments provided turfgrass quality ratings of 8.3–9.0, turfgrass color ratings of 8.1–8.7, and turfgrass coverage of 94% to 98% over a 3-year period. The addition of soil-applied Fe sulfate at a rate of 24.4 kg·ha⁻¹ Fe was not beneficial to centipedegrass performance or color. Results indicate that the addition of 97.6 kg·ha⁻¹ N, using split-applications in May and August and a mowing height of 3.8 cm for established centipedegrass, should achieve acceptable turfgrass quality and coverage.

Centipedegrass [*Eremochloa ophiuroides*] is a popular turfgrass grown in the southeastern United States from North Carolina to Florida and along the Gulf Coast to Texas, yet limited published research is available on “best” cultural practices for established centipedegrass. It is a slow growing, naturally yellow-green grass with medium leaf texture that typically exhibits iron (Fe)-deficiency symptoms (Beard, 1973). Centipedegrass is a general-purpose turfgrass that requires little fertilizer, infrequent mowing, and grows best in full sun to moderate shade; however, it does not tolerate heavy traffic, compaction, drought, or high-phosphorus soils very well (Johnson and Burns, 1985). Centipedegrass provides a low-maintenance turfgrass needing to be mowed only every 10–14 d at a recommended range of 2.5–5 cm (McCarty, 2003).

Although centipedegrass requires little maintenance, it must receive proper nutrition to maintain adequate growth (Johnson et al., 1988). Centipedegrass generally responds well to nitrogen (N) fertilization, but the amount and timing are crucial to avoid the

spring occurrence of weak to dead grass termed “centipedegrass decline” (Johnson and Carrow, 1988). Centipedegrass decline is associated with excessive thatch, leaving stolons susceptible to cold temperatures and desiccation. Excessive N fertilization may enhance color and growth but contributes to centipedegrass decline problems. Low N fertilization may result in pale green color and poor growth.

Most turfgrasses, including centipedegrass, are sensitive to Fe applications and generally respond by developing a darker-green color, especially in alkaline soils or soils high in P content (Sartain, 1999). It is known that Fe is required by plants to make chlorophyll, and this helps explain the foliage color response to Fe applications and also why centipedegrass grows better on acidic soils where Fe is more available (Brady and Weil, 2004). Carrow et al. (1988) reported that foliar Fe applications at low rates (1.5 and 2.2 kg·ha⁻¹) improved plant color but contributed to increased phytotoxicity of centipedegrass when applied to turfgrass receiving relatively low N rates (12.2 and 24.4 kg·ha⁻¹).

The objectives of this research were to examine the effects of both soil-applied N and Fe on established centipedegrass quality and density when applied alone or in combination using single or split applications and to

assess whether mowing height affects centipedegrass response to the fertility treatments.

A 3-year field study was conducted in the summers of 2000, 2001, and 2002 at the Clemson Univ. Turfgrass Research Facility in Clemson, SC. The study site was established from sod in May of 1999 on a Cecil sandy loam (clayey, kaolinitic, thermic Typic Hapludult) soil with 6% to 10% slope and pH 5.5. Mehlich III extractable soil phosphorus level was 47 kg·ha⁻¹, and no fertilizer was applied before initiation of the study. Extractable soil phosphorus level was categorized into the medium acceptable range of 11.2–67.2 kg·ha⁻¹ (McCarty, 2005). Irrigation was applied twice weekly (as needed) to provide 2.54 cm of water per week.

A 2 × 10 factorial experiment was used to examine the effects of two mowing heights (1.9 and 3.8 cm) and 10 fertility regimens using various rates and application times of N and Fe (Table 1). Mowing was performed every 7 d throughout the growing season at actual set heights using a rotary-type mower, and clippings were returned. N fertilization was provided by a granular 16N–1.7P–6.6K commercial fertilizer (TriCounty Fertilizer and Specialty Co., Honea Path, S.C.) with equal amounts of soluble urea and insoluble polymer sulfur-coated urea. Fe fertilization was provided by a granular 20% soluble Fe derived from Fe sulfate (Southern Agricultural Insecticides, Hendersonville, N.C.). Fertilizers were applied with hand-held shaker cans using multiple passes in different directions to achieve uniform distribution and watered-in immediately with 6.4 mm of water.

Visual ratings of centipedegrass shoot coverage (not rated in 2000), quality, and color were made every 2 weeks throughout each growing season. Turfgrass quality ratings were on a 1–10 scale with 1 denoting no live grass, 7 denoting minimal acceptable, and 10 denoting best turfgrass quality. Turfgrass color ratings were on a 1–10 scale with 1 denoting brown grass and 10 denoting uniform, dark green color. Turfgrass coverage ratings were on a 0% to 100% scale, with 0% denoting no grass or surface coverage and 100% denoting complete, uniform dense grass.

A split-block (strip plot) experimental design (Kuehl, 2000) arranged in three randomized complete blocks was used to conduct the factorial experiment. Each block consisted of two randomly assigned mowing height whole plots stripped across 10 randomly assigned fertilizer regimen whole plots. Intersections of the perpendicular whole plots provided subplots that measured 2 × 2 m and were used to evaluate interaction between the factors. Analysis of variance was performed to evaluate main and interaction effects of the two factors and determine whether treatment effects were consistent across sampling dates and years using a general linear models procedure (SAS Institute, 2005). The multiple comparisons with the best (MCB) procedure (Hsu, 1984) were used to identify “best” treatments.

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Table 1. Effect of mowing height and fertilizer regimen on centipedegrass quality, 2000–2002.

Mowing ht (cm)	Fertilizer regimen				Turfgrass quality (1–10) ^z		
	N		Fe		2000	2001	2002
	Rate (kg·ha ⁻¹)	Timing ^y	Rate (kg·ha ⁻¹)	Timing ^y			
1.9	0.0	—	0.0	—	5.9	6.3	5.4
	24.4	May	0.0	—	5.9	7.5	7.0
	48.8	May + Aug.	0.0	—	6.3	7.2	6.9
	48.8	May	0.0	—	6.2	7.4	7.0
	97.6	May + Aug.	0.0	—	6.4	8.1	7.6
	195.2	May + Aug.	0.0	—	6.8	8.7*	7.8
	24.4	May	24.4	Aug.	5.8	7.0	6.0
	48.8	May	24.4	Aug.	6.3	7.1	6.4
	24.4	Aug.	24.4	May	5.8	6.4	5.8
	0.0	—	48.8	May + Aug.	5.7	6.4	4.8
	0.0	—	0.0	—	7.5	6.8	5.5
	24.4	May	0.0	—	8.0	7.5	7.1
3.8	48.8	May + Aug.	0.0	—	7.9	7.3	6.6
	48.8	May	0.0	—	7.9	7.5	6.9
	97.6	May + Aug.	0.0	—	8.3*	8.3	8.3
	195.2	May + Aug.	0.0	—	8.6*	8.6*	9.0*
	24.4	May	24.4	Aug.	7.8	7.3	6.7
	48.8	May	24.4	Aug.	7.7	7.5	7.1
	24.4	Aug.	24.4	May	7.3	6.4	6.1
	0.0	—	48.8	May + Aug.	7.6	6.9	6.0

^zTurfgrass quality rated every 2 weeks on a 1–10 scale (1 = all grass dead and 10 = optimal turfgrass quality) and averaged across growing season; treatment by rating date interaction was not detected. Ratings were averaged across multiple rating dates during the growing season.

^y“May + Aug.” denotes split applications with one-half of N applied each time.

*Means within a column are selected by the MCB procedure, with $P = 0.95$, so that the “best” treatment is included.

This procedure selects treatments into a subset such that the “best” treatment is included with $P = 0.95$.

Results

Due to significant treatment $\times$ year interactions ($P < 0.01$), results were examined separately for each year. However, because no meaningful treatment $\times$ date interactions were detected ($P > 0.05$), results were combined across rating dates each year for evaluation of treatment effects.

Year 1 (2000). No mowing height $\times$ fertilizer regimen interaction was observed for centipedegrass quality in 2000 ($P > 0.05$), but main effects of each factor were detected ($P < 0.001$; Table 1). Turfgrass quality was greatly affected by mowing height as ratings averaged 6.1 and 7.9 for the 1.9 and 3.8 cm mowing heights, respectively; thus, the low mowing height resulted in unacceptable (< 7) turfgrass quality in 2000. Increasing the N level resulted in linear increases in turfgrass quality ($P < 0.001$), while the addition of granular Fe did not affect turfgrass quality. In 2000, the “best” turfgrass quality was

achieved with either 97.6 or 195.2 kg·ha⁻¹ N, using split applications in May and August and mowed at 3.8 cm, as these treatments received visual quality ratings of 8.3 and 8.6, respectively.

No mowing height $\times$ fertilizer regimen interaction or main effect of mowing height was observed for centipedegrass color ($P > 0.05$), but main effects of fertilizer were detected ($P < 0.001$; Table 2). Increases in N level resulted in linear increases in turfgrass color ($P < 0.001$), while application of granular Fe did not affect turfgrass color ($P > 0.05$). In 2000, the “best” turfgrass color was

Table 2. Effects of mowing height and fertilizer regimen on centipedegrass color, 2000–2002.

Mowing ht (cm)	Fertilizer regimen				Turfgrass color (1–10) ^z		
	N		Fe		2000	2001	2002
	Rate (kg·ha ⁻¹)	Timing ^y	Rate (kg·ha ⁻¹)	Timing ^y			
1.9	0.0	—	0.0	—	6.7	7.3	6.9
	24.4	May	0.0	—	7.5	7.9	7.6
	48.8	May + Aug.	0.0	—	7.6	7.6	7.3
	48.8	May	0.0	—	7.5	7.8	7.7
	97.6	May + Aug.	0.0	—	8.1*	8.3	8.3
	195.2	May + Aug.	0.0	—	8.1*	8.8*	8.7*
	24.4	May	24.4	Aug.	7.5	7.3	7.0
	48.8	May	24.4	Aug.	7.4	7.3	7.4
	24.4	Aug.	24.4	May	7.1	7.2	7.3
	0.0	—	48.8	May + Aug.	7.3	7.7	7.3
	0.0	—	0.0	—	6.9	7.0	6.2
	24.4	May	0.0	—	7.8	7.6	7.3
3.8	48.8	May + Aug.	0.0	—	7.6	7.3	7.1
	48.8	May	0.0	—	7.8	7.6	7.3
	97.6	May + Aug.	0.0	—	8.3*	8.1	8.3
	195.2	May + Aug.	0.0	—	8.5*	8.7*	8.7*
	24.4	May	24.4	Aug.	7.5	7.0	6.6
	48.8	May	24.4	Aug.	7.8	7.1	7.4
	24.4	Aug.	24.4	May	7.2	6.8	6.8
	0.0	—	48.8	May + Aug.	7.5	7.5	7.0

^zTurfgrass color rated every 2 weeks on a 1–10 scale (1 = completely brown grass and 10 = dark green color) and averaged across growing season; treatment by rating date interaction was not detected. Ratings were averaged across multiple rating dates during the growing season.

^y“May + Aug.” denotes split applications with one-half of N applied each time.

*Means within a column are selected by the MCB procedure, with $P = 0.95$, so that the “best” treatment is included.

achieved with either 97.6 or 195.2 kg·ha⁻¹ N, using split applications in May and August and mowed at either 1.9 or 3.8 cm, as these treatments received visual color ratings that ranged from 8.1 to 8.5.

Year 2 (2001). No mowing height × fertilizer regimen interaction or main effect of mowing height was observed for centipedegrass quality or color ($P > 0.05$), but main effects of fertilizer were detected ($P < 0.01$; Tables 1 and 2). Increases in N level resulted in linear increases in turfgrass quality and color ($P < 0.001$), while application of granular Fe did not affect turfgrass quality or color ($P > 0.05$). In 2001, the “best” turfgrass quality and color were achieved with 195.2 kg·ha⁻¹ N, using split applications in May and August and mowed at either 1.9 or 3.8 cm, as these treatments received visual quality and color ratings >8.5.

No mowing height × fertilizer regimen interaction was observed for centipedegrass shoot coverage ($P > 0.05$), but main effects of each factor were detected ($P < 0.05$; Table 3). Shoot coverage was affected by mowing height as coverage averaged 80% and 86% for the 1.9 and 3.8 cm mowing heights, respectively. Increases in N level resulted in linear increases in shoot coverage ($P < 0.001$), while the addition of granular Fe did not improve shoot coverage ($P > 0.05$). In 2001, the “best” turfgrass shoot coverage was obtained with 97.6 kg·ha⁻¹ N, using split applications in May and August and mowed at 3.8 cm, and with 195.2 kg·ha⁻¹ N, using split applications in May and August and mowed at either 1.9 or 3.8 cm, as these treatments achieved excellent coverage levels of 94%, 95%, and 94%, respectively.

Year 3 (2002). No mowing height × fertilizer regimen interaction or main effect

of mowing height was observed for centipedegrass quality, color, or shoot coverage ($P > 0.05$), but main effects of fertilizer were detected for all three characteristics ($P < 0.001$; Tables 1, 2, and 3). Increases in N level resulted in linear increases in turfgrass quality and color ($P < 0.001$) and curvilinear responses in shoot coverage ($P < 0.01$ for the quadratic term). Application of granular Fe did not affect any of the measured characteristics ($P > 0.05$).

In 2002, the “best” turfgrass quality was achieved with 195.2 kg·ha⁻¹ N, using split applications in May and August and mowed at 3.8 cm, as this treatment received a visual quality rating of 9.0. The “best” turfgrass color in 2002 was achieved with 195.2 kg·ha⁻¹ N, using split applications in May and August and mowed at either 1.9 or 3.8 cm, as these treatments received visual color ratings of 8.7. The “best” turfgrass shoot coverage was obtained with either 97.6 or 195.2 kg·ha⁻¹ N, using split applications in May and August and mowed at 3.8 cm, as these treatments achieved excellent coverage levels of 95% and 98%, respectively.

Discussion

This study demonstrated that mowing height and N fertilization rate affect growth and quality of established centipedegrass turfgrass independently as no significant interactions were detected. Centipedegrass quality, color, and coverage were unaffected by the addition of granular Fe sulfate. Sartain (1999), in a comprehensive article on Fe nutrition for turfgrasses, stated that soil applications require high rates and results are often marginal as ferrous sulfate quickly converts to water-insoluble Fe in near-

neutral to alkaline soil. Centipedegrass may be more responsive to foliar Fe applications as Carrow et al. (1988) and Carrow and Johnson (1990) achieved improved centipedegrass color with foliar rates of only 0.73 kg·ha⁻¹ Fe. However, granular products are often desired by end users over liquid fertilizer formulations, which is the reason they were used in our study.

During this 3-year study, the 3.8 cm mowing height provided equal or higher turfgrass quality than did the 1.9 cm mowing height, and the highest N rate (195.2 kg·ha⁻¹) generally provided better turfgrass quality than did lower N rates. Therefore, the combination of 3.8 cm mowing height and 195.2 kg·ha⁻¹ N, provided in split applications (May and August), was either the “best” treatment or in the “best” subset of treatments for achieving optimal turfgrass quality each year. Johnson and Carrow (1988) also found that split applications during the growing season provided equal or better centipedegrass quality than did a single yearly application of 100 kg·ha⁻¹ N early in the growing season.

Centipedegrass color was influenced by fertility treatments each of the 3 years, but mowing height did not affect turfgrass color any year. Split applications of the two highest N rates (97.6 and 195.2 kg·ha⁻¹) provided optimal turfgrass color in the first year of the study, while the highest N rate resulted in the “best” color ratings in 2001 and 2002. Johnson et al. (1988) also reported enhanced centipedegrass color as the yearly N rate increased from 0 to 200 kg·ha⁻¹ but noted that 200 kg·ha⁻¹ N contributed to progressive centipedegrass decline symptoms over a 4-year period. Carrow et al. (1988) reported centipedegrass color responded to increasing N and foliar Fe rates with optimal color achieved with highest yearly rates (39 kg·ha⁻¹ N and 3 kg·ha⁻¹ Fe).

Centipedegrass shoot coverage was affected by mowing height and fertility treatments in each of the 2 years rated (2001 and 2002). Optimal shoot coverage was generally achieved with the 3.8 cm mowing height in combination with either of the two highest N rates (97.6 or 195.2 kg·ha⁻¹) each year. Miller et al. (1979) concluded that yearly N rates of 25 to 50 kg·ha⁻¹ were sufficient to maintain healthy, dense centipedegrass, but other researchers have reported that much higher N rates are necessary to maintain acceptable centipedegrass quality. Johnson et al. (1988) in Georgia noted 100 kg·ha⁻¹ N per year provided the best centipedegrass coverage, while researchers in Mississippi (Palmertree et al., 1974; Walker and Ward, 1974) and in central Florida (Pritchett and Horn, 1962) have recommended ≈200 kg·ha⁻¹ N. Thus, varying soil and environmental conditions may greatly impact the yearly N rate necessary to maintain acceptable centipedegrass coverage.

In summary, optimal turfgrass quality and coverage of established centipedegrass was generally achieved with yearly split applications of either 97.6 or 195.2 kg·ha⁻¹ N and a mowing height of 3.8 cm. However, as mentioned,

Table 3. Effects of mowing height and fertilizer regimen on centipedegrass density, 2001 and 2002.

Mowing ht (cm)	Fertilizer regimen				Turfgrass coverage (%)*	
	N		Fe			
	Rate (kg·ha ⁻¹)	Timing ^y	Rate (kg·ha ⁻¹)	Timing ^y	2001	2002
1.9	0.0	—	0.0	—	70	65
	24.4	May	0.0	—	87	88
	48.8	May + Aug.	0.0	—	85	86
	48.8	May	0.0	—	84	87
	97.6	May + Aug.	0.0	—	91	92
	195.2	May + Aug.	0.0	—	95*	91
	24.4	May	24.4	Aug.	79	77
	48.8	May	24.4	Aug.	79	80
	24.4	Aug.	24.4	May	67	69
	0.0	—	48.8	May + Aug.	69	62
3.8	0.0	—	0.0	—	83	68
	24.4	May	0.0	—	91	89
	48.8	May + Aug.	0.0	—	89	83
	48.8	May	0.0	—	91	87
	97.6	May + Aug.	0.0	—	94*	95*
	195.2	May + Aug.	0.0	—	94*	98*
	24.4	May	24.4	Aug.	86	79
	48.8	May	24.4	Aug.	86	87
	24.4	Aug.	24.4	May	71	67
	0.0	—	48.8	May + Aug.	78	70

*Turfgrass coverage rated every 2 weeks on a 0% to 100% scale (0% = no grass and 100% = complete, uniform dense coverage) and averaged across growing season; treatment by rating date interaction was not detected. Ratings were averaged across multiple rating dates during the growing season.

^y“May + Aug.” denotes split applications with one-half of N applied each time.

*Means within a column are selected by the MCB procedure, with $P = 0.95$, so that the “best” treatment is included.

Johnson and Carrow (1992) observed some problems with centipedegrass decline after 3 years of their long-term study when $>100 \text{ kg} \cdot \text{ha}^{-1} \text{ N}$, was applied yearly. Although no centipedegrass decline was observed in this study, the lower N rate ($97.6 \text{ kg} \cdot \text{ha}^{-1} \text{ N}$) would probably be most practical in the long term. Use of soil-applied Fe was not found to benefit centipedegrass color or performance.

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