Evaluation of various foliarly applied fertilizer sources for golf course putting greens. Purdue University, 2006

Cale A. Bigelow and Jared R. Nemitz – Agronomy Department

Objective:

To evaluate the effects of various granular and liquid fertilizer products for their ability to produce a high quality putting green turf.

Experimental Procedures:

This field study was conducted at the W.H. Daniel Turfgrass Research and Diagnostic Center, from 22 May – 5 Sept., 2006. The study area consisted of a mature stand of 'G-6' creeping bentgrass. Throughout the growing season the area was tri-plex mowed daily at 0.140 inches with clippings removed and irrigated to promote growth. All treatments were applied with a pressurized CO_2 (35 psi) sprayer equipped with TeeJet XR 8010E tips calibrated to deliver 2.0 gallons of spray volume per 1000 ft^2 or hand applied using a shaker jar depending upon the fertilizer product formulation (e.g. Nutralene was applied as a granule. Treatments were initiated on 22 May, 2006 and subsequently applied as specified by the research protocol. The exact product application rates and dates for all treatments are footnoted in each data table and N application totals for this study were 1.6 lbs. of actual N per 1000 ft^2. Plots were 5 ft x 5 ft and arranged in a randomized complete block with three replications of each treatment. Following each application, the plots were irrigated that evening to supply approximately 0.10 inches of water via an overhead irrigation system. Fungicides and insecticides were applied preventatively for disease and insect control.

Plots were visually assessed weekly throughout the study for turfgrass quality on a 0-10 scale with 0=brown dead turf, 10=optimum greenness, density and uniformity, ratings >7.5 = acceptable putting green turf. Canopy greenness was measured regularly throughout the study using a hand-held reflectance device (Field Scout CM-1000, Spectrum Technologies, Inc.) with five measurements per plot. These measurements were pooled into a single value that was then used for statistical analysis. All data was subjected to analysis of variance using the SAS system (Statistical Analysis Systems Institute Inc., Cary, N.C.) and treatment means separated using Fisher's protected least significant difference (LSD) test at the (p=0.05) level.

Results:

Visual Turfgrass Quality

Turfgrass quality (TQ) ratings ranged from 6.5 – 8.7 depending upon rating date and treatment (Tables 1a – b). With only a few exceptions all treatments were equally effective for producing a high quality turf and differences in treatment effects were evident on only two rating dates, 6 June and 21 July. On 6 June TQ values ranged from 6.5 to 8.7 with most fertilizer treatments falling in the highest statistical category. Four treatments, however, resulted in significantly poorer TQ than the highest treatment, Gary's Green Ultra (18 oz) with a value of 8.7. These included Sulf-N 21-0-0, Nutralene and Urea + Hydrexx (1 oz rate) and urea + Hydrexx (2 oz) which resulted in values of 6.5, 7.7. 7.8 and 7.7 respectively. Only Sulf-N 21-0-0 resulted in a TQ value that would be considered unacceptable, 6.5. This response is primarily attributed to a slight tip-burn observed on this particular application date. On 21 July all treatments had TQ values $\geq$ 8.0, indicating that all treatments had produced a visually high quality surface. On this

date Gary's Green Ultra (18 oz), Lesco 30-0-0 and Nutralene were in the highest statistical category. When TQ values were averaged across all study observations, all treatment values ranged from 7.8-8.4 and produced a surface that exceeded the minimally acceptable TQ value, 7.5. There were subtle differences among treatments with all three Gary's Green products, MacroN 28-7-14 + Lesco's 12-0-0, Lesco 30-0-0, and Proforma 30-0-0 and urea 46-0-0 all falling into the top statistical category.

Canopy Greenness

Canopy greenness measurements ranged from 209 to 359 and varied by measurement date and treatment (Tables 2a-b). Lower greenness measurements were observed early in the study and slightly higher values later in the study. In general, all treatments were effective in producing and maintaining a desirable green canopy color. At no time during this study were highly chlorotic symptoms ever evident.

On the first application date, 22 May, a very slight increase in canopy greenness was measured for most products. Throughout the study, greenness measurements were only significant on three dates, 22 June, 27 July and 31 August. On 22 June values ranged from 253-294 and all treatments generally fell into the highest statistical category. The exceptions were MacroN 28-7-14 + Lesco 12-0-0, Sulf-N 21-0-0, and Nutralene. On 27 July, values ranged from 303-319, with MacroN 28-7-14, Lesco 30-0-0, and urea 46-0-0 producing the least green canopy. On 31 Aug. some of the highest greenness measurements were recorded with values ranging from 333-359 and only two treatments, MacroN 28-7-14, and Nutralene, did not fall into the highest statistical category. When averaged across all measurements values ranged from 282-298, and 7 of the 13 treatments resulted in an average canopy greenness value that fell into the highest statistical category. The exceptions were Urea + Hydrexx (1 oz rate), MacroN 28-7-14, MacroN 28-7-14 + Lesco 12-0-0, Lesco 30-0-0, Sulf-N 21-0-0 and Nutralene. Several of these treatments, Urea + Hydrexx (1 oz rate), MacroN 28-7-14 + Lesco 12-0-0, Lesco 30-0-0 were not statistically different than many of those treatments that fell into the highest statistical grouping and therefore should also be considered when selecting fertilizer products to produce a high quality green putting green turf.

Acknowledgements

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Table 1a. Creeping bentgrass turfgrass quality as affected by various granular and liquid fertilizers, 2006.

Trt #‡	Product	Rate	Turfgrass Quality†							
			June 1	June 6	June 9	June 16	June 22	June 29	July 6	July 14
		---lbs N or oz/1000 ft^2---	----------Visual rating (0-10 scale) ----------							
1	Gary's Green Ultra	18 oz	8.2 a*	8.7 a	8.7 a	8.5 a	8.7 a	8.2 a	8.5 a	8.2 a
2	Gary's Green Ultra + Nutralene	9 oz + 0.1 lb	8.0 a	8.2 abc	8.5 a	8.2 a	8.2 a	8.0 a	8.5 a	8.0 a
3	Gary's Green Ultra + P-K Plus	9oz + 6 oz	8.0 a	8.2 abc	8.5 a	8.2 a	8.3 a	8.2 a	8.2 a	8.3 a
4	Urea + Hydrexx 1 oz rate	0.2 lb. N	7.7 a	7.8 bc	8.3 a	8.0 a	8.2 a	8.3 a	8.0 a	8.0 a
5	Urea + Hydrexx 2 oz rate	0.2 lb. N	7.8 a	7.7 c	8.3 a	8.2 a	8.2 a	7.8 a	8.0 a	8.2 a
6‡	Urea + Hydrexx 2 oz rate	0.4 lb. N	8.2 a	8.3 abc	8.2 a	8.0 a	8.3 a	8.0 a	8.3 a	8.0 a
7	MacroN 28-7-14	0.2 lb. N	8.0 a	8.0 abc	8.3 a	8.2 a	8.2 a	8.2 a	8.0 a	8.3 a
8	MacroN 28-7-14 + 12-0-0 Fe & N + 0-0-18 Phyte	0.2 lb. N + 3oz + 3oz	8.3 a	8.3 abc	8.5 a	8.3 a	8.2 a	8.2 a	8.2 a	8.0 a
9	Lesco 30-0-0	0.2 lb. N	8.0 a	8.0 abc	8.2 a	8.2 a	8.0 a	8.0 a	8.2 a	8.3 a
10	Proforma 30-0-0	0.2 lb. N	8.0 a	8.5 ab	8.3 a	8.5 a	8.0 a	8.2 a	8.0 a	8.0 a
11	Sulf-N 21-0-0	0.2 lb. N	7.5 a	6.5 d	7.8 a	8.2 a	7.2 a	7.5 a	8.0 a	8.0 a
12	Urea 46-0-0	0.2 lb. N	7.8 a	8.3 abc	8.3 a	8.2 a	8.2 a	8.3 a	8.2 a	8.2 a
13‡	Nutralene 40-0-0	0.4 lb. N	7.7 a	7.7 c	8.0 a	7.8 a	7.7 a	8.3 a	8.0 a	8.3 a

† Turfgrass quality was visually assessed on a 0 to 10 scale where 0=bare soil, brown turf, 10=optimum greenness, density and uniformity and values $\geq$ 7.5 = acceptable putting green turf.

‡ All treatments were initially applied on 22 May, 2006 and sequential applications were applied on 5, 19 June, 3, 17, 31 July and 14, 28 August 2006. All treatments with the exception of Nutralene, applied using a shaker bottle, were applied as liquid fertilizer solutions and applied in 2 gallons of spray volume per 1000 ft^2. Treatments 6 and 13 were applied every other application date.

* Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD (P=0.05).

Table 1b. Creeping bentgrass turfgrass quality as affected by various granular and liquid fertilizers, 2006.

Trt #‡	Product	Rate	Turfgrass Quality†							
			July 21	July 27	Aug 3	Aug 11	Aug 19	Aug 24	Sept 5	Study Mean
		---lbs N or oz/1000 ft^2---	----------Visual rating (0-10 scale) ----------							
1	Gary's Green Ultra	18 oz	8.5 a*	8.8 a	8.5 a	8.3 a	8.2 a	8.3 a	8.3 a	8.4 a
2	Gary's Green Ultra + Nutralene	9 oz + 0.1 lb	8.0 c	8.3 a	8.5 a	8.2 a	8.8 a	8.3 a	8.3 a	8.3 ab
3	Gary's Green Ultra + P-K Plus	9oz + 6 oz	8.2 bc	8.5 a	8.5 a	8.3 a	8.5 a	8.2 a	8.2 a	8.3 ab
4	Urea + Hydrexx 1 oz rate	0.2 lb. N	8.2 bc	8.2 a	8.2 a	8.0 a	8.2 a	8.5 a	8.2 a	8.1 bc
5	Urea + Hydrexx 2 oz rate	0.2 lb. N	8.2 bc	8.2 a	8.2 a	8.2 a	7.8 a	8.3 a	8.3 a	8.1 bcd
6‡	Urea + Hydrexx 2 oz rate	0.4 lb. N	8.0 c	8.2 a	8.0 a	8.0 a	8.2 a	8.2 a	8.2 a	8.1 bc
7	MacroN 28-7-14	0.2 lb. N	8.0 c	7.8 a	7.7 a	7.7 a	7.5 a	7.5 a	8.0 a	7.9 cd
8	MacroN 28-7-14 + 12-0-0 Fe & N + 0-0-18 Phyte	0.2 lb. N + 3oz + 3oz	8.0 c	8.5 a	8.3 a	8.0 a	8.0 a	8.0 a	8.0 a	8.2 abc
9	Lesco 30-0-0	0.2 lb. N	8.3 ab	8.0 a	8.0 a	8.2 a	8.3 a	8.3 a	8.0 a	8.2 abc
10	Proforma 30-0-0	0.2 lb. N	8.0 c	7.7 a	8.3 a	8.3 a	8.2 a	8.2 a	8.0 a	8.2 abc
11	Sulf-N 21-0-0	0.2 lb. N	8.0 c	8.2 a	7.7 a	8.3 a	7.8 a	7.8 a	8.0 a	7.8 d
12	Urea 46-0-0	0.2 lb. N	8.0 c	8.0 a	8.0 a	8.2 a	8.0 a	8.2 a	8.2 a	8.2 abc
13‡	Nutralene 40-0-0	0.4 lb. N	8.3 ab	8.2 a	8.2 a	8.2 a	8.0 a	8.5 a	8.3 a	8.1 bcd

† Turfgrass quality was visually assessed on a 0 to 10 scale where 0=bare soil, brown turf, 10=optimum greenness, density and uniformity and values $\geq$ 7.5 = acceptable putting green turf.

‡ All treatments were initially applied on 22 May, 2006 and sequential applications were applied on 5, 19 June, 3, 17, 31 July and 14, 28 August 2006. All treatments with the exception of Nutralene, applied using a shaker bottle, were applied as liquid fertilizer solutions and applied in 2 gallons of spray volume per 1000 ft^2. Treatments 6 and 13 were applied every other application date.

* Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD (P=0.05).

Table 2a. Creeping bentgrass canopy greenness as measured by reflectance and affected by various granular and liquid fertilizers, 2006.

Trt #‡	Product	Rate	Canopy Greenness†							
			May 22 Pre	May 22 Post	May 29	June 2	June 5	June 9	June 22	July 3
		---lbs N or oz/1000 ft^2---	----------Reflectance (spectrum units) ----------							
1	Gary's Green Ultra	18 oz	214 a	230 a	266 a	286 a	272 a	294 a	290 ab	292 a
2	Gary's Green Ultra + Nutralene	9 oz + 0.1 lb	214 a	231 a	276 a	291 a	277 a	293 a	286 abc	299 a
3	Gary's Green Ultra + P-K Plus	9oz + 6 oz	208 a	213 a	264 a	279 a	273 a	293 a	285 abc	296 a
4	Urea + Hydrexx 1 oz rate	0.2 lb. N	210 a	224 a	258 a	279 a	267 a	291 a	285 abc	295 a
5	Urea + Hydrexx 2 oz rate	0.2 lb. N	216 a	225 a	260 a	280 a	265 a	293 a	285 abc	296 a
6‡	Urea + Hydrexx 2 oz rate	0.4 lb. N	218 a	230 a	282 a	306 a	287 a	291 a	280 abc	303 a
7	MacroN 28-7-14	0.2 lb. N	220 a	229 a	269 a	287 a	275 a	290 a	283 abc	292 a
8	MacroN 28-7-14 + 12-0-0 Fe & N + 0-0-18 Phyte	0.2 lb. N + 3oz + 3oz	216 a	221 a	276 a	290 a	276 a	291 a	278 bc	290 a
9	Lesco 30-0-0	0.2 lb. N	209 a	224 a	267 a	290 a	273 a	305 a	287 abc	298 a
10	Proforma 30-0-0	0.2 lb. N	219 a	236 a	286 a	304 a	281 a	313 a	294 abc	298 a
11	Sulf-N 21-0-0	0.2 lb. N	221 a	217 a	247 a	265 a	258 a	268 a	253 d	289 a
12	Urea 46-0-0	0.2 lb. N	223 a	228 a	277 a	291 a	277 a	300 a	287 abc	289 a
13‡	Nutralene 40-0-0	0.4 lb. N	211 a	213 a	267 a	288 a	276 a	285 a	274 c	294 a

† Canopy greenness was measured using a hand-held reflectance meter (CM-1000) with five measurements per plot.

‡ All treatments were initially applied on 22 May, 2006 and sequential applications were applied on 5, 19 June, 3, 17, 31 July and 14, 28 August 2006. All treatments with the exception of Nutralene, applied using a shaker bottle, were applied as liquid fertilizer solutions and applied in 2 gallons of spray volume per 1000 ft^2. Treatments 6 and 13 were applied every other application date.

* Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD (P=0.05).

Table 2b. Creeping bentgrass canopy greenness as measured by reflectance and affected by various granular and liquid fertilizers, 2006.

Trt #‡	Product	Rate	Canopy Greenness†							
			July 21	July 27	Aug 2	Aug 10	Aug 24	Aug 31	Sept 5	Study Mean
		---lbs N or oz/1000 ft^2---	----------Reflectance (spectrum units) ----------							
1	Gary's Green Ultra	18 oz	334 a	318 ab	308 a	344 a	299 a	344 abc	320 a	292 abc
2	Gary's Green Ultra + Nutralene	9 oz + 0.1 lb	334 a	312 abc	306 a	346 a	289 a	346 abc	314 a	293 abc
3	Gary's Green Ultra + P-K Plus	9oz + 6 oz	337 a	319 a	305 a	342 a	297 a	357 a	319 a	292 abc
4	Urea + Hydrexx 1 oz rate	0.2 lb. N	335 a	318 a	300 a	335 a	302 a	352 ab	317 a	290 bcd
5	Urea + Hydrexx 2 oz rate	0.2 lb. N	333 a	313 ab	305 a	347 a	291 a	350 ab	319 a	291 abc
6‡	Urea + Hydrexx 2 oz rate	0.4 lb. N	330 a	318 ab	301 a	338 a	298 a	350 ab	310 a	295 ab
7	MacroN 28-7-14	0.2 lb. N	323 a	303 c	288 a	332 a	273 a	333 c	304 a	286 cd
8	MacroN 28-7-14 + 12-0-0 Fe & N + 0-0-18 Phyte	0.2 lb. N + 3oz + 3oz	328 a	313 ab	294 a	332 a	284 a	338 bc	308 a	288 bcd
9	Lesco 30-0-0	0.2 lb. N	335 a	309 bc	293 a	330 a	295 a	348 ab	320 a	291 bc
10	Proforma 30-0-0	0.2 lb. N	334 a	315 ab	301 a	335 a	300 a	359 a	329 a	298 a
11	Sulf-N 21-0-0	0.2 lb. N	329 a	311 abc	283 a	338 a	291 a	352 ab	315 a	282 d
12	Urea 46-0-0	0.2 lb. N	329 a	304 c	294 a	335 a	293 a	350 ab	322 a	292 abc
13‡	Nutralene 40-0-0	0.4 lb. N	328 a	315 ab	280 a	324 a	291 a	340 bc	310 a	286 d

† Canopy greenness was measured using a hand-held reflectance meter (CM-1000) with five measurements per plot.

‡ All treatments were initially applied on 22 May, 2006 and sequential applications were applied on 5, 19 June, 3, 17, 31 July and 14, 28 August 2006. All treatments with the exception of Nutralene, applied using a shaker bottle, were applied as liquid fertilizer solutions and applied in 2 gallons of spray volume per 1000 ft^2. Treatments 6 and 13 were applied every other application date.

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