The Response of Kentucky Bluegrass Turf to Varying Nitrogen Sources

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Introduction:

The objectives of the 2004 nitrogen (N) source study were to compare the turf response and N release rates of various experimental fertilizer products that are being proposed for marketing in 2005 to a number of industry standards, such as Milorganite, Sustane, Nature Safe, Corn Gluten Meal, and Renaissance. An untreated control was also added for comparison. The research was conducted at the Iowa State University turfgrass research area north of Ames, Iowa on 'Nassau' Kentucky bluegrass turf.

Materials and Methods:

The study included 21 different N fertilizer treatments obtained from varying companies involved in packaging fertilizer materials for the turf industry and a control (Table 1). The study was conducted as a randomized complete block design with 3 replications. With 22 treatments and 3 replications, there were a total of 66 plots. Each of the 'Nassau' Kentucky bluegrass plots measured 5x5ft ($25ft^2$). Following an initial mowing at 1.7 inches, all of the fertilizers were applied at a rate of 1 lb N/$1000ft^2$. The first application date was May 21st, 2004. A broadleaf herbicide application of Trimec® was applied May 27th at a rate of 1.2 fluid oz/$1000ft^2$. The plots were again mown at a uniform height one week after fertilizers were applied. Clipping data collection began one week following that mowing on June 3. Clippings were harvested separately from each plot at a mowing height of 1.7 inches. One mowing 'strip' was taken from each plot. The width of the collection strip was 19 ½ inches using a McClain reel mower with a catch basket. This resulted in clippings being collected from $8.125ft^2$ of plot area. After all clippings were taken for a particular date, the remaining area on the plots was mowed to a uniform height of 1.7 inches and the clippings were collected and then discarded in order to avoid any nitrogen being put back into the soil. Following collection, the clippings were placed in an oven and allowed to dry for a minimum of 3 days at 67° C. They were then weighed and the data were reported on the basis of grams of dry weight tissue/25 ft^2 plot (Table 2).

On June 22nd, phosphorus was applied at a rate of 1 lb P /$1000ft^2$ to the entire area. The next day, June 23rd, 1 lb/$1000ft^2$ of potassium was applied to the entire area and watered in. This was done to eliminate possible differences caused by variations of these elements in the fertilizer products.

Visual quality ratings based on color, density, and overall appearance were taken weekly on a scale of 9-1, with 9 being the highest quality and 1 being the lowest quality. A rating of 6 or higher was considered acceptable turf quality. The second application of N fertilizers was applied on July 8th and the third application of fertilizers was on September 9th. Both of these treatments were made uniformly at a rate of 1 lb N/1000 ft^2.

Clippings were taken a total of 20 times. Every two weeks, weighed clippings were combined together and then ground through a Wiley mill with a twenty mesh screen. Since there were 20 collection dates, there were 10 dates of ground clippings. Once the clippings were ground, 0.1 grams of tissue was weighed, added to Kjeldahl tubes, and processed through the Micro-Kjeldahl procedure using a Lachat BD-46 block digester. The liquid solution resulting from the digestion process was then analyzed with a Lachat nitrogen analysis apparatus in accordance to the Salicylate Method for ammonium determination. The results of the procedure produced dry-weight percentages of N for each tissue sample (Table 3).

Results and Discussion:

Weekly quality data for June 3 to November 6 are listed in Table 1. We have not attempted to make graphic representations of the comparative data because of the large numbers of treatments. Representatives of each company involved in the project are encouraged to make any graphic representations of the data of their product(s) versus the standards of their choice that they like.

Weekly clipping data are listed in Table 2. Clippings provide a more objective measurement of turf response than do the subjective quality ratings. The value of this data will be a demonstration of how the grass responded to each product versus the untreated control. It also shows how quickly the grass responded to the various treatments and how long that response lasted. Again, comparisons of the new proposed products to industry standards will provide useful information.

Table 3 includes data on the uptake of nitrogen by the grass on a % dry tissue basis in response to each treatment over the entire season. Again, we grouped clippings from two week time periods for N analysis. This data gives additional objective measurements that can be used to compare individual products to the control and to other industry standards.

Table 4 includes end of season nutrients, both macro and micro. These nutrients were measured using ICAP procedures and include all other essential elements with the exception of iron and chlorine, which require different testing methods. These nutrients were measured using only the final two weeks worth of clippings.

Table 1. Quality data from Kentucky bluegrass plots treated with varying nitrogen sources during the 2004 season, 9= highest quality and 1= lowest quality.

Treatment	6/3	6/10	6/17	6/25	6/30	7/7	7/15	7/22	7/28	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/24	10/2	10/17	11/6
Control	5.7	6.0	6.0	6.7	6.0	5.7	5.3	5.3	5.0	6.0	5.3	5.7	5.7	6.3	6.0	6.0	6.0	6.0	6.0	5.0
Renaissance 8-2-6	7.0	7.0	6.7	7.0	6.0	6.0	7.0	7.0	7.7	8.7	7.3	7.7	7.7	7.0	7.7	8.3	8.7	7.7	7.0	6.0
Milorganite 6-2-0	6.3	7.0	6.7	7.0	6.0	6.0	6.3	6.3	7.3	8.0	7.7	7.0	7.0	7.0	7.0	8.0	8.0	7.3	7.0	6.0
Nature Safe 10-2-8	5.7	7.0	6.3	7.0	6.0	6.0	6.7	6.7	7.7	8.0	7.7	7.3	7.3	6.7	7.3	7.7	8.0	7.7	7.0	6.0
Leovex 8-0-7	6.0	7.0	7.0	7.7	6.3	6.3	6.3	6.3	7.7	8.7	8.0	7.3	7.3	7.0	7.0	7.0	8.0	8.0	7.0	6.0
Secure Safe 9-0-0	6.0	6.7	6.7	7.0	6.0	6.0	6.3	6.3	7.3	8.3	8.0	8.0	8.0	7.0	7.0	8.3	8.3	8.3	7.0	6.0
Soylpro 9-2-3	6.3	7.0	6.7	6.3	6.0	6.0	6.3	6.3	6.7	7.7	7.0	7.0	7.0	7.0	7.3	7.7	7.7	7.3	7.0	6.0
SoyGreen 11-1-2	6.3	7.0	6.3	6.7	6.0	6.0	7.0	7.0	7.3	7.7	7.0	7.7	7.7	7.0	8.0	8.7	8.0	7.7	7.0	6.0
Sustane 5-2-4	5.7	6.0	6.0	6.3	6.0	6.0	6.0	6.0	7.0	7.7	7.3	7.0	7.0	7.0	6.7	7.0	7.3	7.3	7.0	6.0
Sustane 8-2-4	6.3	7.0	6.7	7.0	6.0	6.0	6.7	6.7	7.0	8.0	7.3	7.3	7.3	7.0	7.3	8.0	8.7	8.0	7.0	6.0
Sustane 5-2-4 + Fe	6.3	7.0	6.3	6.7	6.0	6.0	7.0	8.0	7.0	7.7	7.0	7.0	7.0	7.0	7.3	8.0	7.7	7.3	7.0	6.0
Ladybug 8-2-4	6.0	7.3	6.7	7.0	6.3	6.3	6.3	6.3	7.0	8.0	7.0	7.0	7.0	7.0	7.3	8.0	8.0	7.7	7.0	6.0
Four All Seasons 9-1.2-1.55	5.3	6.3	6.7	6.7	6.0	6.0	6.0	6.0	7.3	8.0	7.3	7.3	7.3	7.0	8.0	8.0	7.7	8.0	7.0	6.0
Organisoil 3% N	5.7	6.3	6.0	6.0	6.0	6.0	6.0	6.0	6.3	7.0	6.7	6.3	6.3	6.0	6.3	6.7	7.0	6.7	6.0	5.0
Worm casts 0.754%	6.0	6.3	5.7	6.0	6.0	6.0	6.7	6.7	6.7	7.0	6.3	6.3	6.3	6.0	6.7	6.3	6.7	6.3	6.0	5.0
Aaron Tech 1.2%	5.3	7.0	6.3	7.0	6.0	6.0	5.0	5.0	7.0	7.7	7.3	7.7	7.7	7.0	6.0	8.0	8.3	8.0	7.0	6.0
Rootein 8-2-2	6.3	7.0	6.7	6.7	6.0	6.0	7.7	8.0	7.0	7.7	7.3	7.0	7.0	7.0	7.7	8.3	7.7	7.3	7.0	6.0
Rootein 12-5-3	7.0	7.7	7.0	7.0	6.3	6.3	8.0	8.7	7.0	7.7	7.3	7.3	7.3	7.0	9.0	9.0	8.3	7.7	7.0	6.0
Rootein 17-6-2	7.3	8.7	7.7	7.7	6.3	6.3	8.3	8.7	8.3	8.0	8.3	8.0	7.0	7.0	8.7	9.0	8.7	8.3	7.0	6.0
Perfectly Nat. 9-1-4	7.0	7.7	7.0	7.0	6.3	6.3	7.7	8.7	7.3	8.7	7.3	7.3	7.3	7.0	8.0	8.3	7.7	7.3	7.0	6.0
Perfectly Nat. 10-0-8	6.3	7.3	7.0	7.0	6.0	6.0	7.7	8.3	7.3	7.7	7.3	7.0	7.0	7.0	7.7	9.0	8.0	8.0	7.0	6.0
Perfectly Nat. 12-0-4	7.0	7.7	7.0	7.0	6.3	6.3	7.7	8.7	7.0	7.3	7.3	7.7	7.7	7.0	8.3	9.0	8.0	7.7	7.0	6.0
LSD 0.05	**NS**	**0.8**	**0.9**	**0.9**	**NS**	**NS**	**1.0**	**0.9**	**1.2**	**1.1**	**0.9**	**0.7**	**0.7**	**0.3**	**0.7**	**0.8**	**0.9**	**0.9**	**0.9**	**0.9**

Table 2. Clipping data from Kentucky bluegrass plots treated with varying nitrogen sources during the 2004 season.

	Date of Clipping Collection																			
Treatment	**6/3**	**6/10**	**6/17**	**6/25**	**6/30**	**7/7**	**7/15**	**7/22**	**7/28**	**8/5**	**8/12**	**8/19**	**8/26**	**9/2**	**9/9**	**9/16**	**9/24**	**10/2**	**10/17**	**11/6**
	Grams of tissue																			
Control	34.0	19.6	11.2	12.3	5.3	10.2	10.8	9.7	7.5	23.0	6.3	8.5	8.7	12.7	10.0	8.4	9.0	7.0	5.7	4.0
Renaissance 8-2-6	44.2	30.2	22.3	19.8	8.8	15.9	21.7	34.8	18.9	58.1	19.3	17.6	21.6	29.2	26.5	39.1	27.5	19.9	14.1	12.4
Milorganite 6-2-0	37.5	19.7	15.2	14.2	6.4	11.2	14.9	16.6	13.0	40.0	12.4	13.3	20.0	22.4	25.2	29.1	21.6	13.5	11.3	11.4
Nature Safe 10-2-8	39.1	26.2	17.5	20.0	8.5	17.0	18.8	24.3	18.5	56.8	18.8	18.2	24.2	28.3	23.6	27.5	24.7	17.3	12.2	11.2
Leovex 8-0-7	44.2	26.1	26.5	24.3	11.1	16.8	19.7	20.7	17.5	53.9	22.4	25.0	26.1	27.4	23.6	25.3	22.0	18.6	16.7	17.9
Secure Safe 9-0-0	35.8	28.8	24.8	23.7	13.1	20.7	20.5	21.0	13.4	41.3	25.5	24.2	28.4	28.4	24.6	27.1	25.3	21.0	19.0	15.5
Soylpro 9-2-3	46.4	23.8	18.1	14.7	7.6	11.7	16.5	19.6	13.8	42.4	13.7	14.7	15.6	22.2	21.6	23.7	20.5	13.6	11.2	9.8
SoyGreen 11-1-2	50.9	30.0	18.1	9.8	7.8	15.0	26.7	31.3	14.9	45.8	16.7	16.1	18.5	19.7	25.5	37.5	28.6	14.2	12.2	10.4
Sustane 5-2-4	49.4	26.4	18.1	17.5	8.1	12.6	14.6	17.6	12.6	38.7	14.7	11.9	13.7	19.5	17.7	20.6	18.1	13.5	11.0	9.2
Sustane 8-2-4	45.3	25.0	20.1	18.2	12.3	16.8	20.6	20.7	18.1	55.7	17.9	17.2	19.6	27.0	24.5	30.2	30.4	19.2	14.6	12.9
Sustane 5-2-4 + Fe	44.8	21.3	16.5	16.9	7.5	12.6	23.1	22.6	15.5	47.8	14.2	14.1	17.2	20.9	23.7	29.7	22.3	14.1	11.6	10.6
Ladybug 8-2-4	46.9	27.8	22.2	19.1	9.4	17.0	16.3	23.2	17.9	55.0	16.7	15.3	17.7	22.9	20.7	25.3	24.5	14.6	12.0	11.1
Four All seasons 9-1.2-1.55	48.5	28.9	18.1	16.9	7.3	14.5	15.6	14.5	13.3	41.0	13.5	15.7	20.1	22.0	18.3	23.7	24.2	14.1	11.9	10.8
Organisoil 3N	35.2	20.9	11.8	11.4	5.6	11.2	10.4	9.6	8.3	25.7	8.0	8.2	10.6	17.3	12.0	16.9	15.7	9.9	9.4	6.4
Worm Castings 0.754	41.7	18.7	15.1	12.5	6.4	11.3	12.7	12.8	10.7	32.9	10.0	10.1	12.6	17.1	16.6	16.1	15.6	10.0	9.0	6.8
Aaron Tech Solution 1.2% N	64.2	37.4	22.0	21.0	8.1	13.8	27.0	37.5	19.8	61.0	16.3	16.3	20.9	25.3	35.9	44.7	31.1	18.3	12.1	9.0
Rootein 8-2-2	48.9	26.0	16.9	16.7	7.9	12.6	26.3	26.4	12.1	37.2	15.8	17.6	18.9	22.6	33.4	37.8	28.8	16.9	12.9	9.7
Rootein 12-5-3	67.6	38.9	23.1	20.5	10.0	13.3	31.7	30.3	13.8	42.5	15.3	14.0	16.5	19.5	36.8	46.9	29.1	18.3	14.4	11.5
Rootein 17-6-2	72.8	50.9	26.6	25.8	12.5	19.9	49.2	44.8	27.4	84.2	20.6	20.0	19.6	23.4	42.1	57.4	32.4	18.4	15.2	11.5
Perfectly Natural 9-1-4	50.0	29.6	19.6	18.8	7.7	14.3	31.5	31.2	15.4	47.4	18.2	16.2	21.8	24.9	34.1	42.4	27.9	16.1	12.6	11.5
Perfectly Natural 10-0-8	46.4	27.4	18.9	16.3	8.3	15.5	34.8	35.6	21.6	66.5	18.1	18.4	20.9	22.7	33.8	41.9	30.3	17.6	14.0	12.7
Perfectly Natural 12-0-4	58.1	35.7	23.1	20.2	8.5	14.7	34.2	38.0	20.8	63.9	18.5	20.0	23.5	24.9	36.1	45.4	29.4	18.7	14.2	11.4
LSD	**13.5**	**10.7**	**5.3**	**5.8**	**2.6**	**4.6**	**7.3**	**7.6**	**7.0**	**21.7**	**4.3**	**4.3**	**5.4**	**5.4**	**6.9**	**11.8**	**7.9**	**6.1**	**5.8**	**6.0**

Table 3. Percentage nitrogen content in the tissue of grasses treated with varying nitrogen sources.

Treatment	6/3 & 6/1	6/17 & 6/25	6/30 & 7/7	7/15 & 7/22	7/28 & 8/5	8/12 & 8/19	8/26 & 9/2	9/9 & 9/16	9/24 & 10/2	10/17 & 11/6
	----------Percentage N----------									
Control	2.4	2.1	2.7	3.1	2.9	3.0	3.6	3.5	3.3	2.9
Renaissance 8-2-6	3.0	2.3	2.8	3.9	3.4	3.3	3.9	4.2	3.8	3.2
Milorganite 6-2-0	2.8	2.3	2.9	3.6	3.4	3.4	3.8	4.2	3.7	3.2
Nature Safe 10-2-8	2.8	2.3	2.9	3.8	3.5	3.3	3.8	4.1	3.8	3.2
Leovex 8-0-7	2.6	2.5	3.1	3.5	3.7	3.5	3.9	4.0	3.9	3.4
Secure Safe 9-0-0	3.1	2.5	3.2	3.6	3.9	3.7	4.1	4.3	4.2	3.5
Soylpro 9-2-3	2.5	2.2	2.9	3.7	3.3	3.4	3.9	4.1	3.7	3.1
SoyGreen 11-1-2	3.2	2.3	3.1	4.1	3.5	3.4	3.9	4.5	3.9	3.2
Sustane 5-2-4	2.6	2.1	2.8	3.4	3.3	3.3	3.8	4.0	3.6	3.1
Sustane 8-2-4	2.8	2.3	3.1	3.7	3.4	3.4	4.0	4.3	3.9	3.3
Sustane 5-2-4 + Fe	2.6	2.2	3.1	3.7	3.2	3.3	3.7	4.3	3.8	3.1
Ladybug 8-2-4	2.9	2.3	3.1	3.8	3.5	3.5	4.0	4.3	4.0	3.3
Four All Seasons 9-1.2-1.55	2.9	2.4	3.1	3.7	3.5	3.5	3.9	4.3	4.1	3.3
Organisoil 3% N	2.5	2.1	2.9	3.2	3.0	3.2	3.6	4.1	3.8	3.1
Worm casts 0.754%	2.5	2.2	3.0	3.4	3.1	3.4	3.7	3.9	3.5	3.0
Aaron Tech 1.2%	3.4	2.4	3.1	4.6	3.6	3.5	4.0	4.8	4.3	3.3
Rootein 8-2-2	2.9	2.4	3.1	3.9	3.4	3.6	4.0	4.6	4.0	3.1
Rootein 12-5-3	3.2	2.3	3.1	4.0	3.3	3.4	4.1	4.7	4.1	3.2
Rootein 17-6-2	3.6	2.5	3.2	4.6	3.7	3.5	4.1	5.0	4.4	3.3
Perfectly Nat. 9-1-4	3.2	2.4	3.1	4.2	3.5	3.5	3.9	4.6	4.1	3.3
Perfectly Nat. 10-0-8	2.9	2.4	2.9	4.2	3.3	3.4	3.6	4.5	3.8	3.2
Perfectly Nat. 12-0-4	3.3	2.4	3.0	4.4	3.7	3.7	3.9	4.8	4.1	3.3
LSD 0.06	**0.3**	**0.3**	**0.3**	**0.2**	**0.3**	**0.3**	**0.2**	**0.3**	**0.3**	**0.2**

Table 4. 2004 Organic Nitrogen Fertilizer ICAP Readings (ppm)

	Boron	Calcium	Copper	Potassium	Magnesium	Manganese	Molybdenum	Sodium	Phosphorus	Sulfur	Zinc
Control	4.2	5500.0	4.9	14466.7	2456.7	9.0	0.6	72.5	3396.7	1656.7	24.0
Renaissance 8-2-6	4.4	5078.3	4.1	14416.7	2343.3	9.2	0.5	53.1	3336.7	1460.0	23.6
Milorganite 6-2-0	4.0	5085.0	4.9	13833.3	2361.7	7.9	0.8	55.9	3360.0	1470.0	24.5
Nature Safe 10-2-8	4.1	5300.0	4.7	13933.3	2358.3	10.1	0.5	59.2	3226.7	1523.3	23.9
Leovex 8-0-7	4.2	5181.7	4.4	15083.3	2231.7	10.9	0.5	65.5	3268.3	1365.0	23.3
Secure Safe 9-0-0	3.3	4916.7	4.7	14800.0	2138.3	10.4	0.5	51.1	3245.0	1420.0	21.5
Soylpro 9-2-3	4.1	4966.7	4.7	14200.0	2308.3	8.8	0.5	62.8	3296.7	1441.7	24.2
SoyGreen 11-1-2	3.5	4888.3	4.5	14616.7	2285.0	8.9	0.7	64.8	3273.3	1450.0	22.3
Sustane 5-2-4	4.6	4765.0	4.6	14266.7	2183.3	8.4	0.7	61.7	3391.7	1448.3	24.1
Sustane 8-2-4	3.5	4673.3	4.6	14166.7	2266.7	8.9	0.5	55.7	3423.3	1418.3	24.4
Sustane 5-2-4 + Fe	5.4	4900.0	4.5	14166.7	2383.3	7.6	0.8	54.1	3343.3	1530.0	24.3
Ladybug 8-2-4	4.1	4701.7	4.4	14150.0	2371.7	8.2	0.5	57.8	3385.0	1440.0	24.7
Four 9-1.2-1.55	3.8	5080.0	5.1	14066.7	2376.7	9.1	0.6	52.2	3281.7	1523.3	24.5
Organisoil 3% N	3.9	4913.3	4.6	14400.0	2086.7	8.7	0.6	68.3	3281.7	1413.3	23.5
Worm casts 0.754%	3.8	4888.3	4.2	14000.0	2166.7	8.1	1.2	56.4	3221.7	1473.3	23.2
Aaron Tech 1.2%	3.2	4478.3	4.3	13733.3	2151.7	8.7	0.5	74.7	3133.3	1418.3	23.2
Rootein 8-2-2	4.4	5468.3	4.1	13950.0	2335.0	9.2	0.5	58.3	3248.3	1411.7	22.3
Rootein 12-5-3	3.5	6150.0	4.3	14300.0	2246.7	10.1	0.6	55.5	3343.3	1391.7	22.9
Rootein 17-6-2	3.3	5316.7	4.6	14733.3	2325.0	9.4	0.5	65.8	3310.0	1545.0	21.1
Perfectly Nat. 9-1-4	4.3	4893.3	4.9	15316.7	2128.3	9.8	0.5	71.2	3258.3	1468.3	22.5
Perfectly Nat. 10-0-8	4.5	5093.3	4.7	15066.7	2218.3	9.2	0.5	68.8	3333.3	1491.7	23.6
Perfectly Nat. 12-0-4	3.5	4790.0	4.3	14183.3	2320.0	9.2	0.5	68.5	3213.3	1563.3	23.8
LSD	**1.2**	**NS**	**NS**	**1920.7**	**310.3**	**2.2**	**0.2**	**NS**	**NS**	**NS**	**2.7**