

# Comparison of Foliar N Sources for Putting Green Performance

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## Objectives:

*The purpose of this research project is to compare the performance of several commonly available plant nutrient packages versus urea and  $\text{FeSO}_4$  applied weekly throughout the growing season.*

Putting green maintenance has evolved significantly in the last 15 years as turfgrass scientists and managers have begun to better understand the factors that create turfgrass stress. Management strategies that have been successfully implemented include tree removal to increase light penetration, fans to improve air movement and evaporative cooling, and better water management to keep rootzones at optimal moisture levels. An additional practice has been light, frequent liquid applications of nitrogen and other plant nutrients.

The purpose of this research project is to compare the performance of several commonly available plant nutrient packages versus urea and  $\text{FeSO}_4$  applied weekly throughout the growing season.

## Materials and Methods

This trial was restarted on May 7, 2014 on a creeping bentgrass (*Agrostis palustris* L. cv "A-4") putting green mowed at 0.125". The putting green was not fertilized for all of 2012 to reduce the fertility level of the green. The trial started in June of 2013 when the same treatments were applied weekly throughout 2013. Fertilizers (Table 1) were applied weekly at a rate of 0.1 lbs N/M from May 7 through September 25, 2014 for a foliar fertilizer application rate of 1.8 lbs N/M. Because growth was below normal in the spring and recovery was very slow, we applied 1 lb N/M as urea on 5/29/14.

Fungicides were applied preventatively to control dollar spot, yellow tuft, and other foliar diseases observed in 2014. A total of 7 fungicide applications were made in 2014. Topdressing sand was applied weekly beginning on May 8 and continued until September 17. Topdressing was applied at a very light rate estimated at 0.5 mm per application.



**Field trial to compare plant nutrient packages versus urea nitrogen and  $\text{FeSO}_4$ .**

Turf color, quality, and clipping weights were collected once per week throughout the trial. Color and quality were rated visually on a scale of 1-9 where 9= maximum turf quality. The plots were mowed 5 times per week at a height of 0.125" and clippings were usually discarded. However, once each week clippings from each plot were collected into individual bags, dried in a forced air oven at 65 C, and weighed to determine dry weight.

## Results and Discussion

Turf quality was poor on all treatments during May. The low level of fertility applied in 2013 was insufficient to sustain turf quality. On May 29th, a decision was made to apply 1 lb N/M as urea and to aerify the trial area to improve turf quality. Turf quality improved quickly following these two treatments. Interestingly, the Nutri-

**Table 1. Turf Quality as influenced by various foliar fertilizers.**

Trmt	5/9	5/16	5/23	5/29	6/11	6/18	6/25	7/2	7/9	7/16	7/23	7/30	8/6
Nutri-Rational True Foliar 19-1-6	3.8	4.0 a	4.0 a	5.0 a	7.1 a	6.8 a	7.4 a	7.1 a	7.3 a	6.5 a	7.0 a	7.4 a	8.5 a
Floratine Power 23-0-0	3.8	3.0 b	2.5 bc	4.1 bc	5.9 b	5.9 b	6.3 bcd	7.1 a	7.1 a	7.0 a	7.4 a	7.9 a	8.5 a
Gary's Green 18-3-4 + iron	3.8	2.9 bc	3.0 b	5.0 a	6.0 b	6.0 b	6.8 b	6.9 a	6.5 a	6.6 a	7.5 a	7.8 a	8.8 a
Simplot Partners 18-3-6 with UMAXX	3.0	2.8 bc	2.5 bc	4.5 ab	5.9 b	6.0 b	6.3 bcd	7.3 a	6.8 a	6.9 a	7.4 a	7.8 a	8.6 a
Urea + FeSO4	3.8	2.8 bc	2.5 bc	4.3 abs	5.9 b	5.9 b	6.4 bc	6.6 a	6.8 a	6.9 a	7.3 a	7.3 a	8.4 a
Control	3.5	2.3 c	2.0 c	2.8 d	5.3 c	5.6 b	5.8 d	5.4 b	4.8 b	5.1 b	4.9 b	4.5 b	5.3 b
Foliar Pak 23-0-0	3.8	3.1 b	2.8 bc	3.6 c	6.0 b	6.0 b	6.1 cd	6.5 a	7.0 a	6.6 a	7.3 a	7.3 a	8.5 a
LSD (P=0.05)	NS	0.7	0.7	0.8	0.5	0.5	0.6	0.8	0.8	0.6	0.9	1.2	0.9

**Table 1 (Cont'd). Turf Quality as influenced by various foliar fertilizers.**

Trmt	8/14	8/21	8/28	9/4	9/12	9/18	9/25	10/2	10/10	10/17	10/24	10/31
Nutri-Rational True Foliar 19-1-6	8.6 a	8.8 a	7.8 a	7.6 b	7.6 b	8.5 a	8.5 ab	7.8 b	7.8 b	7.4 a	7.0 a	7.3 a
Floratine Power 23-0-0	8.5 a	8.5 a	8.3 a	8.6 a	8.9 a	9.0 a	9.0 a	8.7 a	8.8 a	7.8 a	7.1 a	7.0 a
Gary's Green 18-3-4 + iron	8.8 a	8.6 a	8.6 a	9.0 a	8.9 a	9.0 a	8.5 ab	8.8 a	8.8 a	7.8 a	7.3 a	7.0 a
Simplot Partners 18-3-6 with UMAXX	8.8 a	8.8 a	8.3 a	8.5 a	8.6 a	8.8a	9.0 a	8.5 ab	8.3 ab	7.6 a	7.3 a	7.0 a
Urea + FeSO4	8.5 a	8.8 a	8.3 a	8.9 a	8.5 a	9.0 a	8.3 b	8.5 ab	8.5 ab	7.9 a	7.4 a	7.0 a
Control	5.9 b	5.6 b	5.0 b	5.8 c	5.5 c	5.5 b	5.3 c	5.8 c	5.8 c	5.4 b	5.5 b	5.3 b
Foliar Pak 23-0-0	8.5 a	8.5 a	8.0 a	8.5 a	8.5 a	8.8 a	8.8ab	9.0 a	8.5 ab	7.8 a	7.4 a	7.0 a
LSD (P=0.05)	0.7	0.7	0.9	0.8	0.8	0.6	0.7	0.9	0.9	0.6	0.4	0.3

Rationale True Foliar product showed significantly better quality than all of the other fertilizer treatments beginning on June 11th and continuing through the June 29th rating. Beginning in July and continuing through August, all fertility treatments gave similar quality and only the unfertilized control was different from any of the fertility treatments.

Beginning in September, differences between foliar treatments began to emerge. Nutri-Rational True Foliar, which had performed best early in the season began to lag the other treatments with significant lower turf quality on four of the six ratings in September through mid-October. During the September and October evaluation period, only one treatment, urea + FeSO<sub>4</sub>, had significantly less quality than the other fertility treatments and that was only on the September 25th evaluation.

Monthly average turf quality data paints largely the same picture. Nutri-Rational True Foliar provided significantly better turf quality than the other products in May and June, similar quality in July and August, and reduced quality in September compared to all the other foliar fertilizers. In October, Foliar Pak provided significantly better quality than did Nutri-Rational True foliar, but neither product was different than the other four foliar fertilizers.

Turf color data was similar to the quality data with Nutri-Rational True Foliar providing better color in the early season with that trend reversing in the mid-summer evaluations. Gary's Green was notable in the mid-summer evaluations for consistently producing the highest level of turf color during the mid-summer ratings.

Interestingly, in 2014 we observed what appeared to be differences in worm castings that were affected by treatments. We counted worm castings per plot in May and October of 2014. On both dates, Nutri-Rational True Foliar had significantly more earth worm casts than any other foliar fertilizer treatment (Table 4). On May 1, Nutri-Rational True Foliar had 26 castings per plot compared to 8.5/plot for Floratine Power to 3.8/plot for Urea + FeSO<sub>4</sub>. On October 14th, Nutri-Rational True Foliar had 43 castings per plot compared to 14.3 for Floratine Power and 8.3 for Gary's green. On each observation date, Nutri-Rational True Foliar had more than 3 times the number of earthworm casts as the average of the other five products combined.

Even more interesting, there was a significant reduction in dandelion plants per plot between foliar fertilizer treatments. Again, Nutri-Rational True Foliar had only 1 dandelion per plot while all the other foliar fertilizer treatments averaged 14.5 plants per plot (Table 4). This

**Table 2. Turf color as influenced by various foliar fertilizers.**

Trmt	5/9	5/16	5/23	5/29	6/11	6/18	6/25	7/2	7/9	7/16	7/23	7/30	8/6
Nutri-Rational True Foliar 19-1-6	4.5	4.0 a	4.4 a	6.0 a	7.6 a	7.1 a	7.4 a	7.6 a	7.3 a	7.0 a	7.3 a	7.9 a	8.0 b
Floratine Power 23-0-0	4.3	3.0 b	2.6 bc	4.4 bc	5.8 bc	5.9 c	6.3 bc	7.3 ab	7.0 a	6.9 a	7.1 a	7.5 a	8.3 ab
Gary's Green 18-3-4 + iron	4.3	2.8 b	3.1 b	5.0 b	5.8 bc	6.0 bc	6.4 bc	7.3 ab	7.3 a	7.0 a	7.6 a	8.0 a	9.0 a
Simplot Partners 18-3-6 with UMAXX	4.3	2.8 b	2.4 bc	4.3 bc	6.1 b	6.3 b	6.5 bc	7.3 ab	7.1 a	6.8 a	7.3 a	7.5 a	8.3 ab
Urea + FeSO4	4.0	2.8 b	2.5 bc	3.3 de	5.5 c	5.8 c	6.5 bc	6.6 bc	6.8 a	6.9 a	7.0 a	7.3 a	8.4 ab
Control	4.8	2.0 c	2.3 c	2.5 e	5.9 bc	6.0 bc	6.1c	6.1c	5.8 b	5.4 b	5.4 b	5.6 b	6.0 c
Foliar Pak 23-0-0	4.3	2.5 b	2.5 bc	4.0cd	5.9 bc	5.9 c	6.8 b	6.6 bc	7.0 a	6.9 a	7.1 a	7.5 a	8.3 ab
LSD (P=0.05)	NS	0.6	0.9	0.9	0.6	0.4	0.5	0.9	0.8	0.5	0.7	0.8	0.9

**Table 2 (Cont'd). Turf color as influenced by various foliar fertilizers.**

Trmt	8/14	8/21	8/28	9/4	9/12	9/18	9/25	10/2	10/10	10/17	10/24	10/31
Nutri-Rational True Foliar 19-1-6	8.3 a	8.6 ab	7.8 a	7.0 c	7.3 b	7.3 b	7.0 c	8.1 a	8.3 ab	7.9 a	7.1 ab	7.3 ab
Floratine Power 23-0-0	8.6 a	8.6 ab	7.3 ab	8.5 ab	8.5 a	8.8 a	8.8 a	8.5 a	8.5 ab	7.9 a	7.3 ab	7.0 b
Gary's Green 18-3-4 + iron	9.0 a	9.0 a	8.0 a	9.0 a	8.6 a	8.8 a	8.3 ab	8.6 a	8.8 a	7.8 a	7.0 b	7.0 b
Simplot Partners 18-3-6 with UMAXX	8.3 a	8.3 b	7.4 ab	8.8 ab	8.4 a	8.3 a	8.3 ab	8.0 a	7.9 b	7.6 a	7.0 b	7.1 ab
Urea + FeSO4	8.5 a	8.6 ab	7.4 ab	8.5 ab	8.5 a	8.4 a	8.3 ab	8.3 a	8.8 a	7.8 a	7.4 a	7.0 b
Control	6.1 b	6.0 c	4.8 c	5.4 d	5.6 c	5.5 c	5.1 d	5.0 b	5.0 c	4.9 b	5.1 c	5.0c
Foliar Pak 23-0-0	8.3 a	8.6 ab	6.8 b	8.3 b	8.1 a	8.3 a	8.0 b	8.3 a	8.4 ab	7.8 a	7.1 ab	7.4 a
LSD (P=0.05)	0.8	0.6	0.8	0.7	0.6	0.8	0.7	0.6	0.8	0.5	0.3	0.3

is a significant difference that should be investigated more closely. In areas where herbicides are not allowed to be used, this could be a significant finding if further studies confirm this observation.

**Clipping Weights**

Clipping weight data is highly variable. Weekly sand topdressing makes getting accurate clipping weights even more problematic. Regardless, there is some interesting information to be gleaned from this data. The Nutri-Rational True Foliar product showed a significant increase in clipping weights on the very first collection date of May 8th, which was one day after the first application of 2014 (Table 5). This trend continued on the May 20th collection date, but was significant only at the P=0.1 level. These data indicate that some effect from 2013 applications has carried over into 2014. This is borne out by the earthworm casting and dandelion data (Table 4). Could some of the nitrogen in the Nutri-Rational product be slow release? Or, alternatively, is there some effect on microbial activity that stimulates soil mineralization? Following those slight differences in May, the data is mostly non-significant for the rest of May, June, and most of July. Beginning in August, clipping

growth finally begins to reflect the cumulative effects of the weekly applications at 0.1 lbs N/M. Each clipping evaluation in August gave significant differences, and beginning with August 14 clipping collection, some of the foliar treatments began to show differences. The Nutri-Rational product often gave significantly less clippings than the other foliar fertilizer products on 3 of the 5 dates when significant differences were observed. In the August and September time frame, Urea + FeSO<sub>4</sub> and Gary's Green were always in the highest statistical ranking for growth. Foliar Pak gave less growth than the top rated fertilizers on 2 evaluation dates while Floratine Power and Simplot Partners had less growth on 1 evaluation date.

When the clipping data was reported as a monthly average, these differences became more clear (Table 6). In May, Nutri-Rational produced more clippings than all foliar fertilizers except for Simplot Partners. The months of June and July showed no differences. In August, Nutri-Rational produced fewer clippings than Floratine Power, Gary's Green, Simplot Partners, and Urea. Foliar Pak was not different Nutri-Rational, but produced less growth than Urea. In September, Nutri-Rational again produced less clippings than Urea and Floratine Power, but was similar to the other foliar fertilizers.



**Table 3. Monthly average quality ratings as affected by various foliar fertilizers in 2014.**

Trmt	May	Jun	Jul	Aug	Sep	Oct
Nutri-Rational True Foliar 19-1-6	4.2 a	7.1 a	7.1 a	8.4 a	8.1 b	7.4 b
Floratine Power 23-0-0	3.3 b	6.0 b	7.3 a	8.4 a	8.9 a	7.9 ab
Gary's Green 18-3-4 + iron	3.7 b	6.3 b	7.1 a	8.7 a	8.8 a	7.9 ab
Simplot Partners 18-3-6 with UMAXX	3.2 b	6.0 b	7.2 a	8.6 a	8.7 a	7.7 ab
Urea + FeSO4	3.3 b	6.0 b	7.0 a	8.5 a	8.7 a	7.9 ab
Control	2.6 c	5.5 c	4.9 b	5.4 b	5.5 c	5.5 c
Foliar Pak 23-0-0	3.3 b	6.0 b	6.9 a	8.4 a	8.6 a	7.9 a
LSD (P=0.05)	0.5	0.3	0.6	0.7	0.5	0.5

**Table 4. Miscellaneous observations of the effects of various foliar fertilizers**

Trmt	Worm Castings		Dandelion counts	Moss Severity
	5/1	10/14	5/1	5/29
Nutri-Rational True Foliar 19-1-6	25.8 a	43.0 b	1.0 b	6.3
Floratine Power 23-0-0	8.5 bc	14.3 c	14.3 a	8.0
Gary's Green 18-3-4 + iron	5.3 bc	8.3 c	15.0 a	5.8
Simplot Partners 18-3-6 with UMAXX	7.0 bc	13.0 c	15.8 a	7.3
Urea + FeSO4	3.8 c	12.8 c	14.0 a	7.4
Control	12.3 b	59.8 a	22.3 a	8.0
Foliar Pak 23-0-0	4.8 bc	13.8 c	13.3 a	6.5
LSD (P=0.05)	8	16	9	NS

**Summary Points**

- While these products are matched so as to apply the same rate of nitrogen, it is clear that there are subtle and not-so-subtle differences in response.
- Nutri-Rationale True Foliar looked good at the start of the year, but then faded as the summer wore on.
- Gary's Green, Floratine Power, and Foliar Pak provided great mid-summer quality.
- The final piece of this project is to measure nitrogen uptake from these sources to determine whether any differences in nitrogen uptake occur because of the product formulations.
- Differences observed in clipping weights imply that growth differences are occurring, but is this a difference in nitrogen utilization or are other factors involved? This question must be answered.

**Table 5. Clipping weights as a percent of the control as affected by various foliar fertilizer products.**

Trmt	5/8	5/20	5/28	6/12	6/17	7/3	7/9	7/16	7/24	7/29
Nutri-Rational True Foliar 19-1-6	132 a	131	119	122	120	136	135	120	168 a	137
Floratine Power 23-0-0	100 b	84	125	113	176	105	118	104	155 a	98
Gary's Green 18-3-4 + iron	92 b	71	109	92	188	122	130	107	187 a	96
Simplot Partners 18-3-6 with UMAXX	106 b	84	138	102	188	100	128	94	183 a	113
Urea + FeSO4	99 b	74	118	88	214	108	144	105	172 a	110
Control	100 b	100	100	100	100	100	100	100	100 b	100
Foliar Pak 23-0-0	103 b	83	104	95	176	112	137	109	171 a	103
LSD (P=0.05)	21	¶	NS	NS	¶	NS	¶	NS	45	NS

**Table 5 (Cont'd). Clipping weights as a percent of the control as affected by various foliar fertilizer products.**

Trmt	8/5	8/14	8/21	8/28	9/4	9/17	9/26
Nutri-Rational True Foliar 19-1-6	174 a	164 c	170 a	162 c	140	153	140 c
Floratine Power 23-0-0	203 a	217 ab	165 a	211 b	166	168	217 ab
Gary's Green 18-3-4 + iron	157 ab	243 a	174 a	235 ab	148	126	227 ab
Simplot Partners 18-3-6 with UMAXX	203 a	205 abc	176 a	220 b	148	157	206 ab
Urea + FeSO4	205 a	237 ab	182 a	258 a	167	148	236 a
Control	100 b	100 d	100 b	100 d	100	100	100 d
Foliar Pak 23-0-0	178 a	189 bc	171 a	221 ab	152	126	188 b
LSD (P=0.05)	57	51	25	38	¶	¶	40

¶ Indicates significance at the P = 0.01 level of probability.

**Table 6. Monthly clipping weights, as a percent of control, for various foliar fertilizer products.**

Trmt	May	Jun	Jul	Aug	Sep
Nutri-Rational True Foliar 19-1-6	127 a	121	139	168 c	144 b
Floratine Power 23-0-0	103 b	144	116	199 ab	183 a
Gary's Green 18-3-4 + iron	91 b	140	128	202 ab	167 ab
Simplot Partners 18-3-6 with UMAXX	109 ab	145	124	201 ab	170 ab
Urea + FeSO4	97 b	151	128	220 a	184 a
Control	100 b	100	100	100 c	100 c
Foliar Pak 23-0-0	97 b	136	126	190 bc	155 ab
LSD (P=0.05)	21	NS	NS	30	31