Foliar Applications of Hydro-Gro and UAN 32 on Overseeded Bermudagrass Greens Turf

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Abstract

Hydro-Gro (10-0-0) and UAN 32 (32-0-0) were applied once every 10, 15 or 30 days on a bermudagrass green overseeded with Poa trivialis at the rate of 9.0 lbs. PLS/M in mid October, 2007. Regardless of application frequency, each product was applied to achieve a 020. lb./N/1000 ft^2 nitrogen rate. Hydro-Gro produced a darker green turf than did the UAN, when averaged over all application timings. Enhanced turfgrass color was more consistent when Hydro-Gro was applied every 15 days (2x/monthly) compared to the 10 and 30 day application timings of this product. For the UAN source, no single application timing scheme produced a consistently darker Poa trivialis turf compared to any other application timing for the same product.

Turfgrass quality was slightly greater on average for Hydro-Gro than that of the UAN treatments, although each source produced a better quality turf at one time or another within the two month application / evaluation period (Nov 15, 2007 to Jan 3, 2008). The addition of supplemental P and K did not enhance visual color or quality for either of these N source products from November to early January.

Neither N source, their application timings, or the addition of supplemental P and K had any affect on turfgrass density, texture or overall uniformity.

Introduction

Foliar applications of fertilizers for turf have been practiced by superintendents for almost 35 years. Potential benefits include uniform application of low doses of fertilizer (important in greens management), rapid uptake of nitrogen in urea and sulfate forms, as well as for the uptake of iron complexes. Limitations include time required preparing and applying spray tank preparations, loss of nutrients from drift and in clippings if collected, and increased compaction potential from extra traffic from spray equipment use.

The objectives of this test were to evaluate a liquid nitrogen product 10-0-0, with trace elements, known as HYDRO-GRO (HG) for turfgrass performance versus a comparable liquid fertilizer UAN 32-0-0. Both fertilizers were applied on a per product basis (N carrier alone), as well in conjunction with tandem applications of phosphorous and potash from 0-52-34 in order to compare –N- treatments alone vs. N-P-K.

Materials and Methods

The test treatment structure included three treatments of HYDRO-GRO (HG), and three treatments of UAN applied either once a month at 0.20 lbs N/M, twice monthly (every 15 days) at 0.10 lbs N/M, and three times per month (every 10 days) at 0.07 lb N/M. These treatments were devised to evaluate if spilt applications provided a better turf response than a single monthly application (Appendix Table –A). Note that the same amount of nitrogen per month was applied, but at three different timings. The same nitrogen rate and timing of applications were executed identically for both sources. In addition, each test plot was split with applications of supplemental P and K which was calculated to produce a N-P-K ratio of 2: 1: 0.33. The UAN treatments also received Miller's Trace elements in an amount which best matched the applied magnesium rate of the (HG). The two month total application rates are provided in Appendix Table B. Thus there were twelve fertilizer treatments, plus a non-fertilized control in the test. Each treatment appeared three times in a Randomized Complete Block Design applied to Poa trivialis turf overseeded onto a Tifgreen bermudagrass green. The putting green was overseeded on October 17,2007 at the rate of 9.0.0 lbs PLS/M.

Again, treatments were applied over a two month period from November 15, 2007, to January 3, 2008, and are identified as treatments applied every 10 days (6 apps total), 15 days, (4 applications total), and at 30 days (2 applications total, see Appendix Table –A-).

Turfs received visual scores for turfgrass color, density, quality texture and uniformity using NTEP visual scale assignments (1 = dead, 5 = marginal, 6 = fully acceptable, 9 = best possible). Note that the inherent color of Poa trivialis is normally light in color compared to most other turfgrasses. A one time rating for the degree of expression and percent plot dormant bermudagrass turf occurred in early January after several successive hard frosts had

occurred. Least significant different values were calculated to compare statistical differences between treatment means only if the mean square value for the treatment main effect was significant at P=0.05, or less.

Polynomial contrasts were tested to compare logical treatment mean comparisons for the average performance of either selected treatments, or groups of treatments. This resulted in eight statistical contrasts which are described in Appendix –C-, and provided in full in *Contrast Tables 1-8.*

Results and Discussion

All fertilizer treatments improved color over the non-treated Poa trivialis on all six evaluation dates from 20 November 2007 to 19 January 2008 (Table 1). The highest overall color scores occurred on 20 November, with fully acceptable color scores realized up until early January. By 19 January, the affects of fertilizations were still evident, noting a general decrease in performance following a culmination of "two months" of applications.

On 20 November, the single monthly application of 0.20 lbs N/M of (HG) produced a dark green color turf (8.0) while the HG at the three times per month treatment of 0.07 lbs /N per application were lighter in color (5.3). The 10-day treatment had only been applied only once at this time. The UTC (untreated control) averaged 5.0 in color. The 0.10 lb N/M rate which coincided with the 15-day application interval (applied only once at this time) was intermediate at 7.0 for color on 20 November (Table 1).

On 20 November there was no enhanced color effect from including P+K across any fertilizer/timing application combinations, regardless of the nitrogen source. However, linear contrasts showed that based on applied N alone, the average HG treated turf had statistically better color (6.8) than that of the UAN treated turfs (6.2) (Contrast Table 1). When P and K were added, the average HG + PK treated turfs averaged 6.8, while the average UAN + PK treated turfs averaged 6.2 (Contrast Table 2). Thus there was no change in turf performance by adding P and K for color at this time. Also at this time, HG at the 6 application treatment (applied only once by this date) was slightly less in color (5.3) than the same UAN treatment (6.0) when only the liquid –N- was applied. Similar results occurred when P+K were included to the same 6 application treatments, as the HG + PK treatment had a mean color score of 5.3, versus 6.0 from that of the UAN + PK treated turf (Contrast Table 4). Once again, there was no color enhancement by the addition of P and K for either nitrogen source.

The "four application" series (applied once to date at the 0.10 lb NM rate) showed that HG had produced a darker color turf (7.0) compared to that of the UAN source (6.0), when only nitrogen was applied (no P&K) (Contrast Table 5). The same exact results occurred for these two treatments when P+K were added, respectively, noting that there was no color enhancement from P and K additions (Contrast Table 6). For the single monthly application treatments now applied once at the full 0.20 lb N/M allotment, the HG treated turf averaged (8.0) for color, while the

UAN averaged (6.7) (Table 1, Contrast Table 7). The same identical color scores occurred for these –N- sources which were unaffected when P+K were added (Table 1, Contrast Table 8).

Turfgrass color scores generally increased from 20 November until 6 January. Afterwards, color scores declined naturally occurred since the last applications were made on Jan 3rd. Note that the total rate for all treatments was 0.40 lbs/N over two months. Among HG liquid –N- only treatments, the 15 day treatments generally produced consistently high color scores from 20 November to 19 January, with either the 6 application or the two application treatments of HG liquid –N- alone often changing rank in color mean performance (Table 1).

The same seasonal trend occurred for the UAN –N- alone treatment series, but note that mean color scores were generally lower in all cases compared to that of the identical HG –N- only treatments (Table 1). Poa trivialis is inherently light in color, and HG generally improved the visual turfgrass color over that of UAN, when applying –N- alone. Again, the addition of P and K did not improve color over the –N- only application treatments, regardless of their source (HG or UAN).

Among the additional treatment "contrasts" for turfgrass color, results showed that when applied without P+K (as –N- source only), the bulk color mean of all (HG) treatments was significantly greater than that of the bulk color mean of the UAN –N- source only treatments. This contrast compared the bulk means of treatments 2,3,4 versus 5,6,7 (UAN) when these means were 6.8 vs. 6.2; 6.8 vs. 6.4; 7.2 vs. 5.8; 7.2 vs. 5.4; and 6.6 vs. 5.1 respectively, for color scores on 20 November, 21 December, 28 December, 6 January, and 19 January, respectfully (Contrast Table 1, Figure 1). The same was true for color bulk mean performance of HG vs. UAN treatments when P+K were supplemented. In each case, HG & P and K treatments had significantly higher mean bulk color scores than their UAN counterparts on all five evaluation dates (Contrast Table 2).

The addition of P+K itself did not improve visual color within, or between liquid –N- source products however. Turfgrass mean color scores for each/product/timing combination sequence (no P&K added) are provided in Figure 2. Hydro-Gro applied every 15 days (twice monthly) provided consistently high levels of green color on the Poa trivialis.

Turfgrass Quality

Overall turfgrass quality was a significant response for the "treatment mean squares" on four of five evaluation dates, with all turfs being identical in quality on 20 November (8.0), at the beginning of the test. Among fertilized turfs, individual treatment mean scores ranged from 6.3 to 8.3, with scores of 8.0 or greater occurring on any and all evaluation dates, which experienced 20°F nights in December and January (Table 2). The HG source when used alone (for applied –N- only) provided slightly better quality turfs when applied once monthly (2 applications) than

when applied every 10 days (6 applications). The greatest difference between the 2 and 6 total application programs for HG (-N- only), occurred on 28 December and 6 January, during the coldest night temperature periods. Here, the single monthly applications (2 applications total in two months) produced higher ranking turf quality values over the 3 times/month applications (8.3 vs. 7.0: 8.3 vs. 6.7) (Table 2). This most likely shows the importance of increasing applied nitrogen prior to cold temperatures for 28 December and 6 January, respectively, for absolute quality maintenance.

For quality, the mean treatment scores for UAN (-N- only) were less variable than the HG treatments, but were generally not as great as the HG treated turf after 21 December. For 28 December, 6 January and 19 January, the overall turfgrass quality bulk mean score for all HG (-N-) vs. all UAN (-N-) showed that HG treated turfs had slightly better quality scores than their UAN counterparts (Contrast 1).

When P+K were added, the bulk mean quality score of 7.8 (for UAN) was significantly greater than that of 7.0 for HG on 21 December. The reverse occurred for these same treatments on 19 January, as the HG (plus P and K) bulk quality mean score of 7.3 was statistically greater than that of the UAN (plus P and K) bulk mean quality score of 6.2, showing a better residual effect (Contrast Table 2).

The addition of P+K produced better turf quality bulk mean scores for UAN (7.8) vs. HG (7.0) when P+K was added on the 21 December evaluation date (Contrast Table 2). The reverse was true on 19 January when the HG plus (P and K) turfs had a better bulk mean score (7.3) than that of the UAN bulk mean quality score of (6.2) (Contrast Table 2). When unfertilized, the Poa trivialis overseed seasonally exhibited decreases in quality from 5.7 on 21 December, to 5.0 on 19 January (Table 3).

Uniformity

Visual uniformity scores in this test were an integration of “within plot likeness” for smoothness, color uniformity, leaf texture consistency and shoot density. The “treatment mean” squares were significant for uniformity on 6 January and 19 January (Table 3). On both of those dates, the bulk mean (Contrast Table 1) of the HG (-N- only) were statistically greater than the UAN (-N- only) bulk mean (7.0 vs. 6.6 : 6.7 vs. 5.4), respectively (Contrast Tables 1 and 3). Note that this same contrast comparison was significant for color and quality on these evaluation dates as well.

Texture

Apparent leaf blade texture was not affected by treatments on the three evaluation dates of 28 December, 6 January, or 19 January. Mean treatment texture scores ranged from 6.3 to 8.0 throughout the test (Table 3).

Density

The treatment mean squares for the treatment main effect were not statistically significant on any of the four evaluation dates for overall visual density estimates. All plots had acceptable density from the 9.0 lb./M/ PLS overseed rate. Density mean scores ranged from 6.0 to 8.7 throughout the test among all treated and the non-treated turf (Table 4).

\Degree and Amount of Dormant Bermudagrass Straw

As noted previously, the dormant bermudagrass became noticeable by January 6, 2008. Basically, the non-fertilized turfs had 20% of the plot cover as straw on January 6, with a strong visible presence of necrotic leaf tissue (Table 5). Among fertilizer treated turfs, the degree of the straw was similar (2.3 to 3.3), but the percent plot cover exhibiting straw leaves was highly noticeable. The Hydro-Gro bulk mean score of 3.1% straw was less than that of 6.0 for UAN, when these products were applied without supplemental P+K. The addition of P+K to all (HG) treated turfs slightly increased the amount of straw cover (5.7% on average). For the HG (-N- alone) treated turfs, the amount of straw was less (3.1% of the plot) data not shown. UAN treated turfs had about the same amount of straw cover with the UAN (-N- alone) having a bulk mean of 6%, as the UAN (+P/K) bulk was 7.5%. Once again, the least amount of plot straw (2.0 – 3.7%) on January 6 occurred on the Hydro Gro turf, while the non-treated controls averaged 20% straw cover (Table 5)

Conclusions

1. When foliar applied as a base product, Hydro-Gro liquid fertilizer (10-0-0) produced darker visible turfgrass color (on Poa trivialis) than the equivalent rate of UAN (32-0-0) on five evaluation dates from 20 November 2007 to 19 January 2008, when averaged over all treatment application timing sequences (10, 15, or 30 day applications). Note that each treatment applied the same monthly total amount of nitrogen of 0.20 lbs. N/M/month, but in different timing sequences.

2. As a fall application series, applications of Hydro-Gro applied every 15 days provided very good color of Poa trivialis that was consistent, while the 3x/monthly and the 1x/monthly timings were more variable in color performance.

3. The 1x/month application produced on average, higher ranking color mean scores than the 3x/month application program for Hydro-Gro alone.

4. Overall, the color differences due to treatment application timings for UAN were not greatly different from each other, with a noticeable exception being on 19 January when the 1x/month timing sequence produced a darker color than the 3x/month application (5.7 vs. 4.7, respectively).

5. Adding P and K relative to –N- for a ratio of 2 : 1 : 0.33 of N-P-K to either product at any of the application timing sequences, did not appreciably affect turfgrass color.

6. Overall turfgrass quality was enhanced for Hydro-Gro alone vs. UAN on three of five evaluation dates (28 December, 6 January, 19 January), when averaged over all timing sequences.

7. The addition of P and K to the nitrogen sources alone produced increased quality for UAN over Hydro-Gro on 21 December 2007, while Hydro-Gro was superior to UAN on 19 January, 2008

8. Both the 15 day and 30 day application sequences of Hydro-Gro produced excellent quality turfs, being slightly numerically better than that of the every 10 day treatment program (no P/K added).

9. Both the 15 and 30 day application sequences for UAN produced higher ranking mean quality scores than that of the 10 day application program (no P/K added).

10. The greatest differences in turf response between these two nitrogen source products occurred for turfgrass color, followed by and to a lesser extenst, overall turfgrass quality. There was essentially no difference between these two source products (and their application timings) for apparent visible leaf texture, uniformity or visual plot turf density.

11. The addition of supplemental P and K nutrients were of no benefit in this test for promoting turfgrass color, and were of minor and inconsistent benefit for overall turfgrass quality.

12. Note that clipping and soil fertility levels were not assessed during this test. No nitrogen was added from September 1 through initial overseeding. The first applications were made on 15 November 2007 and ended on January 3, 2008.

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Key words: hydro-gro hydrogro hydro gro UAN 32 cooper skrbek resrep res rep jeff

Table 1. Mean color [1] scores of Poa trivialis overseed after foliar applications of select -N- liquid fertilizers both with and without supplememtal P and K applications. Univ. Arizona, Fall 2007, Winter 2008.

Trt #	**Treatment** [2]	color 20-Nov	color 21-Dec	color 28-Dec	color 6-Jan	color 19-Jan
1	UTC	**5.0**	**4.3**	**4.0**	**4.0**	**4.0**
2	HydroGro@0.07#@10-D(6apps)	**5.3**	**7.7**	**6.7**	**6.7**	**6.3**
3	HydroGro@0.10#@15-D(4apps)	**7.0**	**7.7**	**7.3**	**8.0**	**6.3**
4	HydroGro@0.20#@30-D(2apps)	**8.0**	**5.0**	**7.7**	**7.0**	**7.0**
5	UAN@0.07#+STEM@10-D(6apps)	**6.0**	**6.7**	**6.0**	**5.7**	**4.7**
6	UAN@0.10#+STEM@15-D(4apps)	**6.0**	**6.7**	**5.7**	**5.7**	**5.0**
7	UAN@0.20#+STEM@30-D(2apps)	**6.7**	**4.7**	**5.7**	**5.0**	**5.7**
8	trt #2 + P&K	**5.3**	**7.7**	**6.7**	**6.7**	**6.3**
9	trt #3 + P&K	**7.0**	**7.7**	**7.7**	**7.7**	**6.0**
10	trt #4 + P&K	**8.0**	**4.7**	**7.7**	**7.3**	**7.0**
11	trt #5 + P&K	**6.0**	**6.7**	**6.0**	**5.7**	**5.3**
12	trt #6 + P&K	**6.0**	**6.0**	**5.3**	**6.0**	**5.3**
13	trt #7 + P&K	**6.7**	**4.3**	**5.7**	**5.0**	**6.0**
	Test Mean [3]	**6.4**	**6.1**	**6.3**	**6.2**	**5.8**
	LSD [4]	**0.5**	**1.3**	**0.8**	**0.7**	**1.1**

[1] Color = (1-9), 1= dead, 5 = light green, 6=moderate green, 9= forest green. Values are the mean of three replications.

[2] Treatment = HYDRO-GRO or UAN 32, with/without supplemental P and K applied every 10/15/30 days per month, for 2 months.

[3] Test mean = mean of all treated and non-treated (UTC) turfs for each evaluation date.

[4] LSD value = Mean separation statistic. difference between two means must greater than the LSD value if treatments are statistically different from each other. NS = non-significant..

Table 2 . Mean visual quality scores of Poa trivialis overseed after foliar applications of select -N- liquid fertilizers both with and without supplememtal P and K applications. Univ. Arizona, Fall 2007, Winter 2008.

Trt #	**Treatment** [2]	quality 20-Nov	quality 21-Dec	quality 28-Dec	quality 6-Jan	quality 19-Jan
1	UTC	**8.0**	**5.7**	**5.3**	**5.3**	**5.0**
2	HydroGro@0.07#@10-D(6apps)	**8.0**	**6.7**	**7.0**	**6.7**	**7.0**
3	HydroGro@0.10#@15-D(4apps)	**8.0**	**7.0**	**6.7**	**7.0**	**7.7**
4	HydroGro@0.20#@30-D(2apps)	**8.0**	**6.3**	**8.3**	**8.3**	**7.3**
5	UAN@0.07#+STEM@10-D(6apps)	**8.0**	**6.7**	**7.0**	**6.3**	**6.0**
6	UAN@0.10#+STEM@15-D(4apps)	**8.0**	**7.7**	**7.7**	**7.0**	**6.7**
7	UAN@0.20#+STEM@30-D(2apps)	**8.0**	**6.0**	**7.0**	**7.3**	**7.0**
8	trt #2 + P&K	**8.0**	**7.7**	**7.3**	**6.7**	**7.0**
9	trt #3 + P&K	**8.0**	**7.0**	**7.3**	**7.3**	**7.0**
10	trt #4 + P&K	**8.0**	**6.3**	**8.0**	**7.7**	**8.0**
11	trt #5 + P&K	**8.0**	**7.7**	**6.7**	**7.3**	**6.3**
12	trt #6 + P&K	**8.0**	**8.0**	**7.7**	**6.7**	**6.0**
13	trt #7 + P&K	**8.0**	**7.7**	**7.7**	**7.7**	**6.3**
	Test Mean [3]	**8.0**	**7.0**	**7.2**	**7.0**	**6.7**
	LSD [4]	**NA**	**1.1**	**1.1**	**1.1**	**1.4**

[1] Quality = (1-9), 1= dead, 5 = marginal, 6=acceptable, 9= best possible. Values are the mean of three replications.

[2] Treatment = HYDRO-GRO or UAN 32, with/without supplemental P and K applied every 10/15/30 days per month, for 2 months.

[3] Test mean = mean of all treated and non-treated (UTC) turfs for each evaluation date.

[4] LSD value = Mean separation statistic. difference between two means must greater than the LSD value if treatments are statistically different from each other. NS = non-significant..

Table 3. Mean visual texture and uniformity scores of Poa trivialis overseed after foliar applications of select -N- liquid fertilizers both with and without supplememtal P and K applications. Univ. Arizona, Fall 2007, Winter 2008.

Trt #	**Treatment** [2]	texture 28-Dec	texture 6-Jan	texture 19-Jan	uniformity 21-Dec	uniformity 6-Jan	uniformity 19-Jan
1	UTC	**7.3**	**6.7**	**6.3**	**5.7**	**4.7**	**4.0**
2	HydroGro@0.07#@10-D(6apps)	**7.0**	**8.3**	**7.0**	**6.7**	**6.0**	**6.3**
3	HydroGro@0.10#@15-D(4apps)	**7.0**	**7.3**	**7.0**	**7.3**	**7.3**	**6.7**
4	HydroGro@0.20#@30-D(2apps)	**7.0**	**8.0**	**7.7**	**6.0**	**7.7**	**7.0**
5	UAN@0.07#+STEM@10-D(6apps)	**6.3**	**8.0**	**7.7**	**6.3**	**6.3**	**5.3**
6	UAN@0.10#+STEM@15-D(4apps)	**8.7**	**7.7**	**8.0**	**7.0**	**7.0**	**5.3**
7	UAN@0.20#+STEM@30-D(2apps)	**7.7**	**7.7**	**7.7**	**6.3**	**6.3**	**5.7**
8	trt #2 + P&K	**7.7**	**8.3**	**7.3**	**6.7**	**5.7**	**6.3**
9	trt #3 + P&K	**8.0**	**7.3**	**6.3**	**6.3**	**7.0**	**7.3**
10	trt #4 + P&K	**7.0**	**7.7**	**7.3**	**6.3**	**6.7**	**7.3**
11	trt #5 + P&K	**8.0**	**8.0**	**6.7**	**7.3**	**6.3**	**5.7**
12	trt #6 + P&K	**7.7**	**7.7**	**7.7**	**7.3**	**7.3**	**6.0**
13	trt #7 + P&K	7.7	8.0	7.7	7.0	6.3	6.0
	Test Mean [3]	**7.5**	**7.7**	**7.3**	**6.6**	**6.5**	**6.1**
	LSD [4]	**NS**	**NS**	**NS**	**NS**	**1.4**	**1.2**

[1.] Texture and unifomity = (1-9), 1= dead, 5 = light green, 6=moderate green, 9= forest green. Values are the mean of three replications.

[2.] Treatment = HYDRO-GRO or UAN 32, with/without supplemental P and K applied every 10/15/30 days per month, for 2 months.

[3.] Test mean = mean of all treated and non-treated (UTC) turfs for each evaluation date.

[4.] LSD value = Mean separation statistic. difference between two means must greater than the LSD value if treatments are statistically different from each other. NS = non-significant..

Table 4. Mean visual density scores of Poa trivialis overseed after foliar applications of select -N- liquid fertilizers both with and without supplememtal P and K applications. Univ. Arizona, Fall 2007, Winter 2008.

Trt #	**Treatment** [2]	density 21-Dec	density 28-Dec	density 6-Jan	density 19-Jan
1	UTC	**6.0**	**6.7**	**6.7**	**7.3**
2	HydroGro@0.07#@10-D(6apps)	**7.0**	**6.7**	**7.3**	**8.0**
3	HydroGro@0.10#@15-D(4apps)	**7.7**	**6.0**	**8.0**	**8.7**
4	HydroGro@0.20#@30-D(2apps)	**7.0**	**7.3**	**7.0**	**8.0**
5	UAN@0.07#+STEM@10-D(6apps)	**7.7**	**6.7**	**7.7**	**7.7**
6	UAN@0.10#+STEM@15-D(4apps)	**8.0**	**7.3**	**7.0**	**8.0**
7	UAN@0.20#+STEM@30-D(2apps)	**7.0**	**7.3**	**7.7**	**8.0**
8	trt #2 + P&K	**7.0**	**6.7**	**7.7**	**7.7**
9	trt #3 + P&K	**7.7**	**6.7**	**7.7**	**7.3**
10	trt #4 + P&K	**7.3**	**8.3**	**8.3**	**8.3**
11	trt #5 + P&K	**8.0**	**7.7**	**7.0**	**7.3**
12	trt #6 + P&K	**7.7**	**7.0**	**7.7**	**8.0**
13	trt #7 + P&K	**7.3**	**8.0**	**8.3**	**8.7**
	Test Mean [3]	**7.3**	**7.1**	**7.5**	**7.9**
	LSD [4]	**NS**	**NS**	**NS**	**NS**

[1] Density = (1-9), 1= dead, 5 = marginal, 6=acceptable, 9= best possible. Values are the mean of three replications.

[2] Treatment = HYDRO-GRO or UAN 32, with/without supplemental P and K applied every 10/15/30 days per month, for 2 months.

[3] Test mean = mean of all treated and non-treated (UTC) turfs for each evaluation date.

[4] LSD value = Mean separation statistic. difference between two means must greater than the LSD value if treatments are statistically different from each other. NS = non-significant..

Table 5. Mean degree of and % plot straw cover color scores of Poa trivialis overseed after foliar applications of select -N- liquid fertilizersboth with and without supplememtal P and K applications. Univ. Arizona, Fall 2007, Winter 2008.

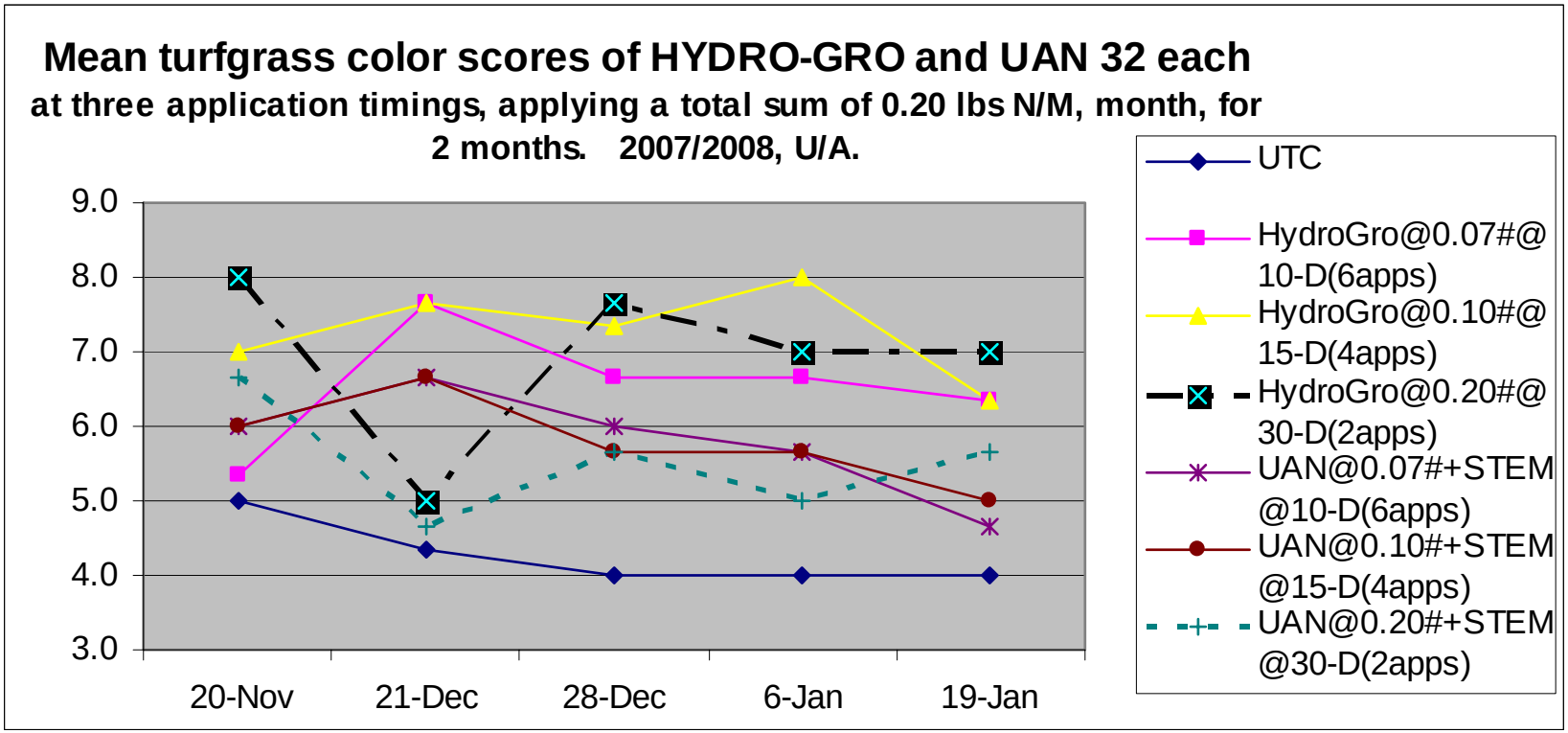
Trt #	**Treatment** [2]	degree strw 6-Jan	%-strw 6-Jan
1	UTC	**5.0**	**20.3**
2	HydroGro@0.07#@10-D(6apps)	**2.3**	**3.7**
3	HydroGro@0.10#@15-D(4apps)	**2.3**	**3.7**
4	HydroGro@0.20#@30-D(2apps)	**2.0**	**2.0**
5	UAN@0.07#+STEM@10-D(6apps)	**3.0**	**8.0**
6	UAN@0.10#+STEM@15-D(4apps)	**2.0**	**5.0**
7	UAN@0.20#+STEM@30-D(2apps)	**2.7**	**5.0**
8	trt #2 + P&K	**3.0**	**5.7**
9	trt #3 + P&K	**3.0**	**6.0**
10	trt #4 + P&K	**2.0**	**5.3**
11	trt #5 + P&K	**3.3**	**8.3**
12	trt #6 + P&K	**3.0**	**7.3**
13	trt #7 + P&K	**3.3**	**7.0**
	Test Mean [3]	**2.8**	**6.7**
	LSD [4]	**1.2**	**4.4**

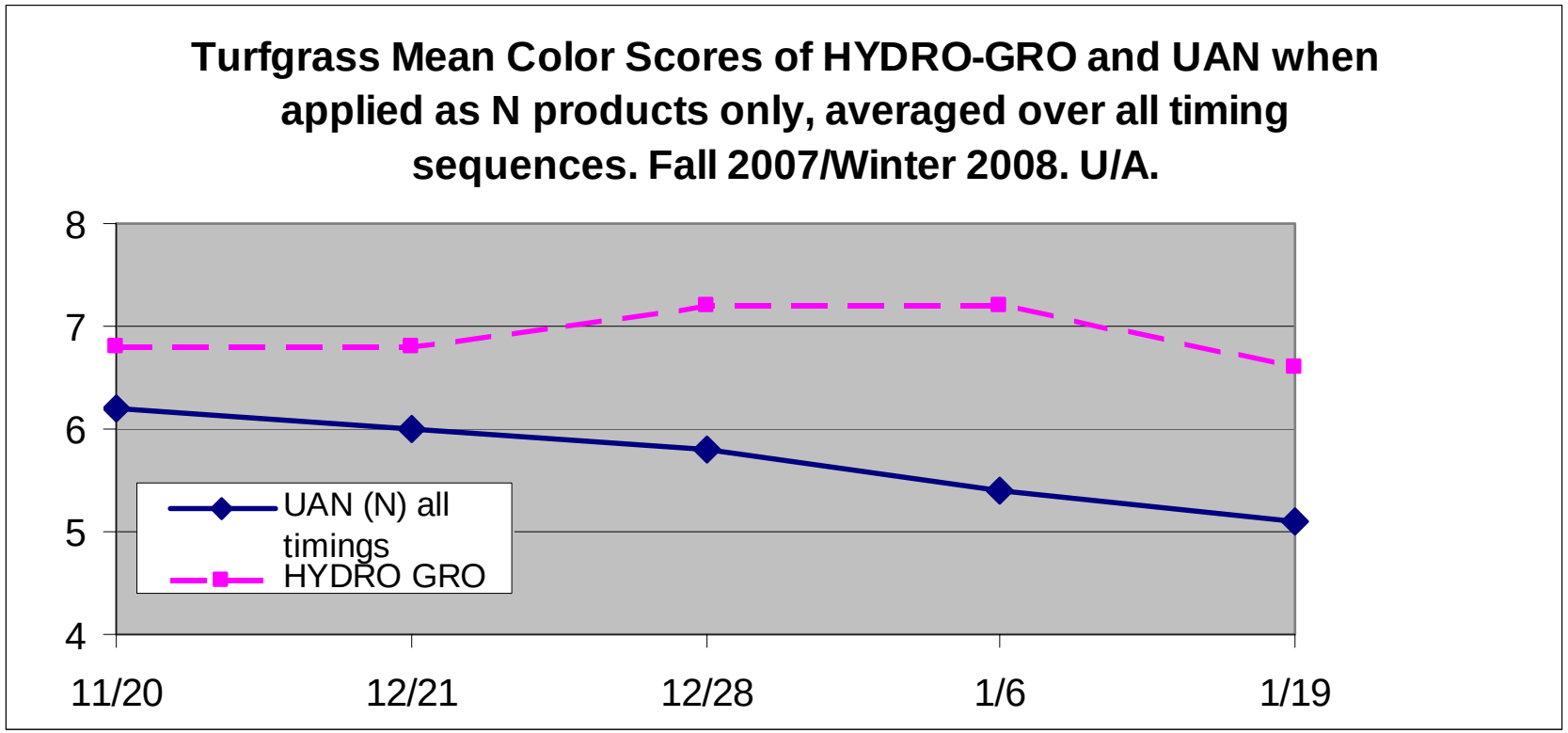
[1] Degree = (1-6), 1= none, 4=moderate, 6=severe expression. Values are the mean of three replications.

[2] Treatment = HYDRO-GRO or UAN 32, with/without supplemental P and K applied every 10/15/30 days per month, for 2 months.

[3] Test mean = mean of all treated and non-treated (UTC) turfs for each evaluation date.

[4] LSD value = Mean separation statistic. difference between two means must greater than the LSD value if treatments are statistically different from each other. NS = non-significant..


Mean turfgrass color scores of HYDRO-GRO and UAN 32 each
at three application timings, applying a total sum of 0.20 lbs N/M, month, for 2 months. 2007/2008, U/A.
9.0
8.0
7.0
6.0
5.0
4.0
3.0
20-Nov
21-Dec
28-Dec
6-Jan
19-Jan
UTC
HydroGro@0.07#@10-D(6apps)
HydroGro@0.10#@15-D(4apps)
HydroGro@0.20#@30-D(2apps)
UAN@0.07#+STEM@10-D(6apps)
UAN@0.10#+STEM@15-D(4apps)
UAN@0.20#+STEM@30-D(2apps)


Turfgrass Mean Color Scores of HYDRO-GRO and UAN when applied as N products only, averaged over all timing sequences. Fall 2007/Winter 2008. U/A.
8
7
6
5
4
UAN (N) all timings
HYDRO GRO
11/20
12/21
12/28
1/6
1/19

Appendix Table -A-. Treatment structure and application dates. HYDRO-GRO and UAN foliar fertilization application trials, Poa trivialis, Fall 2007, Winter 2008. Univ. Az.

Treatment [1]	Product [2]	N-P-K (lbs./1000 ft^2)	Sequence # applications per month	Application dates 15-Nov	26-Nov	30-Nov	6-Dec	14-Dec	24-Dec	3-Jan
1	UTC	(none)								
2	Hydro-Gro	0.07 / 0 / 0	3X/ month = 6 total apps.	x	x	x	x	x	x	x
3	Hydro-Gro	0.10 / 0 / 0	2X/ month = 4 total apps.	x	x			x		x
4	Hydro-Gro	0.20 / 0 /0	1X/ month = 2 total apps.	x					x	
5	UAN	0.07 / 0 / 0	3X/ month = 6 total apps.	x	x	x	x	x	x	x
6	UAN	0.10 / 0 / 0	2X/ month = 4 total apps.	x	x			x		x
7	UAN	0.20 / 0 /0	1X/ month = 2 total apps.	x					x	
8	Hydro-Gro	0.07 / 0.0025 / 0.023	3X/ month = 6 total apps.	x	x	x	x	x	x	x
9	Hydro-Gro	0.10 / 0 .05/ 0.033	2X/ month = 4 total apps.	x	x			x		x
10	Hydro-Gro	0.20 / 0.10 /0.066	1X/ month = 2 total apps.	x					x	
11	UAN	0.07 / 0.0025 / 0.023	3X/ month = 6 total apps.	x	x	x	x	x	x	x
12	UAN	0.10 / 0 .05/ 0.033	2X/ month = 4 total apps.	x	x			x		x
13	UAN	0.20 / 0.10 /0.066	1X/ month = 2 total apps.	x					x	

[1] Treatments apply 0.20 lbs/N/ 1000 ft^2 per month in total
Supplemental P/K supplied at 0.10 and 0.666 lbs./ 1000 ft^2 per month, repsectively.

[2] Hydro-Gro proprietary urea and micro-elements. XXXlb gallon by weight. [10-0-0] analysis
UAN =Urea ammonium nitrate. [32-0-0] analysis. XXX lb gallon. Additional STEM added
for near approximate balance to micronurients in the (HG) product.

Appendix Table -B-. Supplemental fertilzer element additions inherenet to HYDRO-GRO and best match possible from adition of Millers STEM to UAN.

HYDRO GRO trace elements	Total 2 month application rate for HG trace elements. Values are gms/ 1000 $ft^{2.}$
2% Mg	36.3
16% S	290
4% Fe	73
2% Mn	36
1% Zn	18
Millers STEM product	**Total 2 month application rate for STEM Values are gms/ 1000 $ft^{2.}$ (@64 #/acre)**
5.40% Mg	36
0.50% B	3.3
0.05% Co	0.3
1.50% Cu	10
4% Fe	27
4% Mn	27
0.10% Mo	0.7
1.50% Zn	10

STEM applied at the rate of 64 lbs.Acre per 2 months

Poa trivialis overseed 2007/2008. Foliar fertilzation test.

Appendix Table -C-. Selected orthogonal polynomial contrasts for Contrast Tables 1-8.
HYDRO-GRO and UAN Foliar Fertilization Trial, Nov 2007 - Jan 2008.

Contrast #	Treatments compared			Agronomic relevance
1	2,3,4	vs.	5,6,7	Based on -N-alone, averaged over all timing schemes, does HYDRO-GRO and UAN differ in mean overall performance.
2	8,9,10	vs.	11,12,13	With the inclusion of P & K, averaged over all timing schemes, does HYDRO-GRO and UAN differ in mean overall performance.
3	2	vs.	5	Based on -N- alone, does HYDRO-GRO differ from UAN when both are applied every 10 days (3 times/month : 6 times total)
4	8	vs.	11	With the inclusion of P & K, does HYDRO-GRO differ from UAN when each is applied every 10 days (3 times/month : 6 times total).
5	3	vs.	6	Based on -N- alone, does HYDRO-GRO differ from UAN when applied every 15 days (2x/month : 4 times total)
6	9	vs.	12	With the inclusion of P & K, does HYDRO-GRO differ from UAN when applied every 15 days (2x/month : 4 times total)
7	4	vs.	7	Based on -N-alone, does HYDRO-GRO differ from UAN when applied once a month (1x/month : 2 times total)
8	10	vs.	13	With inclusion of P & K, does HYDRO-GRO differ from UAN when applied once a month (1x/month : 2 times total)

Contrasts test if that the selected treatment means (as a group of treatments or as a single treatment) are statistically different from each other using MS error from the analysis of variance.

Contrast Table 1. Based on -N-alone, averaged over all timing schemes, does HYDRO-GRO and UAN differ in mean overall performance.

Variable [1.]	Date	UAN Treatments ***5,6,7***	***vs.***	Hydro Gro Treatments ***2,3,4***	[2] Pr > F
%-strw	**6-Jan**	6.0		3.1	**0.0001**
degree strw	**6-Jan**	2.6		2.2	**0.0337**
color	**20-Nov**	6.2		6.8	**<.0001**
color	**21-Dec**	6.0		6.8	**0.002**
color	**28-Dec**	5.8		7.2	**<.0001**
color	**6-Jan**	5.4		7.2	**<.0001**
color	**19-Jan**	5.1		6.6	**0.0016**
density	**21-Dec**	7.6		7.2	ns
density	**28-Dec**	7.1		6.7	ns
density	**6-Jan**	7.4		7.4	ns
density	**19-Jan**	7.9		8.2	ns
quality	**20-Nov**	8.0		8.0	ns
quality	**21-Dec**	6.8		6.7	ns
quality	**28-Dec**	7.2		7.3	**0.0339**
quality	**6-Jan**	6.9		7.3	**0.0416**
quality	**19-Jan**	6.6		7.3	**0.0571**
texture	**28-Dec**	7.6		7.0	**0.0187**
texture	**6-Jan**	7.8		7.9	ns
texture	**19-Jan**	7.8		7.2	ns
uniformity	**21-Dec**	6.6		6.7	ns
uniformity	**6-Jan**	6.6		7.0	**0.011**
uniformity	**19-Jan**	5.4		6.7	**0.0004**

[1] Degree straw = (visual intensity of straw 1= none 4= moderate 6 = severe. Values are the mean of 3 replications.
% straw = (0-100%) of plot cover showing symptom. Values are the mean of three replications.
color = (1-9), 1= dead, 5= light green, 6 = medium green, 9=forest green. Values are the mean of three replications.
density = (1-9). 1= dead, 5 =marginal, 6 = acceptable, 9=best possible. Values are the mean of three replications.
quality = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications
texture = indication of relative leaf width =(1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible
Values are the mean of three replications
uniformity = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications

2 sig level. NS= non - significant. P value stated refers to the chance of these results happening by chance alone.

Contrast Table 2. With the inclusion of P & K, averaged over all timing schemes, does HYDRO-GRO and UAN differ in mean overall performance.

Variable [1.]	Date	UAN Treatments ***11,12,13*** ***vs.***	Hydro Gro Treatments ***8,9,10***	[2] Pr > F
%-strw	**6-Jan**	7.6	5.7	ns
degree strw	**6-Jan**	3.2	2.7	ns
color	**20-Nov**	6.2	6.8	**0.0005**
color	**21-Dec**	5.7	6.7	**0.0091**
color	**28-Dec**	5.7	7.3	**<.0001**
color	**6-Jan**	5.6	7.2	**<.0001**
color	**19-Jan**	5.6	6.4	**0.0089**
density	**21-Dec**	7.7	7.3	ns
density	**28-Dec**	7.6	7.2	ns
density	**6-Jan**	7.7	7.9	ns
density	**19-Jan**	8.0	7.8	ns
quality	**20-Nov**	8.0	8.0	ns
quality	**21-Dec**	7.8	7.0	**0.0202**
quality	**28-Dec**	7.3	7.6	ns
quality	**6-Jan**	7.2	7.2	ns
quality	**19-Jan**	6.2	7.3	**0.0087**
texture	**28-Dec**	7.8	7.6	ns
texture	**6-Jan**	7.9	7.8	ns
texture	**19-Jan**	7.3	7.0	ns
uniformity	**21-Dec**	7.2	6.4	ns
uniformity	**6-Jan**	6.7	6.4	ns
uniformity	**19-Jan**	5.9	7.0	**0.0022**

[1] Degree straw = (visual intensity of straw 1= none 4= moderate 6 = severe. Values are the mean of 3 replications.
% straw = (0-100%) of plot cover showing symptom. Values are the mean of three replications.
color = (1-9), 1= dead, 5= light green, 6 = medium green, 9=forest green. Values are the mean of three replications.
density = (1-9). 1= dead, 5 =marginal, 6 = acceptable, 9=best possible. Values are the mean of three replications.
quality = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications
texture = indication of relative leaf width =(1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible
Values are the mean of three replications
uniformity = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications

2 sig level. NS= non - significant. P value stated refers to the chance of these results happening by chance alone.

Contrast Table 3. Based on -N- alone, does HYDRO-GRO differ from UAN when both are applied every 10 days (3 times/month : 6 times total).

Variable [1.]	Date	UAN Treatments 5	vs.	Hydro Gro Treatments 2	[2] Pr > F
%-strw	**6-Jan**	8.0		3.7	ns
degree strw	**6-Jan**	3.0		2.3	ns
color	**20-Nov**	6.0		5.3	**0.0003**
color	**21-Dec**	6.7		7.7	ns
color	**28-Dec**	6.0		6.7	**0.0003**
color	**6-Jan**	5.7		6.7	**<.0001**
color	**19-Jan**	4.7		6.3	**0.0211**
density	**21-Dec**	7.7		7.0	ns
density	**28-Dec**	6.7		6.7	**ns**
density	**6-Jan**	7.7		7.3	ns
density	**19-Jan**	7.7		8.0	ns
quality	**20-Nov**	8.0		8.0	ns
quality	**21-Dec**	6.7		6.7	ns
quality	**28-Dec**	7.0		7.0	ns
quality	**6-Jan**	6.3		6.7	ns
quality	**19-Jan**	6.0		7.0	ns
texture	**28-Dec**	6.3		7.0	**0.039**
texture	**6-Jan**	8.0		8.3	ns
texture	**19-Jan**	7.7		7.0	ns
uniformity	**21-Dec**	6.3		6.7	ns
uniformity	**6-Jan**	6.3		6.0	ns
uniformity	**19-Jan**	5.3		6.3	**0.0261**

[1] Degree straw = (visual intensity of straw 1= none 4= moderate 6 = severe. Values are the mean of 3 replications.
% straw = (0-100%) of plot cover showing symptom. Values are the mean of three replications.
color = (1-9), 1= dead, 5= light green, 6 = medium green, 9=forest green. Values are the mean of three replications.
density = (1-9). 1= dead, 5 =marginal, 6 = acceptable, 9=best possible. Values are the mean of three replications.
quality = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications
texture = indication of relative leaf width =(1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible
Values are the mean of three replications
uniformity = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications

2 sig level. NS= non - significant. P value stated refers to the chance of these results happening by chance alone.

Contrast 4. With the inclusion of P & K, does HYDRO-GRO differ from UAN when each is applied every 10 days (3 times/month : 6 times total).

Variable [1.]	Date	UAN Treatments ***11***	***vs.***	Hydro Gro Treatments ***8***	2 Pr > F
%-strw	**6-Jan**	8.3		5.7	ns
degree strw	**6-Jan**	3.3		3.0	ns
color	**20-Nov**	6.0		5.3	**0.0101**
color	**21-Dec**	6.7		7.7	ns
color	**28-Dec**	6.0		6.7	ns
color	**6-Jan**	5.7		6.7	**0.0062**
color	**19-Jan**	5.3		6.3	ns
density	**21-Dec**	8.0		7.0	ns
density	**28-Dec**	7.7		6.7	ns
density	**6-Jan**	7.0		7.7	ns
density	**19-Jan**	7.3		7.7	ns
quality	**20-Nov**	8.0		8.0	ns
quality	**21-Dec**	7.7		7.7	ns
quality	**28-Dec**	6.7		7.3	ns
quality	**6-Jan**	7.3		6.7	ns
quality	**19-Jan**	6.3		7.0	ns
texture	**28-Dec**	8.0		7.7	ns
texture	**6-Jan**	8.0		8.3	ns
texture	**19-Jan**	6.7		7.3	ns
uniformity	**21-Dec**	7.3		6.7	ns
uniformity	**6-Jan**	6.3		5.7	ns
uniformity	**19-Jan**	5.7		6.3	ns

[1] Degree straw = (visual intensity of straw 1= none 4= moderate 6 = severe. Values are the mean of 3 replications.
% straw = (0-100%) of plot cover showing symptom. Values are the mean of three replications.
color = (1-9), 1= dead, 5= light green, 6 = medium green, 9=forest green. Values are the mean of three replications.
density = (1-9). 1= dead, 5 =marginal, 6 = acceptable, 9=best possible. Values are the mean of three replications.
quality = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications
texture = indication of relative leaf width =(1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible
Values are the mean of three replications
uniformity = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications

2 sig level. NS= non - significant. P value stated refers to the chance of these results happening by chance alone.

Contrast 5. Based on -N- alone, does HYDRO-GRO differ from UAN when applied every 15 days (2x/month : 4 times total)

Variable [1.]	Date	UAN Treatments 6	vs.	Hydro Gro Treatments 3	[2] Pr > F
%-strw	**6-Jan**	5.0		3.7	ns
degree strw	**6-Jan**	2.0		2.3	ns
color	**20-Nov**	6.0		7.0	**<.0001**
color	**21-Dec**	6.7		7.7	ns
color	**28-Dec**	5.7		7.3	**<.0001**
color	**6-Jan**	5.7		8.0	**<.0001**
color	**19-Jan**	5.0		6.3	**0.0211**
density	**21-Dec**	8.0		7.7	ns
density	**28-Dec**	7.3		6.0	ns
density	**6-Jan**	7.0		8.0	ns
density	**19-Jan**	8.0		8.7	ns
quality	**20-Nov**	8.0		8.0	ns
quality	**21-Dec**	7.7		7.0	ns
quality	**28-Dec**	7.7		6.7	**0.0158**
quality	**6-Jan**	7.0		7.0	ns
quality	**19-Jan**	6.7		7.7	ns
texture	**28-Dec**	8.7		7.0	ns
texture	**6-Jan**	7.7		7.3	ns
texture	**19-Jan**	8.0		7.0	ns
uniformity	**21-Dec**	7.0		7.3	ns
uniformity	**6-Jan**	7.0		7.3	ns
uniformity	**19-Jan**	5.3		6.7	**0.0261**

[1] Degree straw = (visual intensity of straw 1= none 4= moderate 6 = severe. Values are the mean of 3 replications.
% straw = (0-100%) of plot cover showing symptom. Values are the mean of three replications.
color = (1-9), 1= dead, 5= light green, 6 = medium green, 9=forest green. Values are the mean of three replications.
density = (1-9). 1= dead, 5 =marginal, 6 = acceptable, 9=best possible. Values are the mean of three replications.
quality = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications
texture = indication of relative leaf width =(1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible
Values are the mean of three replications
uniformity = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications

2 sig level. NS= non - significant. P value stated refers to the chance of these results happening by chance alone.

Contrast Table 6. With the inclusion of P & K, does HYDRO-GRO differ from UAN when applied every 15 days (2x/month : 4 times total)

Variable [1.]	Date	UAN Treatments ***12***	vs.	Hydro Gro Treatments ***9***	[2] Pr > F
%-strw	**6-Jan**	7.3		6.0	ns
degree strw	**6-Jan**	3.0		3.0	ns
color	**20-Nov**	6.0		7.0	**0.0003**
color	**21-Dec**	6.0		7.7	**0.0117**
color	**28-Dec**	5.3		7.7	**<.0001**
color	**6-Jan**	6.0		7.7	**<.0001**
color	**19-Jan**	5.3		6.0	ns
density	**21-Dec**	7.7		7.7	ns
density	**28-Dec**	7.0		6.7	ns
density	**6-Jan**	7.7		7.7	ns
density	**19-Jan**	8.0		7.3	ns
quality	**20-Nov**	8.0		8.0	ns
quality	**21-Dec**	8.0		7.0	ns
quality	**28-Dec**	7.7		7.3	ns
quality	**6-Jan**	6.7		7.3	ns
quality	**19-Jan**	6.0		7.0	ns
texture	**28-Dec**	7.7		8.0	ns
texture	**6-Jan**	7.7		7.3	ns
texture	**19-Jan**	7.7		6.3	ns
uniformity	**21-Dec**	7.3		6.3	ns
uniformity	**6-Jan**	7.3		7.0	ns
uniformity	**19-Jan**	6.0		7.3	**0.0261**

[1] Degree straw = (visual intensity of straw 1= none 4= moderate 6 = severe. Values are the mean of 3 replications.
% straw = (0-100%) of plot cover showing symptom. Values are the mean of three replications.
color = (1-9), 1= dead, 5= light green, 6 = medium green, 9=forest green. Values are the mean of three replications.
density = (1-9). 1= dead, 5 =marginal, 6 = acceptable, 9=best possible. Values are the mean of three replications.
quality = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications
texture = indication of relative leaf width =(1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible
Values are the mean of three replications
uniformity = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications

2 sig level. NS= non - significant. P value stated refers to the chance of these results happening by chance alone.

Contrast 7. Based on -N-alone, does HYDRO-GRO differ from UAN when applied once a month (1x/month : 2 times total)

Variable [1.]	Date	UAN Treatments **7**	*vs.*	Hydro Gro Treatments **9**	[2] Pr > F
%-strw	**6-Jan**	5.0		2.0	**<.0001**
degree strw	**6-Jan**	2.7		2.0	**0.0027**
color	**20-Nov**	6.7		8.0	**0.0003**
color	**21-Dec**	4.7		5.0	**0.0008**
color	**28-Dec**	5.7		7.7	**<.0001**
color	**6-Jan**	5.0		7.0	**<.0001**
color	**19-Jan**	5.7		7.0	ns
density	**21-Dec**	7.0		7.0	**ns**
density	**28-Dec**	7.3		7.3	ns
density	**6-Jan**	7.7		7.0	ns
density	**19-Jan**	8.0		8.0	ns
quality	**20-Nov**	8.0		8.0	ns
quality	**21-Dec**	6.0		6.3	ns
quality	**28-Dec**	7.0		8.3	**0.0034**
quality	**6-Jan**	7.3		8.3	ns
quality	**19-Jan**	7.0		7.3	ns
texture	**28-Dec**	7.7		7.0	ns
texture	**6-Jan**	7.7		8.0	**0.0206**
texture	**19-Jan**	7.7		7.7	ns
uniformity	**21-Dec**	6.3		6.0	ns
uniformity	**6-Jan**	6.3		7.7	**0.0252**
uniformity	**19-Jan**	5.7		7.0	**0.0261**

[1] Degree straw = (visual intensity of straw 1= none 4= moderate 6 = severe. Values are the mean of 3 replications.
% straw = (0-100%) of plot cover showing symptom. Values are the mean of three replications.
color = (1-9), 1= dead, 5= light green, 6 = medium green, 9=forest green. Values are the mean of three replications.
density = (1-9). 1= dead, 5 =marginal, 6 = acceptable, 9=best possible. Values are the mean of three replications.
quality = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications
texture = indication of relative leaf width =(1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible
Values are the mean of three replications
uniformity = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications

2 sig level. NS= non - significant. P value stated refers to the chance of these results happening by chance alone.

Contrast 8. With inclusion of P & K, does HYDRO-GRO differ from UAN when applied once a month (1x/month : 2 times total)

Variable [1.]	Date	UAN Treatments ***13***	*vs.*	Hydro Gro Treatments ***10***	[2] Pr > F
%-strw	**6-Jan**	7.0		5.3	ns
degree strw	**6-Jan**	3.3		2.0	**0.0354**
color	**20-Nov**	6.7		8.0	**<.0001**
color	**21-Dec**	4.3		4.7	ns
color	**28-Dec**	5.7		7.7	**<.0001**
color	**6-Jan**	5.0		7.3	**<.0001**
color	**19-Jan**	6.0		7.0	ns
density	**21-Dec**	7.3		7.3	ns
density	**28-Dec**	8.0		8.3	ns
density	**6-Jan**	8.3		8.3	ns
density	**19-Jan**	8.7		8.3	ns
quality	**20-Nov**	8.0		8.0	ns
quality	**21-Dec**	7.7		6.3	**0.0214**
quality	**28-Dec**	7.7		8.0	ns
quality	**6-Jan**	7.7		7.7	ns
quality	**19-Jan**	6.3		8.0	**0.0209**
texture	**28-Dec**	7.7		7.0	ns
texture	**6-Jan**	8.0		7.7	ns
texture	**19-Jan**	7.7		7.3	ns
uniformity	**21-Dec**	7.0		6.3	ns
uniformity	**6-Jan**	6.3		6.7	ns
uniformity	**19-Jan**	6.0		7.3	**0.0261**

[1] Degree straw = (visual intensity of straw 1= none 4= moderate 6 = severe. Values are the mean of 3 replications.
% straw = (0-100%) of plot cover showing symptom. Values are the mean of three replications.
color = (1-9), 1= dead, 5= light green, 6 = medium green, 9=forest green. Values are the mean of three replications.
density = (1-9). 1= dead, 5 =marginal, 6 = acceptable, 9=best possible. Values are the mean of three replications.
quality = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications
texture = indication of relative leaf width =(1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible
Values are the mean of three replications
uniformity = (1-9) 1=dead, 5=marginal, 6= acceptable, 9= best possible Values are the mean of three replications

2 sig level. NS= non - significant. P value stated refers to the chance of these results happening by chance alone.