**Evaluation of Controlled Release Nitrogen Fertilizers on Creeping Bentgrass**

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**Summary**

The objective of this trial was to evaluate the growth effects of various fertilizers on a creeping bentgrass putting green. Colour ratings, which were determined on a weekly basis, provide an evaluation of nitrogen release and initial green-up when compared with an unfertilized control. In addition, colour ratings provided an evaluation of how consistently the fertilizer released its nitrogen when compared with the untreated control. Those fertilizers that consistently showed superior green-up after each fertilizer application were the Lesco Program followed by Agrico 12-5-20. The same fertilizers had the best or were equal to the best for colour ratings over the period of the trial.

Quality ratings were also determined on a weekly basis. The fertilizers that were consistently the best were the Lesco Program and Agrico 12-5-20. In addition, the Agrico 20-5-10 showed superior quality on 15 out of 17 rating dates, while the Harmony Program was the best or equal to the best on 14 out of 17 rating dates.

The fertilizer that consistently produced the highest clipping yield was Agrico 12-5-20 (Table 4). It produced the highest amounts on 17 of 17 rating dates. This was followed in descending order by the Lesco Program (13 rating dates), Urea (10rating dates), Agrico 20-5-10 (9 rating dates). Higher total clipping yields would indicate a more efficient use of the nitrogen applied.

**Introduction**

Previous research conducted at the Prairie Turfgrass Research Centre has shown that temperature is one of the greatest factors in determining the nitrogen release pattern of fertilizers. The research has shown that, because of our cool climate, fertilizers may react very differently than what is reported from other areas of North America. This trial was initiated in order to evaluate various fertilizers for their effects on growth within the cool climate of Alberta.

**Materials and Methods**

Plots were laid out on a native soil Penncross creeping bentgrass green at the Prairie Turfgrass Research Centre (Olds College, Olds, Alberta, Canada). Plots, which were 1.5 by 3 metres in size, were replicated four times and laid out in a Randomized Complete Block Design. Prior to the initiation of the study, two applications of fertilizer were applied in order to grow out the plants from winter dormancy. On May 4 an application of urea 46-0-0 was applied at the rate of 0.5 kg N/100$m^2$ and on May 20 an additional application of Contec 19-2-19 was made at the rate of 0.25 kg N/100$^2$.

Treatment applications were made every three weeks (June 3, June 29, July 3, July 21, August 11, September 3 and September 22) at a rate of 0.2 kg N/100$m^2$. Applications of the granular fertilizers were made using a Gandy drop spreader, which was calibrated for each fertilizer to apply the appropriate amount.

Table 1 - Treatment schedule for creeping bentgrass fertilizer trial, 2004.

| Product Name | Analysis | Nitrogen Rate/3 wks | Formulation |
|---|---|---|---|
| Untreated control | N/A | None | |
| Urea | 46-0-0 | 0.2 kg/100m$^2$ | 100% water soluble |
| Fusion | 14-14-14 | 0.2 kg/100m$^2$ | Controlled release fertilizer blended with water soluble |
| Agrico | 20-5-10 | 0.2 kg/100m$^2$ | Controlled release fertilizer blended with water soluble |
| Agrico | 12-5-20 | 0.2 kg/100m$^2$ | Controlled release fertilizer blended with water soluble |
| Harmony Program | 1$^{st}$ & 2$^{nd}$ 12-3-3<br>3$^{rd}$ and 4$^{th}$ 13-2-5<br>5$^{th}$ & 6$^{th}$ 6-2-12 | 0.2 kg/100m$^2$ | Organic based from composted poultry manure, blended with methylene urea and ammonium sulphate |
| Lesco Program | 1$^{st}$ & 2$^{nd}$ 12-24-14<br>3$^{rd}$ & 4$^{th}$ 18-2-18<br>5$^{th}$ & 6$^{th}$ 12-0-24 | 0.2 kg/100m$^2$ | Controlled release fertilizers blended with water soluble fertilizer |

Colour and quality, as well as clipping yields, were rated weekly. The National Turfgrass Evaluation Program system of rating was used for colour and quality, where 1 is poor and 9 is superior. Colour was rated by 1 indicated a brown dormant turf and 9 indicated a dark green turf coloration. Density and area cover were combined with colour to determine quality ratings. Density, which is a subjective rating of shoots per unit of area, was rated as 1 is poor density and 9 is superior density. The area cover rating is described as the area covered by the desired turfgrass and is rated by 1 indicates a complete lack of cover and 9 equals complete cover. Bare areas and/or weed encroachment reduced the rating values. Clippings were collected with a reel mower that made one pass down the centre of each plot. Clippings were dried for 48 hours and weighed to give a value for clipping yield.

Results were evaluated based on those fertilizers that consistently performed the best. Generated data was first analyzed using an analysis of variance (ANOVA) test. When statistically significant treatment differences are present, least significant difference (LSD) values are presented at the bottom of each table. Treatment differences that were greater than the LSD value indicate a strong probability that the differences were as a result of the treatment and did not occur by chance. Therefore, within a column, if the same letter follows individual numbers there is no significant difference between treatments.

In addition, the data that shows superior colour, quality and clipping yield was evaluated by determining how many weeks the particular fertilizer was either the best or equal to the best fertilizer. This is indicated by the frequency of superior ranking or superior clipping yield. Total clipping yield was determined by adding clipping yields from all 17 weeks.

**Results**

*Precipitation, Irrigation and Temperature*

Average daily temperatures for all four months of the trial were below normal. Precipitation for June was 30% below average, July was average, August was 22% below average and September was 9% above average. Although hours of sunshine were not recorded, it was felt that the past summer had considerably reduced hours of sunshine. Plots were irrigated to sustain turf vigor and eliminate drought stress.

*Turfgrass Colour Ratings*

Colour ratings were determined in order to evaluate initial green-up following application of the fertilizers. In addition, colour ratings provided an evaluation of how consistently the fertilizer released its nitrogen when compared with the unfertilized control (Table 2). Those fertilizers that consistently showed superior green-up after each fertilizer application was the Lesco Program followed by Agrico 12-5-20. The same fertilizers had the best or were equal to the best for colour ratings over the period of the trial.

Table 2 – Creeping bentgrass fertility trial colour ratings, 2004.

| Turf Colour Ratings | Week 1 June 9 | Week 2 June 16 | Week 3 June 23 |
|---|---|---|---|
| Untreated Control | 6.00 | 6.25 B | 6.25 |
| Urea 46-0-0 | 6.50 | 6.93 A | 6.43 |
| Fusion 14-14-14 | 6.50 | 6.75 AB | 6.25 |
| Agrico 20-5-10 | 6.25 | 7.00 A | 6.25 |
| Agrico 12-5-20 | 6.25 | 6.75 AB | 6.43 |
| Harmony Program 12-3-3 | 6.50 | 7.03 A | 6.25 |
| Lesco Program 12-24-14 | 6.50 | 7.08 A | 6.60 |
| $LSD_{0.05}$ = | N/S | 0.52 | N/S |

*Values followed by the same letter are not significantly different at p=0.05.

| Turf Colour Ratings | Week 4 June 30 | Week 5 July 6 | Week 6 July 14 |
|---|---|---|---|
| Untreated Control | 6.25 B | 6.25 BC | 6.00 |
| Urea 46-0-0 | 6.93 A | 6.00 C | 6.25 |
| Fusion 14-14-14 | 6.50 AB | 6.50 BC | 6.50 |
| Agrico 20-5-10 | 6.25 B | 7.25 A | 6.25 |
| Agrico 12-5-20 | 6.93 A | 6.93 AB | 7.03 |
| Harmony Program 12-3-3 | 6.50 AB | 6.43 BC | 6.53 |
| Lesco Program 12-24-14 | 6.85 A | 6.93 AB | 6.25 |
| $LSD_{0.05}$ = | 0.50 | 0.74 | N/S |

*Values followed by the same letter are not significantly different at p=0.05.

| Turf Colour Ratings | Week 7 July 21 | Week 8 July 28 | Week 9 Aug 5 |
|---|---|---|---|
| Untreated Control | 6.00 C | 6.75 | 5.75 C |
| Urea 46-0-0 | 6.69 BC | 7.00 | 6.75 AB |
| Fusion 14-14-14 | 7.25 AB | 6.75 | 6.50 AB |
| Agrico 20-5-10 | 7.00 AB | 7.25 | 6.75 AB |
| Agrico 12-5-20 | 7.00 AB | 7.25 | 7.08 A |
| Harmony Program 13-2-5 | 6.78 BC | 7.25 | 6.25 BC |
| Lesco Program 18-2-18 | 7.25 AB | 7.75 | 7.00 A |
| $LSD_{0.05}$ = | 0.93 | N/S | 0.68 |

*Values followed by the same letter are not significantly different at p=0.05.

| Turf Colour Ratings | Week 10 Aug 11 | Week 11 Aug 18 | Week 12 Aug 25 |
|---|---|---|---|
| Untreated Control | 6.00 | 5.75 C | 5.50 C |
| Urea 46-0-0 | 6.25 | 6.75 B | 6.25 BC |
| Fusion 14-14-14 | 6.25 | 6.75 B | 6.50 B |
| Agrico 20-5-10 | 6.25 | 7.00 B | 6.50 B |
| Agrico 12-5-20 | 6.00 | 8.00 A | 7.50 A |
| Harmony Program 13-2-5 | 5.75 | 7.00 B | 6.50 B |
| Lesco Program 18-2-18 | 5.78 | 8.00 A | 7.00 AB |
| $LSD_{0.05}$ = | N/S | 0.87 | 0.91 |

*Values followed by the same letter are not significantly different at p=0.05.

| Turf Colour Ratings | Week 13 Sept 1 | Week 14 Sept 7 | Week 15 Sept 14 |
|---|---|---|---|
| Untreated Control | 5.50 D | 5.50 B | 5.25 C |
| Urea 46-0-0 | 6.00 CD | 5.75 B | 5.78 BC |
| Fusion 14-14-14 | 6.25 C | 6.25 AB | 6.25 AB |
| Agrico 20-5-10 | 6.50 ABC | 6.75 A | 6.50 AB |
| Agrico 12-5-20 | 7.08 A | 6.68 A | 6.78 A |
| Harmony Program 6-2-12 | 6.33 BC | 6.33 AB | 6.55 AB |
| Lesco Program 12-0-24 | 7.00 AB | 6.70 A | 6.15 AB |
| $LSD_{0.05}$ = | 0.73 | 0.88 | 0.87 |

*Values followed by the same letter are not significantly different at p=0.05.

| Turf Colour Ratings | Week 16 Sept 21 | Week 17 Sept 28 | Frequency of Superior Score |
|---|---|---|---|
| Untreated Control | 5.50 | 5.00 B | |
| Urea 46-0-0 | 6.00 | 6.00 A | 10 OUT OF 17 RATINGS |
| Fusion 14-14-14 | 6.00 | 6.25 A | 13 OUT OF 17 RATINGS |
| Agrico 20-5-10 | 6.25 | 6.50 A | 14 OUT OF 17 RATINGS |
| Agrico 12-5-20 | 6.50 | 6.50 A | 17 OUT OF 17 RATINGS |
| Harmony Program 6-2-12 | 6.50 | 5.78 A | 11 OUT OF 17 RATINGS |
| Lesco Program 12-0-24 | 6.50 | 6.50 A | 17 OUT OF 17 RATINGS |
| $LSD_{0.05}$ = | N/S | 0.73 | |

*Values followed by the same letter are not significantly different at p=0.05.

*Turfgrass Quality Ratings*

Quality ratings were also determined on a weekly basis. The fertilizers that were consistently the best were the Lesco Program and Agrico 12-5-20 (Table 3). In addition, the Agrico 20-5-10 showed superior quality on 15 out of 17 rating dates, while the Harmony Program was the best or equal to the best on 14 out of 17 rating dates.

Table 3 – Creeping bentgrass fertility trial overall turf quality scores, 2004.

| Overall Turf Quality Scores | Week 1 June 9 | Week 2 June 16 | Week 3 June 23 |
|---|---|---|---|
| Untreated Control | 6.30 | 6.40 | 6.4 |
| Urea 46-0-0 | 6.43 | 6.70 | 6.60 |
| Fusion 14-14-14 | 6.40 | 6.58 | 6.40 |
| Agrico 20-5-10 | 6.3 | 6.60 | 6.43 |
| Agrico 12-5-20 | 6.40 | 6.60 | 6.60 |
| Harmony Program | 6.48 | 6.70 | 6.40 |
| Lesco Program | 6.50 | 6.75 | 6.58 |
| $LSD_{0.05}$ = | N/S | N/S | N/S |

*Values followed by the same letter are not significantly different at p=0.05.

| Overall Turf Quality Scores | Week 4 June 30 | Week 5 July 6 | Week 6 July 14 |
|---|---|---|---|
| Untreated Control | 6.40 C | 6.40 B | 6.51 C |
| Urea 46-0-0 | 6.79 AB | 6.71 AB | 6.79 AB |
| Fusion 14-14-14 | 6.58 BC | 6.68 AB | 6.75 BC |
| Agrico 20-5-10 | 6.42 C | 6.93 A | 6.78 AB |
| Agrico 12-5-20 | 6.85 A | 7.00 A | 7.00 A |
| Harmony Program | 6.69 AB | 6.77 A | 6.87 AB |
| Lesco Program | 6.70 AB | 6.77 AB | 6.78 AB |
| $LSD_{0.05}$ = | 0.27 | 0.37 | 0.25 |

*Values followed by the same letter are not significantly different at p=0.05.

| Overall Turf Quality Scores | Week 7 July 21 | Week 8 July 28 | Week 9 Aug 5 |
|---|---|---|---|
| Untreated Control | 6.50 C | 6.33 B | 6.53 B |
| Urea 46-0-0 | 6.74 BC | 7.00 A | 6.93 A |
| Fusion 14-14-14 | 7.00 AB | 7.18 A | 6.85 A |
| Agrico 20-5-10 | 6.85 ABC | 7.00 A | 6.93 A |
| Agrico 12-5-20 | 7.23 A | 7.23 A | 7.00 A |
| Harmony Program | 6.79 BC | 6.98 A | 6.78 A |
| Lesco Program | 7.00 AB | 7.23 A | 7.00 A |
| $LSD_{0.05}$ = | 0.38 | 0.39 | 0.25 |

*Values followed by the same letter are not significantly different at p=0.05.

| Overall Turf Quality Scores | Week 10 Aug 11 | Week 11 Aug 18 | Week 12 Aug 25 |
|---|---|---|---|
| Untreated Control | 7.00 | 6.43 C | 6.03 D |
| Urea 46-0-0 | 7.08 | 6.91 BC | 6.40 CD |
| Fusion 14-14-14 | 7.08 | 7.23 AB | 6.58 BC |
| Agrico 20-5-10 | 7.08 | 7.25 AB | 6.62 BC |
| Agrico 12-5-20 | 7.00 | 7.70 A | 7.08 A |
| Harmony Program | 6.75 | 7.30 AB | 6.51 BC |
| Lesco Program | 6.93 | 7.70 A | 6.93 AB |
| $LSD_{0.05}$ = | N/S | 0.58 | 0.42 |

*Values followed by the same letter are not significantly different at p=0.05.

| Overall Turf Quality Scores | Week 13 Sept 1 | Week 14 Sept 7 | Week 15 Sept 14 |
|---|---|---|---|
| Untreated Control | 5.93 D | 6.33 BC | 5.78 |
| Urea 46-0-0 | 6.33 C | 6.25 C | 6.45 |
| Fusion 14-14-14 | 6.48 BC | 6.78 A | 6.43 |
| Agrico 20-5-10 | 6.75 AB | 6.83 A | 6.50 |
| Agrico 12-5-20 | 6.78 AB | 6.93 A | 6.93 |
| Harmony Program | 6.40 C | 6.68 AB | 6.50 |
| Lesco Program | 6.85 A | 6.93 A | 6.60 |
| $LSD_{0.05}$ = | 0.32 | 0.39 | N/S |

*Values followed by the same letter are not significantly different at p=0.05.

| Overall Turf Quality Scores | Week 16 Sept 21 | Week 17 Sept 28 | Frequency of Superior Score |
|---|---|---|---|
| Untreated Control | 6.08 | 5.93 B | |
| Urea 46-0-0 | 6.60 | 6.50 A | 12 OUT OF 17 RATINGS |
| Fusion 14-14-14 | 6.40 | 6.58 A | 13 OUT OF 17 RATINGS |
| Agrico 20-5-10 | 6.58 | 6.75 A | 15 OUT OF 17 RATINGS |
| Agrico 12-5-20 | 6.75 | 6.75 A | 17 OUT OF 17 RATINGS |
| Harmony Program | 6.68 | 6.60 A | 14 OUT OF 17 RATINGS |
| Lesco Program | 6.75 | 6.75 A | 17 OUT OF 17 RATINGS |
| $LSD_{0.05}$ = | N/S | 0.43 | |

*Values followed by the same letter are not significantly different at p=0.05.

*Turfgrass Clipping Yields*

The fertilizer that consistently produced the highest clipping yield was Agrico 12-5-20 (Table 4). It produced the highest amounts on 17 of 17 rating dates. This was followed in descending order by the Lesco Program (13 rating dates), Urea (10rating dates), Agrico 20-5-10 (9 rating dates). Higher total clipping yields would indicate a more efficient used of the nitrogen applied.

Table 4 – Creeping bentgrass fertility trial clipping yields, 2004.

| Clippings Dry wt. (g/m2) | Week 1 June 9 | Week 2 June 16 | Week 3 June 23 |
|---|---|---|---|
| Untreated Control | 7.93 | 16.03 C | 15.30 D |
| Urea 46-0-0 | 9.73 | 25.55 A | 24.25 A |
| Fusion 14-14-14 | 8.83 | 20.45 BC | 17.38 CD |
| Agrico 20-5-10 | 10.63 | 19.20 BC | 20.33 ABC |
| Agrico 12-5-20 | 9.75 | 23.43 A | 22.08 AB |
| Harmony Program | 7.05 | 17.88 C | 17.85 BCD |
| Lesco Program | 9.28 | 20.75 BC | 21.30 ABC |
| $LSD_{0.05}$ = | N/S | 4.59 | 4.99 |

*Values followed by the same letter are not significantly different at p=0.05.

| Clippings Dry wt. (g/m2) | Week 4 June 30 | Week 5 July 6 | Week 6 July 14 |
|---|---|---|---|
| Untreated Control | 9.98 | 7.18 C | 17.33 C |
| Urea 46-0-0 | 12.55 | 12.48 AB | 32.30 A |
| Fusion 14-14-14 | 10.03 | 1.48 ABC | 22.20 BC |
| Agrico 20-5-10 | 13.15 | 10.58 BC | 25.03 ABC |
| Agrico 12-5-20 | 13.73 | 15.93 A | 32.48 A |
| Harmony Program | 10.03 | 9.05 BC | 20.98 BC |
| Lesco Program | 12.85 | 12.98 AB | 27.85 AB |
| $LSD_{0.05}$ = | N/S | 4.59 | 8.34 |

*Values followed by the same letter are not significantly different at p=0.05.

| Clippings Dry wt. (g/m2) | Week 7 July 21 | Week 8 July 28 | Week 9 Aug 5 |
|---|---|---|---|
| Untreated Control | 11.68 C | 11.25 D | 10.80 |
| Urea 46-0-0 | 18.55 AB | 21.55 AB | 13.60 |
| Fusion 14-14-14 | 15.85 BC | 17.68 BC | 10.23 |
| Agrico 20-5-10 | 17.05 AB | 18.10 BC | 13.35 |
| Agrico 12-5-20 | 21.45 A | 25.43 A | 13.35 |
| Harmony Program | 16.40 BC | 16.98 C | 12.38 |
| Lesco Program | 18.13 AB | 21.58 AB | 10.20 |
| $LSD_{0.05}$ = | 4.93 | 4.36 | N/S |

*Values followed by the same letter are not significantly different at p=0.05.

| Clippings Dry wt. (g/m2) | Week 10 Aug 11 | Week 11 Aug 18 | Week 12 Aug 25 |
|---|---|---|---|
| Untreated Control | 7.33 D | 11.90 D | 2.63 E |
| Urea 46-0-0 | 10.10 BC | 23.33 ABC | 6.13 BC |
| Fusion 14-14-14 | 8.38 CD | 21.30 BC | 4.55 CDE |
| Agrico 20-5-10 | 10.98 AB | 17.88 C | 5.40 BCD |
| Agrico 12-5-20 | 10.70 ABC | 28.50 A | 9.73 A |
| Harmony Program | 8.60 BCD | 19.08 C | 3.60 DE |
| Lesco Program | 12.75 A | 26.98 AB | 7.23 B |
| $LSD_{0.05}$ = | 2.42 | 5.82 | 2.47 |

*Values followed by the same letter are not significantly different at p=0.05.

| Clippings Dry wt. (g/m2) | Week 13 Sept 1 | Week 14 Sept 7 | Week 15 Sept 14 |
|---|---|---|---|
| Untreated Control | 5.15 D | 3.85 B | 5.23 C |
| Urea 46-0-0 | 8.75 BC | 3.60 B | 8.48 BC |
| Fusion 14-14-14 | 8.53 BC | 5.33 AB | 10.00 B |
| Agrico 20-5-10 | 10.05 AB | 6.60 A | 10.98 B |
| Agrico 12-5-20 | 12.60 A | 6.54 A | 15.63 A |
| Harmony Program | 7.08 CD | 7.00 A | 7.38 BC |
| Lesco Program | 9.70 ABC | 7.48 A | 10.65 B |
| $LSD_{0.05}$ = | 2.92 | 2.38 | 3.72 |

*Values followed by the same letter are not significantly different at p=0.05.

| Clippings Dry wt. (g/m2) | Week 16 Sept 21 | Week 17 Sept 28 | Frequency of Superior Score |
|---|---|---|---|
| Untreated Control | 1.38 C | 1.45 D | |
| Urea 46-0-0 | 2.07 B | 2.38 CD | 10 OUT OF 17 RATINGS |
| Fusion 14-14-14 | 3.20 B | 2.83 BC | 4 OUT OF 17 RATINGS |
| Agrico 20-5-10 | 3.83 B | 2.93 BC | 9 OUT OF 17 RATINGS |
| Agrico 12-5-20 | 5.19 A | 4.90 A | 17 OUT OF 17 RATINGS |
| Harmony Program | 2.09 B | 2.25 CD | 4 OUT OF 17 RATINGS |
| Lesco Program | 3.48 B | 3.68 AB | 13 OUT OF 17 RATINGS |
| $LSD_{0.05}$ = | 1.19 | 1.29 | |

*Values followed by the same letter are not significantly different at p=0.05.