

# The Evaluation of Various Fertilizers for Use on Turf

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## Objective of the trial

This objective of this trial was to assess various fertilizers from Agrium Advanced Technologies for various growth characteristics, specifically colour, quality and clipping yield.

## Methodology

Plots were laid out on a Kentucky bluegrass/fescue area at the Prairie Turfgrass Research Centre located at Olds College, Olds, Alberta, Canada. Plot sizes were 1 X 2 metres and laid out in a Randomized Complete Block Design. The performance of the various fertilizers was compared against urea and an untreated control (UTC).

A single application of fertilizer was applied on July 6 at the rate of application listed in Table 1. Application of the granular fertilizers was made using a Scott's drop spreader, which was calibrated to apply the appropriate amount of each fertilizer. Colour and turf quality were determined one week after application and then every two weeks from then on. Clipping yields were collected every second week.

Table 1 – Fertilizer products and rates of application applied July 8, 2011.

Fertilizer	Rate of application	
	lbs N/1000ft	kg N/100m <sup>2</sup>
1. Untreated control		
2. Urea 46-0-0	1.00	0.49
3. Polyon 44-0-0 SGN 250	1.25	0.61
4. Polyon 44-0-0 SGN 190	1.25	0.61
5. Polyon 43-0-0 SGN 250	1.75	0.85
6. Polyon 43-0-0 SGN 190	1.75	0.85
7. Polyon 42-0-0 SGN 250	2.00	0.98
8. XCU 43-0-0 SGN 260	1.25	0.61
9. XCU 43-0-0 SGN 190	1.25	0.61
10. ProTurf Poly-S 40-0-0 SGN 190	1.25	0.61

For colour ratings, 1 indicated a brown dormant turf and 9 indicated a dark green turf. The individual treatments were also assessed for superior colour, i.e. a treatment was considered superior when it had an 'a' ranking. Density was combined with colour to determine quality ratings. Density, which is a subjective rating of shoots per unit of area, was based on 1 was poor density and 9 was superior density.

Clippings were collected with a reel mower that made one pass down the centre of each plot. Clippings were then dried for 48 hours at 70°C in a drying oven and weighed. Clipping yield values were recorded as grams of clippings per square meter per week.

The chlorophyll content in the treated turf was measured using an ASD Field Spec Hand Held photospectrometer (model HH325). The mean of five separate readings for each

plot was used to calculate normalized difference vegetative index values (NDVI) for each treatment for weeks: 2, 6 and 10 of the trial.

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 numbers there is no significant difference between treatments.

## Results

As far as initial green-up (week 1) was concerned there was no colour change one week after application of the products (table 2). As far as consistently superior colour was concerned Polyon 43-0-0 SGN 190, XCU 43-0-0 SGN 260 and the XCU 43-0-0 SGN 190 has consistently the best or equal to the best colour (each received an 'a' ranking on each of the seven rating dates). Those that had superior colour at the end of the trial period were Polyon 43-0-0 SGN 190, Polyon 42-0-0 SGN 250, and both sizes of the XCU 40-0-0.

Table 2 – Turf colour ratings, 2011.

Treatment	lbs N/1000ft <sup>2</sup>	Initial	1 – 9 scale		
			Week 2	Week 4	Week 6
Untreated Control	----	7.0a	6.7b	6.2d	6.7c
Urea 46-0-0	1.00	7.0a	7.7a	7.2bc	7.0bc
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	7.0a	7.7a	8.0a	7.2bc
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	7.0a	7.5a	7.7ab	7.2bc
Polyon 43-0-0 SGN 250	1.75	7.0a	7.5a	8.0a	7.5ab
Polyon 43-0-0 SGN 190	1.75	7.0a	7.7a	8.0a	8.0a
Polyon 42-0-0 SGN 250	2.00	7.0a	6.7b	7.0c	7.7ab
XCU 43-0-0 SGN 260	1.25	7.0a	7.5a	8.0a	7.7ab
XCU 43-0-0 SGN 190	1.25	7.0a	7.7a	8.0a	7.7ab
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	7.0a	8.0a	8.0a	8.0a
LSD <sub>0.05</sub> =		n/s	0.6	0.5	0.7

Treatment	lbs N/1000ft <sup>2</sup>	1 – 9 scale		
		Week 8	Week 10	Week 12
Untreated Control	----	6.7c	6.0a	5.7d
Urea 46-0-0	1.00	7.0bc	6.2a	6.2cd
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	7.1bc	6.5a	6.7abc
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	7.1bc	6.2a	6.2cd
Polyon 43-0-0 SGN 250	1.75	7.5ab	6.2a	6.2cd
Polyon 43-0-0 SGN 190	1.75	8.0a	6.2a	7.2a
Polyon 42-0-0 SGN 250	2.00	7.7ab	6.7a	7.2a
XCU 43-0-0 SGN 260	1.25	7.6ab	6.5a	7.0ab
XCU 43-0-0 SGN 190	1.25	7.7ab	6.2a	6.7abc
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	8.0a	6.0a	6.5bc
LSD <sub>0.05</sub> =		0.7	n/s	0.5

\* Values that have the same letter as a suffix are not significantly different from each other.

All fertilizers except for Polyon 42-0-0 SGN 250 and the untreated control showed initial improvements in turf quality when measured during the first two rating periods (Table 3). Those fertilizers that showed the best overall quality (consistently rated an 'a') were Polyon 43-0-0 SGN 190, XCU 43-0-0 SGN 260 and the XCU 43-0-0 SGN 190. Those that had superior quality at the end of the trial period were Polyon 43-0-0 SGN 190, Polyon 42-0-0 SGN 250, and both sizes of the XCU 40-0-0.

Table 3 - Overall turf quality ratings, 2011.

Treatment	lbs N/1000ft <sup>2</sup>	Initial	Week 2	Week 4	Week 6
		— mean of 3 quality factors —			
Untreated Control	----	7.0a	6.9bc	6.7c	6.9c
Urea 46-0-0	1.00	7.0a	7.2a	7.0b	7.0bc
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	7.0a	7.2a	7.3a	7.0bc
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	7.0a	7.1ab	7.2a	7.0bc
Polyon 43-0-0 SGN 250	1.75	7.0a	7.1ab	7.3a	7.1abc
Polyon 43-0-0 SGN 190	1.75	7.0a	7.3a	7.3a	7.3a
Polyon 42-0-0 SGN 250	2.00	7.0a	6.8c	7.0b	7.2ab
XCU 43-0-0 SGN 260	1.25	7.0a	7.1ab	7.3a	7.2ab
XCU 43-0-0 SGN 190	1.25	7.0a	7.2a	7.3a	7.2ab
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	7.0a	7.3a	7.3a	7.3a
	LSD <sub>0.05</sub> =	n/s	0.2	0.1	0.2

Treatment	lbs N/1000ft <sup>2</sup>	Week 8	Week 10	Week 12
		— mean of 3 quality factors —		
Untreated Control	----	6.9c	6.9ab	6.5d
Urea 46-0-0	1.00	7.0bc	6.9ab	6.7cd
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	7.1abc	7.0ab	6.9d
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	7.1abc	6.8b	6.7cd
Polyon 43-0-0 SGN 250	1.75	7.2ab	7.0ab	6.7cd
Polyon 43-0-0 SGN 190	1.75	7.3a	7.0ab	7.1a
Polyon 42-0-0 SGN 250	2.00	7.2ab	7.1a	7.1a
XCU 43-0-0 SGN 260	1.25	7.2ab	7.0ab	7.0ab
XCU 43-0-0 SGN 190	1.25	7.2ab	6.9ab	6.9abc
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	7.3a	7.0ab	6.8bc
	LSD <sub>0.05</sub> =	0.2	0.2	0.2

\* Values that have the same letter as a suffix are not significantly different from each other.

Those fertilizers that produced an early response in clipping yields (week two) were urea 46-0-0, Polyon 44-0-0 SGN 250, Polyon 43-0-0 SGN 190, XCU 43-0-0 SGN 260 and Poly S 40-0-0 SGN 190. The fertilizer that produced consistently the highest clipping yields was Polyon 43-0-0 SGN 190 as it ranked highest or equal to the highest on each of the six rating dates. As far as total clippings for the year was concerned it also produced the highest yields. The smaller particle size of the Polyon 43-0-0 appeared to release nitrogen more efficiently to the plant than did the large particle size. However, that did not appear to be the case when considering the Polyon 44-0-0. There did not appear to be a difference between the two sizes of the XCU product.

Table 4 - Clipping yields collected grams per square meter per week, 2011.

Treatment	lbs N/1000ft <sup>2</sup>	Week 2	Week 4	Week 6
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		g/m <sup>2</sup> /wk		
Untreated Control	----	6.2e	4.4e	3.4a
Urea 46-0-0	1.00	14.3a	11.2cd	4.8a
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	11.8abcd	16.2ab	6.2a
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	8.7cde	9.9d	4.4a
Polygon 43-0-0 SGN 250	1.75	8.4de	12.4bcd	5.1a
Polygon 43-0-0 SGN 190	1.75	13.5ab	18.5a	8.3a
Polygon 42-0-0 SGN 250	2.00	5.3e	4.9e	5.3a
XCU 43-0-0 SGN 260	1.25	13.4ab	14.7abc	4.8a
XCU 43-0-0 SGN 190	1.25	9.5bcde	15.1abc	5.9a
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	13.2abc	14.4abcd	5.6a
LSD <sub>0.05</sub> =		4.6	4.7	n/s

Treatment	lbs N/1000ft <sup>2</sup>	g/m <sup>2</sup> /wk			Total Clippings
		Week 8	Week 10	Week 12	
Untreated Control	----	3.0c	2.1c	0.6a	19.9d
Urea 46-0-0	1.00	6.8bc	4.6bc	0.6a	42.6bc
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	10.0b	3.9bc	1.1a	49.4ab
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	5.3bc	2.9c	1.0a	32.4bcd
Polygon 43-0-0 SGN 250	1.75	7.1bc	4.3bc	0.4a	38.0bc
Polygon 43-0-0 SGN 190	1.75	15.7a	8.5a	1.5a	66.1a
Polygon 42-0-0 SGN 250	2.00	7.9bc	6.0ab	0.9a	30.5cd
XCU 43-0-0 SGN 260	1.25	7.9bc	2.4c	1.0a	44.4bc
XCU 43-0-0 SGN 190	1.25	9.5c	4.0bc	0.7a	44.9bc
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	8.1bc	3.8bc	0.5a	45.7bc
LSD <sub>0.05</sub> =		5.3	2.7	n/s	17.0

\* Values that have the same letter as a suffix are not significantly different from each other

### ***Estimation of turf colour and plant cover using photospectrometry***

Chlorophyll content is mainly influenced by nitrogen availability (Moorby and Besford, 1983). Light reflectance by leaves in the visible region of the spectrum depends primarily on the concentration of chlorophylls and carotenoids. A deficiency in nutrients such as nitrogen decreases pigment formation and leaf color, which subsequently increases reflectivity, or irradiance, due to reduced radiation absorption.

The absorption of light in the red and near infrared bands is strongly influenced by chlorophyll content and plant cover. As chlorophyll content increases so does the absorption of light within the red band with peak absorption occurring at 670 nm. On the other hand, reflection of near infrared light that is measured at 780nm increases when chlorophyll contents are high. Green light when measured at 550nm is generally reflected and irradiance increases as chlorophyll content increases.

The normalized difference vegetative index (NDVI) was proposed by Rouse et al. (1974) and is commonly used to separate green vegetation from the soil background. In order to estimate the amount of chlorophyll present in the leaf the amount of absorption at the red band is compared with the amount of absorption in the infrared band. NDVI has a range of -1 to +1, with bare soil surfaces having an NDVI of approximately 0 and heavy vegetative cover having an NDVI of near 1 (Thiam, 1998).

Given these relationships, NDVI from vegetated surfaces is heavily influenced by chlorophyll content of materials in the vegetation. The following equations determine the NDVI in terms of irradiance from a target with NDVI<sub>550</sub> being a measurement of turf color and NDVI<sub>670</sub> being an indication of turf cover and density.

$$1. \text{NDVI}_{550} = \frac{(\text{Near infrared irradiance} - \text{Green irradiance})}{(\text{Near infrared irradiance} + \text{Green irradiance})}$$

$$2. \text{NDVI}_{670} = \frac{(\text{Near infrared irradiance} - \text{Red irradiance})}{(\text{Near infrared irradiance} + \text{Red irradiance})}$$

Table 5 – Reflectance values collected from Green Band 550nm.

Treatment	lbs N/1000ft <sup>2</sup>	at 550nm ±10nm		
		Week 2	Week 6	Week 10
Untreated Control	----	0.087a	0.103a	0.092bc
Urea 46-0-0	1.00	0.080a	0.103a	0.147a
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	0.066a	0.103a	0.105abc
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	0.084a	0.087a	0.106abc
Polyon 43-0-0 SGN 250	1.75	0.072a	0.093a	0.072c
Polyon 43-0-0 SGN 190	1.75	0.090a	0.094a	0.129ab
Polyon 42-0-0 SGN 250	2.00	0.074a	0.208a	0.072c
XCU 43-0-0 SGN 260	1.25	0.092a	0.088a	0.105abc
XCU 43-0-0 SGN 190	1.25	0.080a	0.133a	0.101bc
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	0.073a	0.097a	0.113abc
LSD <sub>0.05</sub> =		n/s	n/s	0.045

\* Values that have the same letter as a suffix are not significantly different from each other.

Table 6 - Reflectance values collected from Red Band, 670nm.

Treatment	lbs N/1000ft <sup>2</sup>	at 670nm ±10nm		
		Week 2	Week 6	Week 10
Untreated Control	----	0.053a	0.060a	0.070a
Urea 46-0-0	1.00	0.048a	0.064a	0.116a
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	0.027a	0.054a	0.048a
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	0.038a	0.040a	0.051a
Polyon 43-0-0 SGN 250	1.75	0.041a	0.045a	0.037a
Polyon 43-0-0 SGN 190	1.75	0.056a	0.036a	0.049a
Polyon 42-0-0 SGN 250	2.00	0.030a	0.046a	0.038a
XCU 43-0-0 SGN 260	1.25	0.067a	0.053a	0.049a
XCU 43-0-0 SGN 190	1.25	0.043a	0.068a	0.060a
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	0.023a	0.054a	0.064a
LSD <sub>0.05</sub> =		n/s	n/s	n/s

\* Values that have the same letter as a suffix are not significantly different from each other.

Table 7 - Reflectance values collected from Near Infrared Band, 780nm.

Treatment	lbs N/1000ft <sup>2</sup>	at 780nm ±10nm		
		Week 2	Week 6	Week 10

Untreated Control	----	0.472a	0.618a	0.498bc
Urea 46-0-0	1.00	0.474a	0.567a	0.664a
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	0.514a	0.646a	0.554a
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	0.478a	0.558a	0.507bc
Polygon 43-0-0 SGN 250	1.75	0.398a	0.599a	0.510bc
Polygon 43-0-0 SGN 190	1.75	0.478a	0.658a	0.564b
Polygon 42-0-0 SGN 250	2.00	0.502a	0.459a	0.452c
XCU 43-0-0 SGN 260	1.25	0.481a	0.561a	0.561b
XCU 43-0-0 SGN 190	1.25	0.501a	0.662a	0.506bc
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	0.504a	0.640a	0.545b
LSD <sub>0.05</sub> =		n/s	n/s	0.091

\* Values that have the same letter as a suffix are not significantly different from each other.

Table 8 - Ratio of Reflectance NIR/Green.

Treatment	lbs N/1000ft <sup>2</sup>	Week 2	Week 6	Week 10
		(R <sub>780</sub> / R <sub>550</sub> )		
Untreated Control	----	5.5a	6.2a	5.4a
Urea 46-0-0	1.00	6.0a	5.5a	4.7a
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	7.9a	6.4a	5.5a
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	5.7a	6.4a	5.3a
Polygon 43-0-0 SGN 250	1.75	5.7a	6.6a	7.2a
Polygon 43-0-0 SGN 190	1.75	5.3a	6.9a	4.5a
Polygon 42-0-0 SGN 250	2.00	7.2a	4.8a	6.4a
XCU 43-0-0 SGN 260	1.25	7.5a	6.3a	5.5a
XCU 43-0-0 SGN 190	1.25	6.3a	5.2a	4.9a
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	7.4a	6.6a	4.8a
LSD <sub>0.05</sub> =		n/s	n/s	n/s

\* Values that have the same letter as a suffix are not significantly different from each other.

Table 9 – Normalized Differential Vegetation Index, NDVI<sub>550</sub>.

Treatment	lbs N/1000ft <sup>2</sup>	Week 2	Week 6	Week 10
		(R <sub>780</sub> - R <sub>550</sub> ) / (R <sub>780</sub> + R <sub>550</sub> )		
Untreated Control	----	0.68a	0.72a	0.69a
Urea 46-0-0	1.00	0.72a	0.69a	0.64a
ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	0.77a	0.72a	0.67a
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	0.69a	0.73a	0.65a
Polygon 43-0-0 SGN 250	1.75	0.69a	0.73a	0.75a
Polygon 43-0-0 SGN 190	1.75	0.67a	0.74a	0.62a
Polygon 42-0-0 SGN 250	2.00	0.74a	0.48a	0.72a
XCU 43-0-0 SGN 260	1.25	0.68a	0.71a	0.68a
XCU 43-0-0 SGN 190	1.25	0.72a	0.66a	0.66a
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	0.75a	0.73a	0.65a
LSD <sub>0.05</sub> =		n/s	n/s	n/s

\* Values that have the same letter as a suffix are not significantly different from each other.

Table 10 - Normalized Differential Vegetation Index, NDVI<sub>670</sub>.

Treatment	lbs N/1000ft <sup>2</sup>	Week 2	Week 6	Week 10
		(R <sub>780</sub> - R <sub>670</sub> ) / (R <sub>780</sub> + R <sub>670</sub> )		
Untreated Control	----	0.79cd	0.82a	0.77a
Urea 46-0-0	1.00	0.81bcd	0.79a	0.72a

ProTurf turf N (Polyon) 44-0-0 SGN 250	1.25	0.90ab	0.84a	0.84a
ProTurf turf N (Polyon) 44-0-0 SGN 190	1.25	0.85abcd	0.86a	0.81a
Polygon 43-0-0 SGN 250	1.75	0.81bcd	0.86a	0.86a
Polygon 43-0-0 SGN 190	1.75	0.77d	0.89a	0.83a
Polygon 42-0-0 SGN 250	2.00	0.88abc	0.78a	0.84a
XCU 43-0-0 SGN 260	1.25	0.76d	0.80a	0.84a
XCU 43-0-0 SGN 190	1.25	0.84abcd	0.81a	0.77a
ProTurf turf N (Poly-S) 40-0-0 SGN 190	1.25	0.91a	0.84a	0.79a
	LSD <sub>0.05</sub> =	0.09	n/s	n/s

\* Values that have the same letter as a suffix are not significantly different from each other.