

Evaluation of a Plant Growth Promoting Rhizobacteria for its Effect on Turfgrass

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Summary

The product PGPR (Plant Growth Promoting Rhizobacteria) was compared with a synthetic and an organic fertilizer for its effect on turfgrass quality, growth response, and nutrient uptake. The trial was conducted on a USGA specification sand based putting green located at Olds College, Olds, Alberta.

The PGPR product produced better turfgrass quality than the untreated control on seven of the eight rating dates, although it was only statistically different on the final rating date (table 1). Generally, the PGPR was equal to the fertilized treatments in spite of the fact that there was no nutrient value to the product.

The plots treated with PGPR had a better growth response, as measured by clipping yields, than the untreated control on each rating date and was significantly better on three rating dates (table 2). The PGPR produced clipping yields that were statistically similar to three of the four fertility treatments, Milorganite at 0.6 and 1.0 kg N/100m² and the Contec at 0.6 kg n/100m².

When compared with the untreated control plant nutrient values were significantly higher for nitrogen, phosphorus, potassium, copper and magnesium when the PGPR product was applied (table 3 and 4). Calcium was considerably higher for the PGPR treatment, but it was not statistically different. The plant nutrient value for potassium in the PGPR treatment was equal to the high rate of Contec which had 0.5 kg K/100m² added to the plots. These results would indicate that the PGPR promoted nutrient availability and uptake.

Methodology

The trial was established at the Prairie Turfgrass Research Centre located at Olds College, Olds, Alberta. Test plots that measured 1x 2 metres were laid out on a creeping bentgrass, cv. Penncross sand green. Each treatment was replicated four times within a randomized complete block design (RCBD).

Following the experimental design, the PGPR (Plant Growth Promoting Rhizobacteria) product was applied twice during the course of the eight week study. The first application of the PRPG product occurred on June 20th, while the second application occurred four weeks later on July 18th.

For each application, the PGPR product was evenly applied to the turf plots using a compressed CO₂ hand sprayer. The PGPR product at a rate of 162mls/litre was mixed with non-chlorinated reverse osmosis water to produce the desired spray dilution. A Teejet VS8004E even flat fan nozzle was calibrated to deliver a spray volume of 8.14L/100m² uniformly across a one metre wide spray swath. Following each application, the experiment was irrigated to move the treatments into the root zone of the turf. There was no supplemental fertilizer applied to these plots.

The fertilizer treatments were applied only at the beginning of the experiment on June 20th. All of the fertilizers were applied using a Scott's professional drop spreader. Prior to applying the fertilizer treatments, the fertilizer discharge rate for the drop spreader was calibrated for each type

and rate of fertilizer. Milorganite is an industry standard organic fertilizer made from processed sewage sludge, while Contec is a synthetic methylene urea type fertilizer.

Turfgrass quality was collected on a weekly basis. The plots were evaluated for three quality factors, colour, density and area cover. These ratings were based on the National Turfgrass Evaluation Program (NTEP) protocols where numeric values are assigned to individual plots based on 9 is best and 1 is poorest, and 6 is considered acceptable. Turf colour was evaluated by 1 was a brown dormant turf and 9 was a very uniform dark green turf. Density, a measure of the number of shoots per unit area, was rated based on 1 was a thin, weak turf stand and 9 was a very dense tight-knit stand. The third factor that was rated was area cover where values range from a 1 for a complete absence of turf to a 9 for complete cover with the desired turf. To compare the effect of the treatments on the overall turf quality, the average of the combined colour, density and area cover scores for each plot was calculated and statistically analyzed.

Clipping yield was determined on a weekly basis with a reel mower that made one pass down the centre of each plot. Clippings were dried for 48 hours at 70°C and weighed to give a value for clipping yield. The dried clippings from the last sampling date along with initial baseline samples were packaged and shipped to ALS Laboratory Group for nutrient tissue analysis. Samples were analyzed for nitrogen, phosphorus, potassium, magnesium, calcium, iron, sulphur, manganese, boron, copper, zinc and sodium. Nitrogen was analyzed with a CNS combustion analyzer and other minerals were analyzed by ICP emission spectroscopy.

Treatments were:

1. Untreated control
2. Milorganite 6-2-0 organic fertilizer 0.5 kg N/100m²
3. Milorganite 6-2-0 organic fertilizer 1.0 kg N/100m²
4. Contec 22-3-11 Synthetic fertilizer 0.5 kg N/100m²
5. Contec 22-3-11 synthetic fertilizer 1.0 kg N/100m²
6. PGPR 1.3 litres/100m²

Results

Weather Conditions

Temperatures were 0.8°C above normal for June, 2.1°C above normal for July and normal for the month of August. Precipitation was 18% below average for June, 74% below average for July and 14% below average for the month of August.

Turf Quality

The PGPR product produced better turfgrass quality than the untreated control on seven of the eight rating dates, although it was only statistically different on the final rating date (table 1). Generally, the PGPR was equal to the fertilized treatments, with the exception of the high rate of synthetic fertilizer which produced higher turfgrass quality on two rating dates. There was no fertilizer included with the PGPR treatment.

Table 1 - Overall turf quality, 2006.

Treatment	June 27th	July 4th	July 11th	July 18th	July 25th	Aug 1st	Aug 8th	Aug 15th
	1-9 scale							
Untreated control	5.8a	5.8a	5.7c	5.6c	5.9a	5.7a	5.8a	5.5b
Organic fertilizer 0.6kg N/100m ² Milorganite	6.0a	6.0a	5.8bc	6.1b	6.2a	6.0a	5.9a	5.9a
Organic fertilizer 1.0kg N/100m ² Milorganite	5.9a	5.9a	5.9bc	6.1b	6.3a	6.1a	6.0a	6.0a
Synthetic fertilizer 0.6kg N/100m ² Contec	5.9a	5.9a	6.0b	6.1b	6.1a	6.1a	6.0a	5.9a
Synthetic fertilizer 1.0kg N/100m ² Contec	5.8a	6.0a	6.4a	6.6a	6.4a	6.1a	6.1a	6.0a
PGPR 1.3 l/100m ²	5.7a	5.9a	5.9bc	5.9bc	6.2a	5.9a	5.8a	5.9a
LSD _{0.05} =	n/s	n/s	0.2	0.3	n/s	n/s	n/s	0.3

* Values followed by the same letter are not significantly different from each other

Clipping Yield

The plots treated with PGPR had a better growth response, as measured by clipping yields, than the untreated control on each rating date and was significantly better on three rating dates (table 2). The PGPR produced clipping yields that were statistically similar to three of the four fertility treatments, Milorganite at 0.6 and 1.0 kg N/100m² and the Contec at 0.6 kg n/100m². This was in spite of the fact that no additional fertilizer was added to any of these plots. Generally, the high rate of the synthetic fertilizer produced significantly higher clipping yields.

Table 2 - Clipping yield dry weight, 2006.

Treatment	June 27th	July 4th	July 11th	July 18th	July 25th	Aug 1st	Aug 8th	Aug 15th
	g/m ²							
Untreated control	11.3a	7.5c	5.9c	6.6e	8.6c	3.9c	4.6c	0.9b
Organic fertilizer 0.6kg N/100m ² Milorganite	10.2a	8.0bc	8.8b	11.4d	14.9b	6.3bc	6.6ab	1.3b
Organic fertilizer 1.0kg N/100m ² Milorganite	7.25a	8.3bc	10.7b	14.4bc	14.6b	7.9b	6.3b	1.7b
Synthetic fertilizer 0.6kg N/100m ² Contec	10.4a	10.6b	10.9b	15.3b	13.8bc	7.0b	6.5ab	1.4b
Synthetic fertilizer 1.0kg N/100m ² Contec	12.1a	13.5a	16.8a	26.5a	24.3a	12.1a	7.5a	3.2a
PGPR 1.3 l/100m ²	11.6a	9.3bc	9.9b	13.1cd	11.6bc	5.6bc	6.2b	1.4b
LSD _{0.10} =	n/s	2.6	2.5	2.1	5.2	2.4	1.1	1.0

* Values followed by the same letter are not significantly different from each other

Plant Nutrient Values

When compared with the untreated control plant nutrient values were significantly higher for nitrogen, phosphorus, potassium, copper and magnesium when the PGPR product was applied (table 3 and 4). Calcium was considerably higher for the PGPR treatment, but it was not statistically different. The plant nutrient value for potassium was equal to the high rate of Contec, in spite of the fact that 0.5 kg K/100m² was added. These results would indicate that the PGPR promoted nutrient availability and uptake.

Table 3 - Plant nutrient values August 15, 2006.

Treatment	Nitrogen	Phosphorus	Potassium	Copper	Iron	Calcium	
	%	mg/kg					
Untreated control	3.9c	5000c	21775b	13c	175a	5000a	
Organic fertilizer 0.6kg N/100m ² Milorganite	4.1b	5200abc	21825b	15a	158a	4825a	
Organic fertilizer 1.0kg N/100m ² Milorganite	4.1b	5325ab	21650b	14b	248a	4975a	
Synthetic fertilizer 0.6kg N/100m ² Contec	4.1b	5100bc	21525b	14b	153a	4850a	
Synthetic fertilizer 1.0kg N/100m ² Contec	4.3a	5325ab	22975a	15a	163a	4850a	
PGPR 1.3 l/100m ²	4.1b	5400a	23375a	15a	158a	5125a	
	LSD _{0.10} =	0.1	256	735	0.6	n/s	n/s

* Values followed by the same letter are not significantly different from each other

Table 4 - Plant nutrient values August 15, 2006.

Treatment	Manganese	Magnesium	Boron	Sulphur	Zinc	Sodium	
	mg/kg						
Untreated control	38a	3400b	12a	5225abc	39a	437a	
Organic fertilizer 0.6kg N/100m ² Milorganite	36a	3325b	13a	5300ab	38a	426a	
Organic fertilizer 1.0kg N/100m ² Milorganite	40a	3375b	11a	5125c	42a	471a	
Synthetic fertilizer 0.6kg N/100m ² Contec	37a	3275b	10a	5175bc	38a	415a	
Synthetic fertilizer 1.0kg N/100m ² Contec	39a	3450ab	11a	5325a	39a	450a	
PGPR 1.3 l/100m ²	37a	3600a	10a	5125c	39a	459a	
	LSD _{0.10} =	n/s	183	n/s	134	n/s	n/s

* Values followed by the same letter are not significantly different from each other