

**Fall Applications of Nitrogen and Potassium and their Effect
on Winter Hardiness on Annual Bluegrass**

Progress Report to:

Canadian Turfgrass Research Foundation

Research Team:

Katie Dodson

James B. Ross

Mark Anderson

**Prairie Turfgrass Research Centre
Olds College**

December 2014

Fall Applications of Nitrogen and Potassium and their Effect on Winter Hardiness on Annual Bluegrass

Objectives of this Study

The overall objectives are:

- to determine the effects of fall applied nitrogen and potassium on cold hardiness,
- to determine the relationship between plant cold hardiness, soil nutrient status, and plant tissue content,
- to determine if soil nutrient deficiencies or excesses have an impact on plant cold hardiness,
- to develop recommendations based on soil nutrient and plant tissue status with regard to fall fertilization in order to ensure maximum cold hardiness.

Plot Establishment and Treatments List

This trial was established on a USGA specification putting green located at Olds College. This green was established in the summer and fall of 2012 with annual bluegrass seed cv. Two Putt. Baseline fertility levels were established in year one with the intent of having all nutrients in the sufficiency range at the commencement of the trial in mid-August. Soil extractable nutrient status and plant tissue testing were used to determine deficient, sufficient and excessive levels.

Table 1 - List of Treatments

Treatments	Nutrient Source & Rate	
	Ammonium Sulphate 21-0-0	Potash Sulphate 0-0-52
Nitrogen 0x Rate + Potash 0x Rate	0.0 kg N/100m ²	0.0 kg K/100m ²
Nitrogen 0x Rate + Potash ¼x Rate	0.0 kg N/100m ²	0.125 kg K/100m ²
Nitrogen 0x Rate + Potash ½x Rate	0.0 kg N/100m ²	0.25 kg K/100m ²
Nitrogen 0x Rate + Potash 1x Rate	0.0 kg N/100m ²	0.5 kg K/100m ²
Nitrogen ¼x Rate + Potash 0x Rate	0.125 kg N/100m ²	0.0 kg K/100m ²
Nitrogen ¼x Rate + Potash ¼x Rate	0.125 kg N/100m ²	0.125 kg K/100m ²
Nitrogen ¼x Rate + Potash ½x Rate	0.125 kg N/100m ²	0.25 kg K/100m ²
Nitrogen ¼x Rate + Potash 1x Rate	0.125 kg N/100m ²	0.5 kg K/100m ²
Nitrogen ½x Rate + Potash 0x Rate	0.25 kg N/100m ²	0.0 kg K/100m ²
Nitrogen ½x Rate + Potash ¼x Rate	0.25 kg N/100m ²	0.125 kg K/100m ²
Nitrogen ½x Rate + Potash ½x Rate	0.25 kg N/100m ²	0.25 kg K/100m ²
Nitrogen ½x Rate + Potash 1x Rate	0.25 kg N/100m ²	0.5 kg K/100m ²
Nitrogen 1x Rate + Potash 0x Rate	0.5 kg N/100m ²	0.0 kg K/100m ²
Nitrogen 1x Rate + Potash ¼x Rate	0.5 kg N/100m ²	0.125 kg K/100m ²
Nitrogen 1x Rate + Potash ½x Rate	0.5 kg N/100m ²	0.25 kg K/100m ²
Nitrogen 1x Rate + Potash 1x Rate	0.5 kg N/100m ²	0.5 kg K/100m ²

Research Initiated Since Last Report

- Representative tissue and soil samples were collected in July 2014 and sent to the lab for the determination of baseline levels for the initiation of the study in mid-August 2014. The results of this testing showed that the deficiencies found in the spring sampling were addressed by our spring and summer fertilizer applications. This ensured that the fertilizer treatments applied this fall should be measurable.

- Fertilizer treatments commenced after an initial soil and tissue sampling on Aug. 15th 2014. A total of 4 applications were put down on a biweekly basis through to the first of October.
- Soil and tissue samples were collected on Sept. 15th and Oct. 15th to look at the effects of the fertilizer treatments on both the plant tissue and rhizosphere.
- Randomized plot sampling with a soil probe was performed on Oct. 6, Oct. 20, Nov. 3 and Nov. 24. Originally the plan was for 3 samplings, however the weather did not cool off significantly until mid Nov. so a fourth sampling occurred on Nov. 24th and the plants are currently in the regrowth stage in the greenhouse for the LT50 tests.
- Percent moisture of the crowns was determined for each sampling date mentioned above. Twenty-five crowns were isolated from a probe core and the top 5mm and bottom 3mm from the base of the crown were used to determine the percent moisture content of each plot.

Progress to Date

- The 2014 fall treatments were all successfully applied and samples taken. All results from Brookside labs have been entered into a table for further analysis.
- All LT50 data, with the exception of the fourth sampling have been completed and analyzed.
- Percent crown moisture has been determined for the four sampling dates for all 64 plots.

Results Since Last Report

Tissue analysis

- As expected treatments that received 0 lbs of either N or K showed a small decline overtime with respect to each nutrient. (Table 1)
- There appears to be an interaction between the N treatments and the K treatments. As the amount of N goes up more K is incorporated into the plant tissue. (Table 1)

Soil analysis

- Soil analysis showed that phosphorus levels were either sufficient or deficient, depending on the extraction method!
- Nitrogen levels in the soil were estimated but a treatment difference was not specifically noted (Table 2)
- Potassium levels responded well to the various K levels added during the course of the experiment (Table 2)

LT50 test results:

- Very little difference between the first 3 sampling dates, most likely due to relatively warm fall (Fig. 1) (Table 3)
- Initial run through the statistics program shows that K is not playing a role in the survival rate of the plants; however N has statistically significant differences. Superficially it appears that the 0.25 and 0.5 rates of N slightly increased winter hardiness, while the high rate of N (1) lowered the winter hardiness rate. (Table 3)

Crown Moisture results:

- Crown moisture results ranged between 60 and 78% moisture. (Table 4)
- Statistically N rates were significantly different, while K rates did not result in significant differences. (Table 4)
- K rates are affected by N rates suggesting the importance of N in respect to K uptake by the plant. (Table 4)

Plan for the next Period:

Once the final data for the last round of LT50s is collected (Dec. 16th) correlations between % crown moisture, LT50, and tissue test results will be run. A spring sampling is scheduled for the end of April once the spring temperatures have arrived and snow cover is lost, with the expectations of examining the plant's health and overall cold tolerance after the winter. The overall plot will be treated uniformly throughout the spring and summer to ensure a uniform test plot for round two of the trail commencing Aug. 15th 2015.

Treatment	Nitrogen (lbs)	Potassium (lbs)	Aug. 15 N (%)	Aug. 15th P (%)	Aug. 15 th K (%)	Sept. 15 N (%)	Sept 15 P (%)	Sept. 15 K (%)	Oct 15 N (%)	Oct 15 P (%)	Oct 15 K (%)
1	0	0	2.195	0.26375	1.8725	2.085	0.28125	2.1475	1.86	0.2025	2.0625
2	0	0.25	2.1225	0.271	1.885	2.43	0.302	2.51	2.135	0.21325	3.14
3	0	0.5	2.335	0.277	2.1325	2.235	0.299	2.6575	1.5125	0.15425	2.945
4	0	1	2.305	0.29475	2.145	2.2	0.27925	2.9375	1.705	0.162	3.8875
5	0.25	0	2.455	0.32075	2.1425	2.935	0.32325	2.395	3.53	0.29625	2.045
6	0.25	0.25	2.465	0.2865	2.1	2.8	0.3075	2.585	2.855	0.2345	2.5025
7	0.25	0.5	2.3075	0.282	2.1025	2.815	0.3105	2.735	2.96	0.24075	3.3025
8	0.25	1	2.1975	0.251	1.95	2.7975	0.286	2.8125	2.2875	0.184	3.2175
9	0.5	0	2.4175	0.26	2.0475	3.285	0.303	2.32	3.3325	0.28675	1.9475
10	0.5	0.25	2.4575	0.2615	2.1	3.3075	0.29225	2.635	3.0125	0.26425	2.83
11	0.5	0.5	2.565	0.29575	2.2	3.065	0.29025	2.8375	3.085	0.24	3.2775
12	0.5	1	2.4225	0.294	2.175	2.7075	0.29775	3.04	2.975	0.22525	3.9575
13	1	0	2.625	0.282	2.0175	4.105	0.33525	2.345	3.9525	0.276	1.71
14	1	0.25	2.72	0.28525	2.0675	4.1925	0.3275	2.79	3.955	0.28025	2.885
15	1	0.5	2.47	0.27225	2.0425	4.28	0.32125	2.9475	4.29	0.287	4.1675
16	1	1	2.4675	0.27375	2.0125	4.0425	0.33	3.1325	3.19	0.23125	4.0225

Table 1: Summary of Tissue analyses from Aug, Sept and Oct. 2014 with respect to N,P,K. Phosphorus remained at a relatively steady state throughout the experiment, while N and K varied with respect to the rates of N and K applied during the experiment. The highest levels of K in the tissue correlated with N applications, suggesting that applying K alone may not help with getting more K into the plant.

Treatment	Nitrogen (lbs)	Potassium (lbs)	Aug. 15 N (ppm)	Aug. 15 P* (mg/kg)	Aug 15 K* (mg/kg)	Sept. 15 N (ppm)	Sept 15 P* (mg/kg)	Sept 15 K* (mg/kg)	Oct. 15 N (ppm)	Oct 15 P* (mg/kg)	Oct 15 K* (mg/kg)
1	0	0	18.63636	22.75	108.75	19.09091	18	108.25	19.88636	14.75	119
2	0	0.25	18.06818	20	97.75	21.13636	18.5	187.5	19.20455	20	331.5
3	0	0.5	19.09091	16.5	126	18.29545	17.5	278.25	18.52273	13.5	653.25
4	0	1	19.09091	20.5	113.25	17.95455	14.75	479.5	19.09091	14	1050.5
5	0.25	0	17.72727	16.25	121.25	17.04545	10.75	93.5	19.54545	15	105
6	0.25	0.25	19.09091	18.25	127	18.52273	17	168	18.86364	14.75	371
7	0.25	0.5	18.86364	21	127	19.31818	17.5	304.5	18.97727	17.5	579.5
8	0.25	1	19.88636	20.25	116.5	18.06818	15.75	477	18.63636	15.5	1047.5
9	0.5	0	19.09091	13	118.75	19.54545	10.75	104.25	19.54545	12	93.25
10	0.5	0.25	18.63636	17	113.5	20.11364	14.25	166.25	19.09091	13.25	364
11	0.5	0.5	18.06818	16.75	122.75	18.40909	14.25	301	18.52273	12.5	694.25
12	0.5	1	18.86364	18	117.5	19.31818	13.25	498.75	19.77273	14.5	945.5
13	1	0	18.29545	17.25	93	20.90909	10.75	73.75	21.25	12.25	70.5
14	1	0.25	17.72727	16	90	18.63636	12.75	162.25	19.77273	12.75	279.25
15	1	0.5	18.97727	14.75	97	18.63636	9.5	239.75	19.31818	12.25	539.75
16	1	1	18.40909	16.75	102	17.84091	16	554	19.20455	13	1083.75

Table 2: Summary of Soil analyses from Aug, Sept and Oct. 2014 with respect to N,P,K. Nitrogen levels did not change with respect to treatment, but that was expected as soil N levels are variable and do not reflect plant uptake. Potassium soil levels responded well to K treatments.

Treatment	Nitrogen (lbs)	Potassium (lbs)	Oct.6	Oct. 20	Nov.3
1	0.00	0.00	-10.00	-9.25	-9.63
2	0	0.25	-8.75	-10.00	-9.00
3	0	0.50	-8.75	-8.63	-10.38
4	0	1.00	-7.38	-7.25	-9.06
5	0.25	0.00	-7.00	-7.38	-9.75
6	0.25	0.25	-7.13	-7.63	-11.50
7	0.25	0.50	-8.38	-7.00	-9.75
8	0.25	1.00	-8.81	-8.25	-7.00
9	0.5	0.00	-8.88	-7.00	-10.25
10	0.5	0.25	-10.06	-7.00	-10.13
11	0.5	0.50	-9.00	-7.63	-9.00
12	0.5	1.00	-8.13	-9.38	-8.88
13	1	0.00	-7.50	-7.00	-8.25
14	1	0.25	-7.50	-6.63	-7.25
15	1	0.50	-7.25	-6.38	-9.75
16	1	1.00	-7.19	-7.00	-7.25

Table 3. Summary of LT50 results based on treatments for first three samplings. Potassium alone did not produce statistical differences, however N does appear to play an important role in respect to winter hardiness.

Treatment	Nitrogen (lbs)	Potassium (lbs)	% moisture 10/8	% moisture 10/22	% moisture 11/5
1	0	0	63.56	63.09	61.83
2	0	0.25	69.28	56.84	69.93
3	0	0.5	64.22	63.00	70.25
4	0	1	63.22	58.63	71.28
5	0.25	0	70.53	64.80	68.07
6	0.25	0.25	72.36	66.97	70.77
7	0.25	0.5	70.75	67.83	69.75
8	0.25	1	69.04	69.92	71.44
9	0.5	0	72.65	71.75	72.84
10	0.5	0.25	72.37	70.45	66.22
11	0.5	0.5	70.88	71.08	70.83
12	0.5	1	70.79	68.68	68.97
13	1	0	77.27	77.58	69.52
14	1	0.25	71.92	70.48	70.76
15	1	0.5	72.84	69.88	68.56
16	1	1	74.15	72.46	70.22

Table 4: Percent Crown Moisture with relation to fertility treatments. Nitrogen appears to play a more important role than potassium in respect to crown moisture content.

Weather Data:

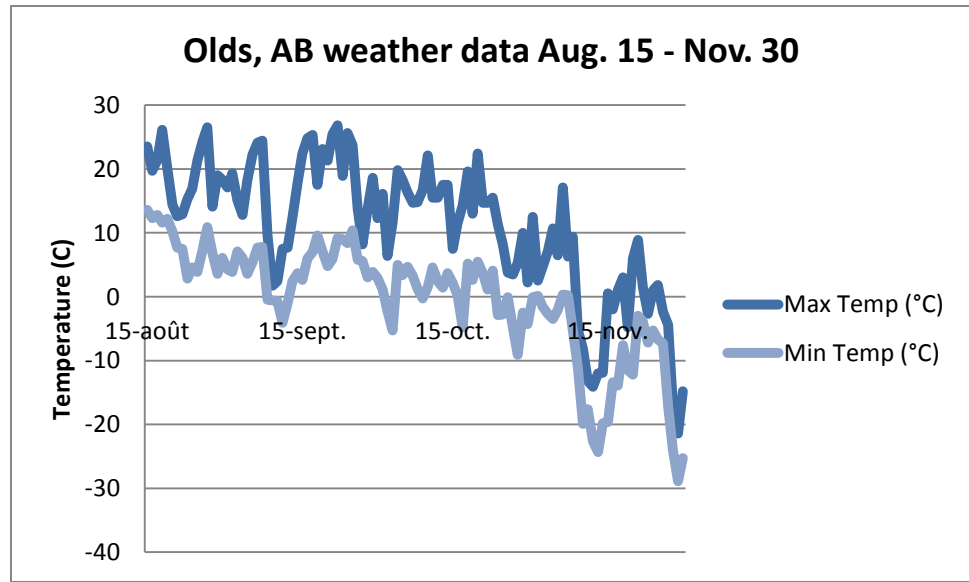


Fig.1. High and low temperatures for Olds, Ab. From Aug. 15th through Nov. 30th 2014. Note we did not have sustained cold temperatures until Nov. 9th, this is why we did a fourth sampling in an attempt to measure the plants after they reached their maximum cold hardiness.