

Identification of Drought Resistant Turfgrass Cultivars for Water Conservation

Progress Report to:

Canadian Turfgrass Research Foundation

**Progress Report from:
Prairie Turfgrass Research Centre
Olds College**

Research Team:

**Dr. Eric Lyons
Principal Investigator
Guelph Turfgrass Institute
University of Guelph**

**James B. Ross (Retired)
Katie Dodson
Dr. Laura Chaves
Mark Anderson
Cory Mossing**

**Prairie Turfgrass Research Centre
Olds College Centre of Innovation**

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Summary

There has been very little progress since the last report was completed in October 2015. Green pixel analysis was completed for the acute (short-term) drought period that was performed on the one-year-old (August 2014) established Kentucky bluegrass trial during the late summer - early fall time period of 2015.

Research Initiated Since Last Report

1. Kentucky bluegrass trial: The green pixel data was analyzed and is summarized below. Procedures for setting white balance and focus for the camera have been reevaluated, and a new procedure has been developed for this upcoming growing season to ensure the data represented in the images are uniform for each sampling date. Correlations using the multivariate analysis in JMP 11 were done between green pixel analysis, and NDVI.
2. Fine fescue trial: The fine fescue trial was planted after the construction of the two rain-out shelters on Aug. 31st, 2015. The trial was originally planted on Aug. 14th, 2015, however a large rainstorm washed seed from one plot to the next, so the soil had to be removed and collected to prevent seed contamination in the new plots. There was enough seed to replant the trial, however now there is no extra seed to overseed in spring 2016 if there is a lot of winter kill. The trial should be ready to run an acute drought period in Aug. 2016, with a full season of data collection in 2017.

Progress to Date

In July 2014, construction was undertaken by Goodwin Golf Ltd. and plots were contoured and drainage swales were constructed. Two raised platforms were constructed out of the native soil that had a 1% slope from north to south. Drainage swales were constructed on each side of the raised platforms to take away excess water from the trial platforms that are currently planted into the Kentucky bluegrass trial and the fine fescue trial. Thirty-six entries of Kentucky bluegrass seed was received on August 2014, and seeding took place on August 19, 2014. Plot sizes were 1 x 1 m and were replicated four times. All plots were considered established by Aug. 5th, 2015. A late summer/ early fall drought period was initiated from Aug. 5th – Sept. 23rd, 2015.

Seed for the fine leaf fescue portion of the study was received in July 2015 and due to weather and construction of the rainout shelter the seed was not seeded until Aug. 31st, 2015. Twenty-five entries of various species of fine fescue seed was planted in 1 x 1 m individual plots replicated four times. The delay in planting of this trial will result in a delay in data collection for the fine fescue trial, which is now anticipated to commence in the late spring of 2017. An acute drought trial is planned for Aug. 1st, 2016, if the plots are considered established.



Fig. 1 – Picture of Kentucky bluegrass drought trial under the rainout shelter. August 5th, 2015.

Results

Kentucky Bluegrass Drought Trial:

Digital pictures using a lightbox, Normalized Difference Vegetative Index (NDVI), soil volumetric moisture content at 1.5” and 3” were taken weekly starting on Aug. 5th, 2015. Statistical comparisons were performed using the Each Pair Student’s T multiple means comparison in JMP 11 for the moisture and NDVI data. NDVI data did not differ statistically for most sampling dates when an ANOVA was run. This suggests that the difference in chlorophyll content did not differ enough between cultivars to be detected on each sampling date.

The data collected at ten days after the drought was initiated, is summarized in Table One. Mallard, a TWCA approved Kentucky bluegrass cultivar, is highlighted in Tables One and Two, to represent a drought resistant KBG cultivar that is considered an industry standard. The data shown in Table One displays that there are more than one strategies being implemented by the various entries. Bedazzled has one of the highest quality at 10 days into drought, and has the highest moisture levels at the 1.5” depth. This suggests that the water use rate of Bedazzled may be lower than Mallard. At 30 days into the drought period, Bedazzled has maintained the highest moisture level reading (Table Two), while Mallard has used significantly more moisture in the upper rhizosphere. It is important to note that the data collection time period for this round of

the trial was during the months of August and September, which in Olds, AB tend to have cool nights and warm days, so heat stress would not be a factor in the trial.

Table One:
Summary of 3" moisture depth, 1.5" moisture depth, NDVI, and Quality of entries after 10 days of drought

Entry	3"	1.5"	NDVI	Quality
T10-18	33.71 CD*	41.39 ABCDEF	0.712 ABC	6.75 A
K13-143	31.18 D	37.72 DEF	0.697 CDE	6.75 A
K13-140	33.26 CD	44.30 ABCDE	0.698 CDE	6.50 AB
K13-139	31.83 D	38.09 CDEF	0.715 ABC	6.50 AB
K10-111	37.90 BCD	38.40 CDEF	0.674 EF	6.50 AB
Geronimo	34.86 CD	39.30 CDEF	0.691 CDE	6.50 AB
Bedazzled	41.16 ABC	50.90 A	0.710 ABC	6.50 AB
A98-344	31.58 D	36.59 DEF	0.710 ABC	6.50 AB
T10-17	33.62 CD	40.70 BCDEF	0.700 BCDE	6.25 ABC
K9-96	31.84 D	33.22 F	0.679 DEF	6.25 ABC
AKB1765	32.43 D	41.26 ABCDEF	0.709 ABCD	6.25 ABC
K10-110	32.14 D	36.71 DEF	0.732 A	6.00 BCD
AO5-204	36.92 BCD	36.32 EF	0.695 CDE	6.00 BCD
AKB1820	35.60 BCD	37.98 CDEF	0.707 ABCD	6.00 BCD
AKB1812	35.93 BCD	41.94 ABCDEF	0.693 CDE	6.00 BCD
AKB1193	31.26 D	37.79 CDEF	0.694 CDE	6.00 BCD
Snap	31.72 D	34.80 EF	0.652 F	5.75 CDE
AKB2454	35.21 CD	47.21 ABC	0.695 CDE	5.75 CDE
AKB2404	34.62 CD	38.54 CDEF	0.673 EF	5.75 CDE
AKB2094	30.96 D	34.24 F	0.707 ABCD	5.75 CDE

AKB1925	35.98	BCD	42.39	ABCDEF	0.692	CDE	5.75	CDE
AKB1222	43.80	AB	46.27	ABCD	0.685	CDE	5.75	CDE
Diva	32.64	D	37.77	CDEF	0.705	ABCD	5.50	DE
AKB2192	37.39	BCD	42.73	ABCDEF	0.730	AB	5.50	DE
AKB1892	32.56	D	33.91	F	0.703	ABCDE	5.50	DE
Midnight	46.34	A	49.27	ABC	0.692	CDE	5.25	E
Mallard	36.41	BCD	34.62	EF	0.697	CDE	5.25	E

*Levels not connected by same letter and in the same colour are significantly different.

Table Two: Summary of 3" moisture depth, 1.5" moisture depth, NDVI, and Quality of entries after 30 days of drought

Entry	3"	1.5"	NDVI	Quality
K13-143	32.71 E*	14.54 EFGH	0.708 A	7.00 A
T10-18	40.00 BCDE	17.64 ABCDEF	0.714 A	7.00 A
Bedazzled	47.83 AB	20.59 A	0.722 A	6.75 AB
K9-96	36.57 DE	15.24 DEFGH	0.712 A	6.75 AB
Geronimo	36.74 DE	13.96 GH	0.697 A	6.50 ABC
K10-111	37.40 CDE	17.91 ABCDE	0.712 A	6.50 ABC
K13-139	32.01 E	14.67 DEFGH	0.705 A	6.50 ABC
AKB1765	37.96 CDE	15.69 DEFGH	0.711 A	6.25 ABCD
K13-140	37.02 CDE	17.28 ABCDEFG	0.704 A	6.25 ABCD
T10-17	32.17 E	15.64 DEFGH	0.715 A	6.25 ABCD
A98-344	36.86 CDE	17.07 BCDEFGH	0.714 A	6.00 ABCDE
AKB1222	46.37 ABC	19.57 AB	0.702 A	6.00 ABCDE
AKB1812	37.92 CDE	16.01 CDEFGH	0.722 A	6.00 ABCDE
Snap	31.84 E	14.87 DEFGH	0.678 A	6.00 ABCDE
AKB1193	34.62 DE	16.19 BCDEFGH	0.704 A	5.75 BCDE
AKB1820	36.13 DE	16.73 BCDEFGH	0.715 A	5.75 BCDE
AO5-204	35.98 DE	16.60 BCDEFGH	0.710 A	5.75 BCDE

K10-110	34.11	DE	14.82	DEFGH	0.706	A	5.75	BCDE
Diva	34.61	DE	17.83	ABCDE	0.700	A	5.50	CDEF
Mallard	36.69	DE	14.71	DEFGH	0.716	A	5.50	CDEF
Midnight	50.69	A	17.94	ABCD	0.713	A	5.50	CDEF
AKB1925	37.37	CDE	17.33	ABCDEFGF	0.700	A	5.25	DEF
AKB2094	33.43	DE	13.73	H	0.702	A	5.25	DEF
AKB2192	36.58	DE	15.38	DEFGH	0.694	A	5.00	EF
AKB2404	37.36	CDE	14.27	FGH	0.683	A	5.00	EF
AKB2454								
3	42.31	ABCD	19.30	ABC	0.686	A	5.00	EF
AKB1892	36.40	DE	14.32	FGH	0.687	A	4.50	F

*Levels not connected by same letter are significantly different.

Digital analysis was completed and the data is summarized in Tables Three and Four. Table Three represents the seasonal mean of the green pixel analysis. The averaging of the data resulted in very little differences between the entries (Table Three), as the individual entry's response were variable and are not captured by meaning the data over the entire drought period. Table Four represents the data at 10 days and 30 days of drought. The green pixel data did not have a strong correlation with the NDVI data ($R=0.51$), which may be caused by a lack of continuity with the data collection with the camera. After reviewing all the images and data, there appeared to be a problem with keeping the white balance and focus set between pictures. A review of the methodology revealed there was a misstep some weeks with maintaining the same area of view for the pictures due to the use of automatic focus and automatic white-balance setting. There also was a problem with the quality of light provided by the light box. The light levels would decrease as the portable generators' charge wore down. A plug station by the rainout shelters was installed last fall for the sump pump and an outlet was placed on by the shelters. To ensure a steady stream of power, a large extension cord will be used to power the light box. The compact fluorescent bulbs will be run for 30 minutes before the onset of data collection to also ensure the quality of light remains consistent during the photo collection period. With these improvements with methodologies we are confident that errors in the data collection will be minimized this upcoming growing season.

Table Three: Seasonal percent green pixel analysis.

Entry	% Green Pixels
AKB1193	A 89.206952
Mallard	A B 88.941571
AKB1820	A B C 88.210524
AKB1812	A B C D 88.054476
T10-18	A B C D E 87.511000
Midnight	A B C D E 87.461857
AKB1765	A B C D E F 87.321190
K10-110	A B C D E F 87.293143

Entry											% Green Pixels			
Bedazzled	A	B	C	D	E	F	G					87.127429		
AKB2192	A	B	C	D	E	F	G					87.030762		
AKB2404	A	B	C	D	E	F	G	H				86.720524		
K13-143	A	B	C	D	E	F	G	H				86.589381		
Geronimo	A	B	C	D	E	F	G	H				86.513762		
K10-111	A	B	C	D	E	F	G	H				86.457286		
Diva		B	C	D	E	F	G	H				86.402524		
A98-344		B	C	D	E	F	G	H				86.336571		
K13-139		B	C	D	E	F	G	H				86.233286		
AKB1222			C	D	E	F	G	H	I			85.974429		
K13-140			C	D	E	F	G	H	I	J			85.648333	
AKB24543				D	E	F	G	H	I	J			85.363286	
AKB1892					E	F	G	H	I	J	K			84.829857
AO5-204						F	G	H	I	J	K			84.599714
AKB1925							G	H	I	J	K			84.432762
AKB2094								H	I	J	K			84.212762
T10-17									I	J	K			83.377810
K9-96										J	K			83.084952
Snap											K			82.396762

Table Four: Percent Green Pixel Analysis for 10 Day and 30 Day Drought.

Entry	10 Day % Green Pixel		30 Day % Green Pixels	
AKB1193	87.365000	A*	86.102250	ABC*
AKB1812	86.699500	A	86.469500	AB
AO5-204	86.687750	A	86.052750	ABC
K10-111	86.587000	A	87.014500	AB
K13-140	86.187000	AB	84.304500	ABCD
T10-18	86.125750	AB	84.483500	ABCD
K9-96	86.088750	AB	85.070750	ABCD
AKB1765	85.801750	ABC	84.717500	ABCD
AKB1222	85.598500	ABC	83.074500	BCD
AKB2094	85.499750	ABC	84.467000	ABCD
Geronimo	85.441750	ABCD	85.144000	ABCD
K10-110	85.292000	ABCD	86.640250	AB
Snap	85.235000	ABCD	85.253750	ABCD
Bedazzled	84.955250	ABCD	86.279750	AB

Entry	10 Day % Green Pixel		30 Day % Green Pixels	
AKB24543	84.912750	ABCD	83.357000	ABCD
AKB2404	84.699000	ABCD	84.682000	ABCD
K13-139	84.423500	ABCD	86.013750	ABC
AKB1925	83.608750	ABCD	81.157250	D
AKB1892	83.566750	ABCD	86.469500	AB
AKB1820	83.345000	ABCD	85.534750	ABCD
A98-344	83.172000	ABCD	85.034250	ABCD
T10-17	83.143500	ABCD	83.770000	ABCD
Diva	82.737000	ABCD	85.021250	ABCD
Mallard	81.636500	ABCD	87.795500	A
Midnight	80.511250	BCD	85.142000	ABCD
AKB2192	79.881250	CD	81.548750	CD
K13-143	79.444250	D	86.848250	AB

Levels not connected by same letter are significantly different.

Plan for the Next Period

May 2016 – Install sump pump at lowest point around the drought research plots. Currently we are using a gas-powered pump, which may be causing a block effect in the KBG drought trial, as water tends to pool just off the west edge of the platform if there is a rainstorm during off hours. Statistical analysis showed a block effect on dates that were close to the few large rain events we had during this time period.

May – August – focus on grow-in of the fine fescue trial

June-August – initiate drought in the KBG trial. The PTRC research team will discuss further with Dr. Lyons on data collection protocols to ensure that our two data sets match.

Changes to the Work Plan

With the re-construction of the plots that occurred in 2014, combined with the delay in receiving the fine fescue seed from the TWCA group the work schedule has been pushed back a full year. Drought tolerance testing of the fine fescue trial will now begin in 2017. There is a small concern around the survivability of the fine fescue trial over this winter due to the seedling stage of the plants (3 leaf stage), however we are currently in discussion with the TWCA group to receive some extra seed of each entry for overseeding purposes.