Evaluation of performance of spreading tall fescue, spreading perennial ryegrass and a drought tolerant tall fescue in Ontario (2012-2014)

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Background

With the passing of the Cosmetic Pesticides Ban it has been more challenging to manage pests and weeds in residential turf. Many of the pests that either attack or infest turf are more difficult to control using a one product – one pest approach. We must really integrate all of our tools, including cultural practices, turf species selection and bio-pesticides for success. In addition, there has been increasing pressure on water supplies, necessitating watering restrictions or bans in many municipalities. Pest tolerant grass species that are also drought tolerant would be a valuable tool for turf managers in Ontario.

With that in mind, a trial was established to investigate the potential use of novel grass species that may be drought tolerant, but may also be able to resist weed invasion and be less susceptible to insect feeding. Rhizomatous tall fescue (RTF) and regenerative perennial ryegrass (RPR) have recently been introduced into the market place in Ontario. Rhizomatous tall fescue is purported to grow better in summer and late fall than tall fescues currently on the market. RTF has endophytes that are different from other tall fescues currently on the market. They require less water as they develop deep root systems, and having rhizomes should give them the ability to fill in gaps that develop if the turf stand thins due to wear, pest damage or other stresses (Wipff and Singh, 2012). Since the introduction of RTF into the Ontario turfgrass market, another spreading tall fescue has been introduced, called Natural Knit tall fescue (NKTF) from Ledeboer Seeds. In addition, a local seed company began marketing a Water Star® qualified tall fescue variety from Pennington's Seed. Turfgrass seed products bearing the Water Star® logo have been through rigorous testing by the Turfgrass Water Conservation Alliance (TWCA) to meet a set of criteria for drought tolerance.

Regenerating Perennial ryegrass (RPR) is a subspecies of perennial ryegrass that produces stolons. It is also referred to as stoloniferous perennial ryegrass. Until now, the cultivars of perennial ryegrass that have been marketed in Ontario have been bunch types. In addition to having stolons, RPR was selected under intense traffic stress for its ability to survive traffic and recover. RPR also contains endophytes. Ledeboer has also introduced a spreading perennial ryegrass cultivar marketed as Natural Knit perennial ryegrass (NKPR).

A trial was established in the fall of 2012 at the Guelph Turfgrass Institute (GTI) to evaluate drought tolerance and weed invasion in plots sown with two spreading tall fescue cultivars (RTF and NKTF), two spreading perennial ryegrass cultivars (RPR and NKPR), and a drought tolerant tall fescue (Water Star®), using a standard home lawn mix (HLM) (50% Kentucky bluegrass, 20%

perennial ryegrass and 30% fine fescue) as a standard, under two irrigation regimes (irrigated vs. non-irrigated).

During the two years of this study (2013 and 2014), both summers had normal rainfall which prevented an evaluation of drought tolerance. During the winter of 2013/2014, all the plots were covered with a thick layer of ice (>5 cm) for > 100 days with colder than average temperatures. This provided the opportunity to evaluate the species/mixtures for winter-hardiness and to assess their ability to recover from winter injury.

Materials and Methods

Establishment, treatments and maintenance

A plot area was worked and prepared for seeding at the Guelph Turfgrass Institute. The experimental plots were arranged in a two by six factorial design (two irrigation regimes and six species/mixtures) with 4 replications of each treatment. Plots measured 1.5 m x 1.5 m (2.25 m^2) and were seeded on Sept. 28, 2012 using a hand held shaker. Treatments and seeding rates are as indicated in Table 1.

Table 1. Treatments and seeding rates

Treatment #	Turf species/mixture	Irrigation treatment	Seeding rate per 100 m^2
1	Rhizomatous tall fescue	Irrigated	2.5 kg
2	Rhizomatous tall fescue	Non-irrigated	2.5 kg
3	Regenerative Perennial ryegrass	Irrigated	3.0 kg
4	Regenerative Perennial ryegrass	Non-irrigated	3.0 kg
5	Natural Knit tall fescue	Irrigated	2.5 kg
6	Natural Knit tall fescue	Non-irrigated	2.5 kg
7	Natural Knit perennial ryegrass	Irrigated	3.5 kg
8	Natural Knit perennial ryegrass	Non-irrigated	3.5 kg
9	Water Star Tall Fescue	Irrigated	2.5 kg
10	Water Star Tall Fescue	Non-irrigated	2.5 kg
11	Home lawn mixture[1]	Irrigated	2.0 kg
12	Home lawn mixture	Non-irrigated	2.0 kg

[1] HLM = 50% Kentucky bluegrass, 20% perennial ryegrass and 30% fine fescue

All plots were mowed weekly (beginning in May, 2013) to a height of 5 cm and were fertilized three times in 2013 (June 7, Aug. 15 and Sept. 15) and 2014 (June 9, Aug. 7, Sept. 16) with a 25-5-10 fertilizer applied at a rate of 0.5kg of N/100m^2. No other cultural practices were performed.

Irrigation

Irrigated plots were individually watered to supply up to 25mm of water per week using a hose-end sprinkler. A flow meter was used to ensure that a precise volume of water was delivered to each plot. If rainfall was equal to 25mm of water, no irrigation was applied. In any given week, if rainfall was between 0 and 25mm, irrigation was applied to bring the total up to 25mm. Non-irrigated plots received rainfall only.

Figures 1 and 2 show the amount of rainfall that occurred per week in the plots in 2013 and 2014. In 2013, only one irrigation event was required; in 2014 there was sufficient natural rainfall and none of the plots required supplemental irrigation.

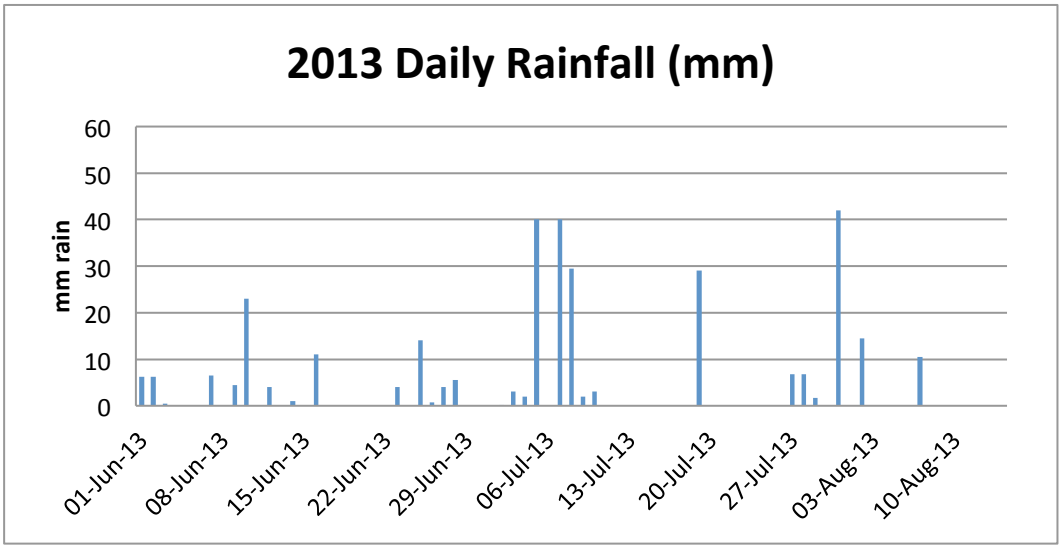

Figure 1. Millimetres of rainfall June to mid-Aug. 2013

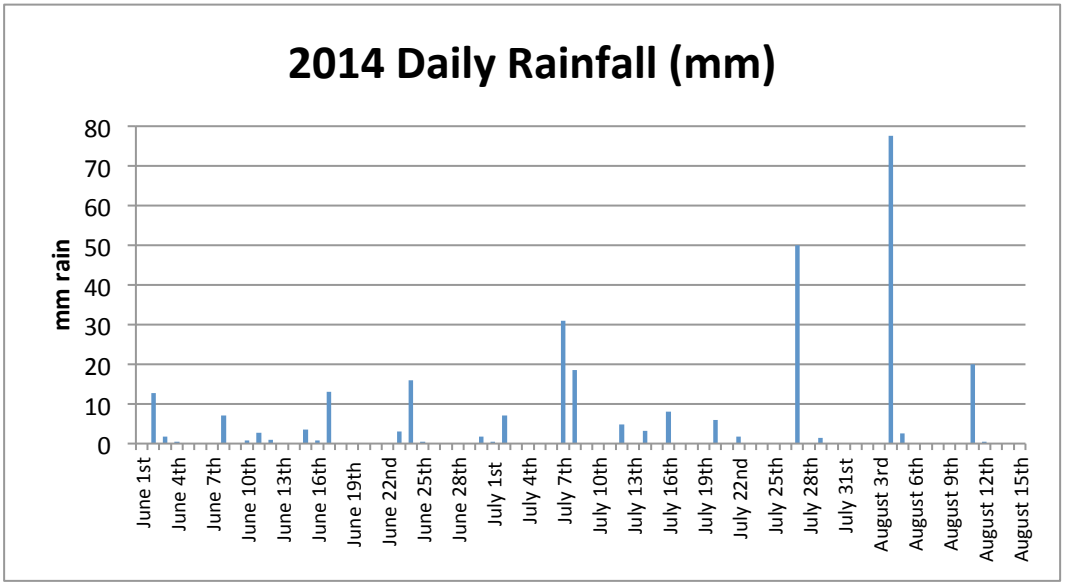

Figure 2. Millimetres of rain and irrigation for June to mid-Aug. 2014

Species composition and weed invasion

Species composition was recorded on four dates in 2013 (May 31, June 26, Aug. 8 and Oct. 11, 2013) and three dates in 2014 (May 22, July 3 and Oct. 16, 2014). Four randomized point quadrats measuring 60 cm x 60 cm with 25 points in each quadrat (points 10 cm apart) (Figure 3) for a total of 100 points in each plot were used to determine percent species cover of each of the turfgrass species [tall fescue (TF), perennial ryegrass (PR), Kentucky bluegrass (KB) and fine fescue (FF)], broadleaf weeds (BLW), bare and dead/brown areas at each assessment date. All data were analysed using appropriate statistical methods.

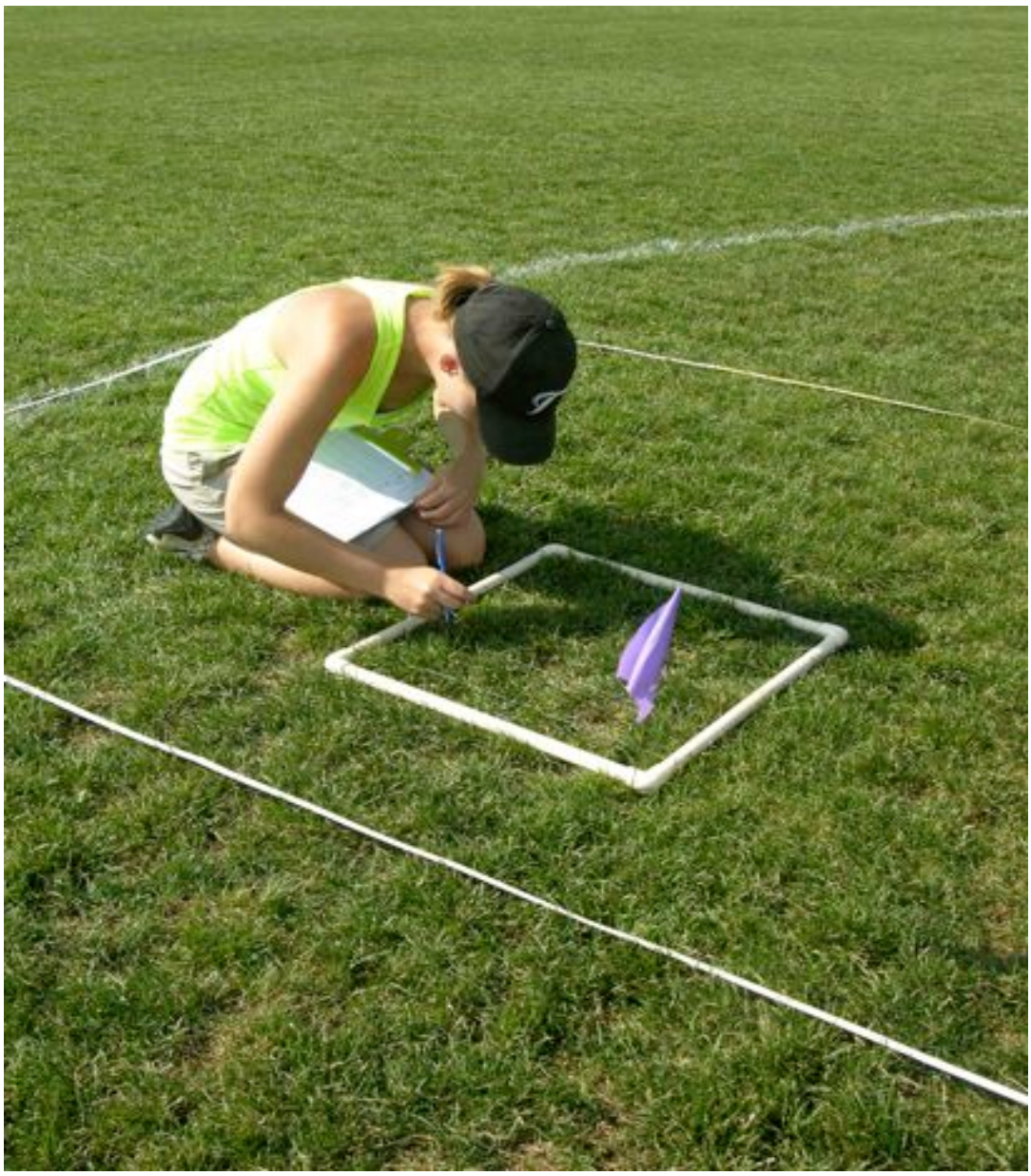

Figure 3. Point quadrat used to estimate percent species cover in plots.

Results

Percent cover of weeds, grass species and bare and dead/brown is presented in Table 2 for May 31 and Oct. 11, 2013 and May 22 and Oct. 16, 2014. The irrigation treatments were pooled with the non-irrigation treatments because, effectively, no irrigation was applied in either year.

Table 2. Percent cover of weeds, grass species and bare and dead/brown for 2013 and 2014.

Treatment	Broadleaf weeds (BLW)				Kentucky bluegrass (KB)			
	06/31/13	10/11/13	05/22/14	10/16/14	06/31/13	10/11/13	05/22/14	10/16/1
RTF	33.87[1] a	ns	1.37 ab	2.12 b	10.25 b	36.87 b	19.62 a	28.25 b
RPR	12.5 b	ns	3.25 a	9.37 a	0.12 c	0.50 c	4.62 b	7.50 cd
NKTF	37.00 a	ns	0.75 b	0.37 b	0.00 c	2.75 c	1.25 b	3.25 cd
NKPR	11.75 b	ns	1.87 ab	8.12 a	0.37 c	0.25 c	0.62 b	14.12 c
Water Star	36.37 a	ns	0.12 b	1.37 b	1.25 c	1.12 c	1.12 b	1.75 d
HLM	9.37 b	ns	0.25 b	2.25 b	23.37 a	54.25 a	25.25 a	44.00 a

Treatment	Perennial ryegrass (PR)				Fine fescue (FF)			
	06/31/13	10/11/13	05/22/14	10/16/14	06/31/13	10/11/13	05/22/14	10/16/14
RTF	2.62 c	0.12 c	1.62 b	0.37 c	0.00 b	0.00 b	0.25 c	0.87 b
RPR	75.50 a	94.25 a	28.62 a	72.50 a	0.00 b	0.00 b	6.50 b	0.12 b
NKTF	2.25 c	0.75 c	0.00 b	0.12 c	0.00 b	0.00 b	1.00 bc	3.37 b
NKPR	77.87 a	97.37 a	31.25 a	58.87 b	0.00 b	0.00 b	0.00 c	2.12 b
Water Star	1.37 c	1.25 c	0.00 b	0.00 c	0.00 b	0.00 b	0.00 c	0.87 b
HLM	43.37 b	26.37 b	5.62 b	0.37 c	5.62 a	18.12 a	46.37 a	49.50 a

Treatment	Tall fescue (TF)				Annual bluegrass (AB)			
	06/31/13	10/11/13	05/22/14	10/16/14	06/31/13	10/11/13	05/22/14	10/16/14
RTF	27.87 b	59.12 b	52.87 b	66.00 b	1.87 b	ns	7.62 a	0.25 b
RPR	3.5 c	0.00 c	0.12 c	0.00 c	2.25 ab	ns	5.75 ab	0.00 b
NKTF	38.62 a	88.00 a	72.75 a	88.5 a	1.50 b	ns	1.25 b	0.25 b
NKPR	2.37 c	0.00 c	0.25 c	0.25 c	2.50 ab	ns	2.37 ab	2.00 a
Water Star	37.00 a	94.87 a	72.75 a	92.12 a	1.75 b	ns	0.75 b	0.12 b
HLM	1.50 c	0 .00 c	0.37 c	0.00 c	5.75 a	ns	3.00 ab	0.00 b

Treatment	Bare				Dead/brown			
	06/31/13	10/11/13	05/22/14	10/16/14	06/31/13	10/11/14	05/22/14	10/16/14
RTF	23.50 a	ns	3.25 b	1.87 b	ns	ns	13.37 c	ns
RPR	6.12 b	ns	7.75 a	10.37 a	ns	ns	43.37 b	ns
NKTF	20.62 a	ns	1.87 b	4.00 b	ns	ns	21.12 c	ns
NKPR	5.12 b	ns	4.00 b	14.50 a	ns	ns	59.62 a	ns
Water Star	22.50 a	ns	4.00 b	3.75 b	ns	ns	21.25 c	ns
HLM	11.12 b	ns	3.75 b	3.87 b	ns	ns	15.37 c	ns

[1] Percent cover area estimated by point quadrat counts. 100 points per plot x 4 replicates. Means within columns followed by the same letter are not significantly different (Tukey's HSD, p=0.05).

Establishment and weed invasion 2013

The species composition in the spring of 2013 demonstrates how quickly each species/mixture established (Figure 4). The species that established most quickly were also the ones that were able to out-compete the BLW. All of the tall fescue cultivars had significantly higher percent BLW than RPR, NKPR and the HLM in the first spring after establishment. In addition to having the highest percent BLW, the tall fescues cultivars also had significantly higher bare areas than the RPR, NKPR and the HLM. It should also be noted that the RTF had 10.25% KB in the spring. The RTF in this study was a blend that was intended for sod production and it contained 10% by weight of Kentucky bluegrass seed. At the first rating date the HLM contained 23.37% KB, 43.37% PR and 5.62% FF.

By Oct. 11, 2013 there were very few BLW in any of the plots and the turf species/mixture did not differ significantly from one another for BLW, AB or bare areas (Figure 4). Even with the slower establishment of the tall fescue cultivars, with one season of fertility, mowing and adequate rainfall, they were able to crowd out the BLW and fill in to the same extent as the RPR, NKPR and HLM. By the end of the first growing season the HLM was 54.25% KB, 26.37% PR and 18.12% FF.

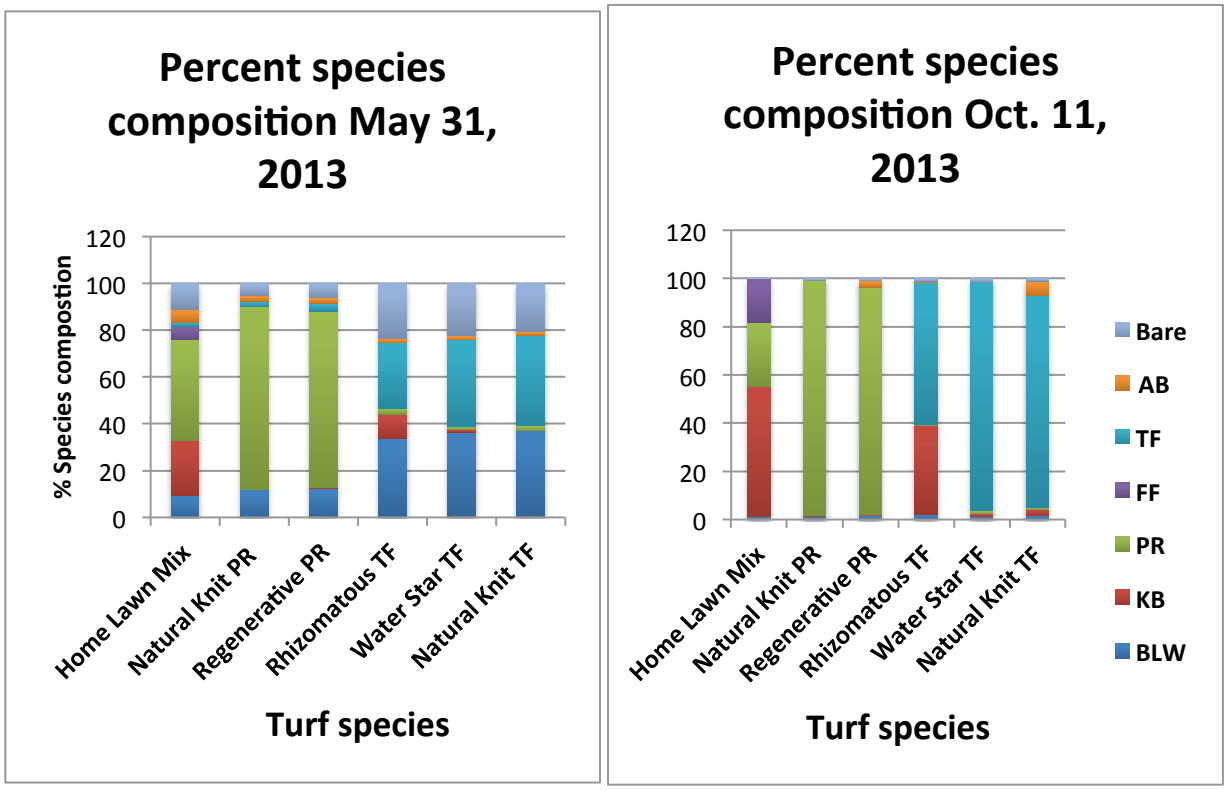

Figure 4. Percent species composition on May 31 and Oct. 11, 2013

Species composition 2014

During the winter of 2013/2014, the plots were covered with a thick layer of ice and were exposed to very low temperatures. Once the turf greened up in the spring of 2014, it was obvious that there was turf loss due to winter injury. As expected the species that had the most winter injury were the perennial ryegrasses (RPR and NKPR) followed by the tall fescues (RTF, NKTF and Water Star®). This is reflected in the % dead/brown for the May 22, 2014 rating date (Table 2 and Figure 5). NKPR had the highest winter injury with 59.62% dead/brown, followed by RPR at 43.37%. All the other species/mixtures had less dead/brown and did not differ significantly from one another. RPR went from 94.25% PR in the fall of 2013 to 28.62% PR the following spring. NKPR went from 97.37% PR to 31.25% over the same period. The percent TF in the RTF only decreased slightly over the same period. The NKTF went from 88.00% to 72.25% TF and the Water Star® went from 94.87% to 72.75% TF. The HLM went from 25.37% PR to 5.65% after the 2013/2014 winter. By the following fall (Oct. 16, 2014), there were no significant differences in dead/brown among the turf species/mixtures. RPR and NKPR had significantly more BLW (9.37 and 8.12% respectively) and bare areas (10.37% and 14.50% respectively). The other treatments did not differ significantly from each other for BLW or bare areas.

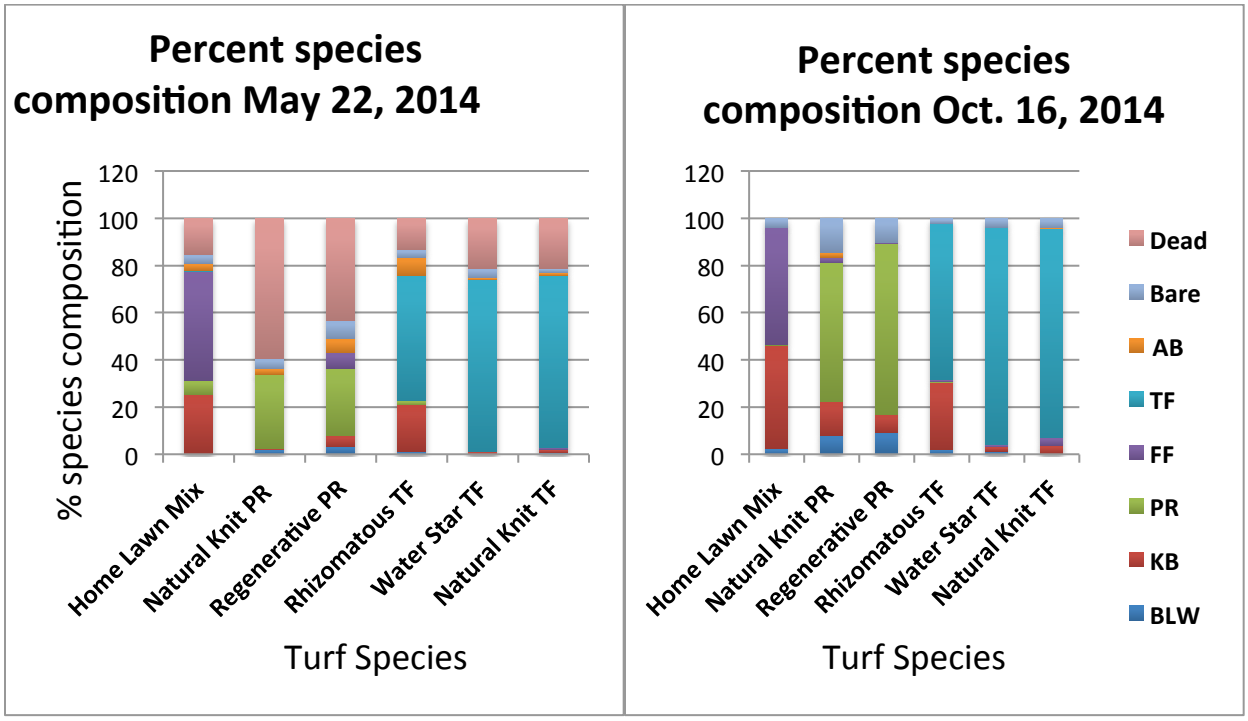

Figure 5. Percent species composition May 22 and Oct. 14, 2014.

Conclusions

Tall fescue

All of the tall fescue cultivars in this trial needed the full 2013 growing season to become completely established (Figure 4). The HLM and the PR cultivars had some bare areas in the spring of 2013 but these did not differ significantly from each other.

The tall fescue cultivars were moderately winter-hardy as seen by the percent TF from the Oct. 11,2013 rating date to the May 22, 2014 rating date. As far as the ability to spread and fill in, the RTF went from 52.87-66.00%, the NKTF went from 72.75-88.5% and the Water Star® went from 72.75 to 92.12% during the 2014 growing season. The spreading types (RTF and NKTF) filled in as well as the non-spreading type (Water Star®). All of the tall fescue cultivars were able to out-compete the BLW as well as HLM at the end of 2013 and 2014.

Perennial Ryegrass

The spreading perennial ryegrass cultivars established quickly as is expected of this species. Also, NKPR was the least winter-hardy of the two cultivars with 59.62% dead/brown compared to 43.37 % for RPR after the 2013/2014 winter. The RPR showed superior spreading growth during the 2014 growing season (28.62 cover to 72.50%) vs. NKPR that only went from 31.25 to 58.87% PR cover. With the inferior ability to spread, the NKPR had the highest BLW invasion at the end of the study. The spreading PR cultivars were able to out-compete weeds to the same extent as the tall fescue cultivars and the HLM during the first growing season. After the extensive winter kill, the spreading PR cultivars could not outcompete the BLW as well as the tall fescue cultivars and the HLM.

Home Lawn Mix

By the end of the 2013 growing season the HLM was well established and composed of 54.25% KB, 26.37% PR and 18.12% FF. This is different from the HLM ratios in the earlier study conducted in 2011 (Charbonneau and Brownbridge, 2015) where the irrigated HLM at the end of the first growing season was 15.75% KB, 32.75% PR, 39.75% FF and 16.5% BLW. By contrast the non-irrigated HLM In that study was 0.5% KB, equal parts PR and FF (20.5%), 15.5% BLW and 37.5% bare. It appears that the temperature and rainfall in the fall and the following growing season have a large impact on the final species composition of a HLM.

After the 2013/2014 winter the HLM plots lost PR also (from 26.37% to 5.62%) and by the end of the trial there was roughly 50% each of KB and FF and there was almost no PR in these plots.

Grub invasion

In the fall of 2013 and spring of 2014, six cup changer plugs of turf per plot were examined for the presence of grubs. The results are shown in Table 3. It was not determined which grub species were present, but it is likely that they were European chafer grubs.

Table 3. Number of grubs per plot for 2013 and 2014

Treatment	Oct. 2013	May 2014
RTF	ns	0.98 a[1]
RPR	ns	0.48 b
NKTF	ns	0.67 b
NKPR	ns	0.25 b
Water Star®	ns	0.56 b
HLM	ns	0.71 b

[1] Average number of grubs per golf course cup changer. Means within columns followed by the same letter are not significantly different (Tukey's HSD, p=0.05).

The grub count in the fall, 2013 showed no significant differences between the species/mixture treatments and in spring, 2014 the RTF had significantly more grubs. Overall, the numbers were very low and probably not a true indication of a preference for grub feeding for any of these species.

References

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