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This publication includes lecture notes of papers presented at the 2018 GREEN EXPO Turf and Landscape Conference. Publication of these lectures provides a readily available source of information covering a wide range of topics and includes technical and popular presentations of importance to the turfgrass industry.

This proceedings also includes research papers that contain original research findings and reviews of selected subjects in turfgrass science. These papers are presented primarily to facilitate the timely dissemination of original turfgrass research for use by the turfgrass industry.

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TALL FESCUE AND KENTUCKY BLUEGRASS MIXTURE RESEARCH, 2018

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KEY RESEARCH FINDINGS

- Wear during autumn did not influence species composition of tall fescue (TF) and Kentucky bluegrass (KBG) mixtures when seeded at a TF/KBG mixing ratio of 90:10 (w/w). Kentucky bluegrass cultivars capable of producing high turf quality (Midnight II and Blue Note) reduced TF composition of mixes well below 50%. Tall fescue populations were greater in mixtures with lower quality KBG cultivars. Tall fescue cultivar choice had minimal impact on KBG and TF populations in mixes.
- Mixing Kentucky bluegrass with better performing tall fescue cultivars had limited benefits to overall turfgrass quality; however, turf quality of a moderate performing tall fescue cultivar (Greenkeeper) was improved when mixed with high quality Kentucky bluegrass cultivars (Midnight II and Blue Note).
- Kentucky bluegrass cultivar choice was the dominant factor affecting the severity of brown patch on KBG and TF mixes. Mixes with Midnight II and Blue Note KBG had less damage caused by brown patch compared to TF alone and mixes with lower quality KBG experimental selections.

Tall fescue (TF; *Schedonorus arundinaceus* [Schreb.] Dumort.) and Kentucky bluegrass (KBG; *Poa pratensis* L.) are commonly established on athletic fields, golf course roughs, home lawns, and parks throughout the north, central, and transition zones of the United States (Meyer and Funk, 1989). Mixtures of TF and KBG are popular with sod producers within the transition zone of the United States; mixing the two species provides a broader range of genetic diversity and tolerance to environmental stresses (Bonos and Huff, 2013). Inclusion of KBG with TF has been shown to improve turf quality and reduce brown patch disease incidence (caused by *Rhizoctonia solani*) compared to some TF cultivars alone (Reynolds et al., 2005).

Kentucky bluegrass has vigorous, dense rhizome and root systems making it a useful species for sod production and provides excellent recuperative ability in athletic fields (Beard, 1973). However, there continues to be concern with KBG dominating the mixture resulting in segregation (i.e., clumping) of TF plants as isolated patches. Turfgrass research has previously assessed species segregation. Juska et al. (1969) reported that a seeded mixture of 'Kentucky 31' TF and common type KBG bluegrass produced more TF clumps compared to TF seeded alone. Brede (1993) found that the tendency for species segregation was more likely when common-type TF was in the mix compared to improved turf-type TF.

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[1]Adapted from: Park, B.S., H. Samaranayake, and J.A. Murphy. 2017. Response of tall fescue and Kentucky bluegrass mixtures to wear. International Turfgrass Society Research Journal 13:346-352.

The recent literature is lacking information on the performance of mixtures comprised of newer TF and KBG cultivars. Moreover, there is a dearth of information on the species composition response of TF and KBG mixtures subjected to traffic stresses. The objectives of this study were to assess the performance and species composition of TF and KBG mixtures containing newer cultivars and subjected to autumn wear.

MATERIALS AND METHODS

The trial was conducted on a loam at the Rutgers Horticultural Farm II in North Brunswick, NJ during 2010 through 2014. Four unique TF cultivars (Falcon V, Mustang 4, Justice, and Greenkeeper) and four genetically diverse types of KBG including the cultivars Midnight II (Compact-Midnight type) and Blue Note (Compact-America type) and the experimental selections A05-361 (Mid-Atlantic ecotype) and A05-344 (Shamrock type) were used to seed 16 mixtures. Compact-Midnight type cultivars are capable of producing excellent turfgrass quality (Park et al. 2005). Similarly, Blue Note was among entries with the best multi-year (2006 to 2010) average turfgrass quality across five Northeast USA locations in the 2005 National Turfgrass Evaluation Program (NTEP) Kentucky Bluegrass Test (NTEP, 2016). In a Rutgers turf trial, A05-361 exhibited moderate turf quality while A05-344 exhibited poor turf quality (Wilson et al., 2010). Tall fescue cultivar selection represented a range of moderate to high turf quality performance (Falcon V and Mustang 4 = high turf quality; Justice = moderate to high turf quality; Greenkeeper = moderate turf quality) (Saxena et al., 2010).

Mixtures were seeded at a rate of 194 and 21 lb per acre of TF and KBG, respectively, which corresponded to a TF:KBG mixing ratio of 90:10 (w/w) or an approximately equal number of TF and KBG seeds (Beard, 1973). Additionally, each TF cultivar was seeded alone at 389 lb per acre; this TF-only seeding rate resulted in an approximate equal number of seeds per acre relative to the TF and KBG mixtures. All plots were seeded during September 2010.

Wear was applied as a strip across half of each plot using the Rutgers Wear Simulator (Bonos et al., 2001; Park et al., 2016) during autumn 2011, 2012, and 2013 to correspond with play on North American football fields; the other half of each plot did not receive wear treatment.

The trial was mowed twice per week at 1.5 inches and irrigated when necessary to avoid drought stress during the growing season (i.e., April through November). The trial was fertilized with nitrogen at 44 lb per acre at seeding in 2010 and 161,102, 136, and 115 lb per acre per year during 2011 through 2014, respectively. Soil testing indicated sufficient soil P and K; lime was applied in November 2011 to adjust soil pH.

Data Collection

Species composition of plots was assessed by visual identification of 24 selected leaves from each plot in July 2012 and August 2013 and 2014.

Plots were visually rated by one evaluator for turf quality at the end of each autumn wear period and May and August of the next year to assess recovery during 2011 through 2014. Plots were rated using a 1 to 9 scale with 9 representing the most complete, uniform turf cover; 6 was considered acceptable quality. Damage from brown patch was visually assessed in August 2012 and July 2013 using a 1 to 9 scale, where 9 represented no disease damage.

Data were analyzed using a 5 (no-KBG, Midnight II, Blue Note, A05-361, and A05-344) x 4 (Falcon V, Mustang 4, Justice, and Greenkeeper TF [main plots]) x 2 (No Wear and Wear) factorial arrangement arranged in a strip plot design. All data were subjected to analysis of variance. Wear treatments (No Wear and Wear) were considered different based on a significant *F* statistic. Main plot means were separated using Fisher's protected least significant difference ($p \leq 0.05$).

RESULTS AND DISCUSSION

Species Composition

Wear during autumn had no effect on TF population of mixes in any of the three years of this trial. We hypothesized that wear would have shifted species composition lowering TF population in favor of greater KBG given the rhizomatous growth and presumed greater post-wear recuperative potential of KBG compared to TF.

TF populations were much smaller in mixes that contained Midnight II and Blue Note KBG than A05-361 and A05-344 KBG regardless of TF cultivar in all three years (Table 1). By the end of the trial, TF composition was 37 and 44% in Midnight II and Blue Note KBG mixes, respectively, while mixes with A05-361 and A05-344 KBG had 75 and 79% TF, respectively. These differences were attributed to overall better turfgrass quality and competitiveness of Midnight II and Blue Note KBG compared to A05-361 and A05-344 KBG.

Tall fescue cultivar choice did not affect influence species composition in 2012 and the effect in 2013 and 2014 was small relative to the effect of Kentucky bluegrass on species composition in 2013 and 2014 (Table 1). Tall fescue populations were no more than 10% greater in Falcon V, Mustang 4, and Justice TF mixes compared to Greenkeeper TF mixes.

Turfgrass Quality

Not surprisingly, wear reduced turfgrass quality at the end of autumn-wear periods. Tall fescue and KBG influenced turfgrass quality as main effects at the end of the first autumn-wear period in October 2011. In subsequent years these species factors interacted to influence turfgrass quality at the end of the wear periods (November 2012 and October 2013); thus TF and KBG cultivar choice became more important as the study progressed in both Wear and No Wear plots.

Mixing KBG with Falcon V, Mustang 4, or Justice TF did not improve turfgrass quality compared to each TF alone at the end of wear periods in 2012 and 2013 (Table 2). Conversely, the turfgrass quality of Greenkeeper TF was better when mixed with Midnight II or Blue Note KBG while mixing with A05-361 and A05-344 KBG had no effect on quality. Turfgrass quality responses in our study indicate that mixing KBG with better performing cultivars of TF may have limited benefits to turfgrass quality.

Brown Patch

Kentucky bluegrass was the dominant species factor affecting the severity of brown patch disease severity on mixes in 2012 and 2013. All mixes with Midnight II KBG had less damage caused by brown patch than the individual TF cultivars alone (Table 3). Blue Note KBG mixed with most TF cultivars had less damage caused by brown patch than the individual TF cultivars; Blue Note KBG did not improve brown patch tolerance when mixed with Falcon V TF. Disease effects on mixes with A05-361 and A05-344 KBG were strongly dependent on the TF cultivar. A05-361 or A05-344 KBG mixed with Falcon V and Mustang 4 TF did not reduce damage compared to these tall fescue cultivars alone, whereas A05-361 or A05-344 KBG mixed with Justice and Greenkeeper TF did reduce damage compared these TF cultivars alone. Thus, Midnight II and Blue Note KBG had a strong positive influence on the brown patch tolerance of mixtures with TF compared to A05-361 and A05-344 KBG. A05-361 and A05-344 KBG only improved brown patch tolerance of TF cultivars (Justice and Greenkeeper) that were more susceptible to the disease, and the improvement in tolerance was less than that provided by Midnight II and Blue Note KBG.

CONCLUSIONS

Turfgrass sod producers and managers should recognize that KBG cultivar choice can strongly influence the species composition and turfgrass quality of TF and KBG mixtures. Our data indicate that while autumn wear did not influence species composition, KBG cultivars capable of producing exceptional turf quality can reduce TF composition of mixes well below 50% when mixed with TF as well as reduce stand susceptibility to brown patch. The tendency for a mixed KBG and TF stand to become clumpy and non-uniform will likely increase as the composition of TF in the stand decreases.

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Table 1. Tall fescue populations of species mixtures in 2012, 2013, and 2014.

Main Effects	July 2012	August 2013	August 2014
	----------(%)[1]----------		
Tall fescue (TF)			
Falcon V + KBG	71	66 a	71 a
Mustang 4 + KBG	70	65 a	66 ab
Justice + KBG	71	67 a	70 a
Greenkeeper + KBG	65	58 b	61 b
Kentucky bluegrass (KBG)			
None (TF alone)	100 a	100 a	100 a
Midnight II + TF	48 c	36 d	37 c
Blue Note + TF	50 c	46 c	44 c
A05-361 + TF	72 b	69 b	75 b
A05-344 + TF	75 b	69 b	79 b

[1] Species composition of plots was assessed by visual identification of randomly selected tillers from each plot

Table 2. Turfgrass quality at the end of the autumn-wear periods in 2012 and 2013 as affected by the interaction of tall fescue and Kentucky bluegrass.

Kentucky Bluegrass	Tall Fescue (TF) (November 2012)				Tall Fescue (October 2013)			
	Falcon V	Mustang 4	Justice	Greenkeeper	Falcon V	Mustang 4	Justice	Greenkeeper
	1 to 9 Scale[1]							
None (TF alone)	6.7 aA[2]	5.8 abB	5.7 abB	4.3 bC	8.2 aA	7.7 aAB	7.3 abB	6.2 bcC
Midnight II	6.7 aA	6.3 aA	6.3 aA	6.0 aA	7.5 aA	7.5 aA	8.0 aA	8.0 aA
Blue Note	6.0 aA	5.5 bAB	5.2 bB	5.3 aAB	8.0 aA	7.5 aAB	7.2 bB	7.5 aAB
A05-361	6.0 aA	5.8 abA	5.5 bA	4.3 bB	7.8 aA	7.7 aAB	7.0 bBC	6.7 bC
A05-344	6.2 aA	5.5 bAB	5.3 bB	4.3 bC	7.8 aA	7.5 aA	7.5 abA	5.7 cB

[1] Visual rating, where 9 represented the most complete, uniform turf cover; 6 equaled acceptable turfgrass quality

[2] Means followed by the same letter (lowercase: columns; uppercase: rows) within a sampling date are not significantly different ($p \leq 0.5$)

Table 3. Brown patch severity as affected by the interaction of tall fescue and Kentucky bluegrass in July 2013.

Kentucky Bluegrass	Tall Fescue (TF)			
	Falcon V	Mustang 4	Justice	Greenkeeper
	----------1 to 9 Scale[1]----------			
None (TF alone)	5.7 bA[2]	5.2 cA	2.8 cB	2.3 dB
Midnight II	8.0 aA	7.3 aA	7.5 aA	8.3 aA
Blue Note	6.2 bA	7.0 abA	7.7 aA	7.2 abA
A05-361	5.8 bAB	4.8 cB	4.8 bB	6.5 bA
A05-344	5.7 bA	5.5 bcAB	4.8 bAB	4.0 cB

[1] Visual rating, where 9 represented no observed brown patch disease

[2] Means followed by the same letter (lowercase: columns; uppercase: rows) within a sampling date are not significantly different ($p \leq 0.5$)