Impact of Mowing Height and Nitrogen Fertility on Crabgrass Cover in 'RTF' Tall Fescue[1]

Matthew Cutulle[2], Jeffrey Derr[3], David McCall[4], Adam Nichols[5], and Brandon Horvath[6]

Abstract

Tall fescue (*Festuca arundinacea* Shreb.) has exceptional utility as a low maintenance lawn in the transition zone. However, during the summer smooth crabgrass [*Digitaria ischaemum (Schreb.) Schreb. ex Muhl.*] infestations can reduce the aesthetic value and function of the turf and lead to a thinning of the tall fescue stand, noticeable after the crabgrass plants have senesced. Research was conducted to evaluate the impact of mowing height and nitrogen fertility on smooth crabgrass plant counts and tall fescue cover in Virginia Beach, VA. Plots were mowed at either 6 cm (2.5 in) or 10 cm (4 in) and received 49, 171, or 220 kg of nitrogen annually per hectare (44, 152, and 196 $lb \cdot A^{-1}$). Mowing at 10 cm with the highest level of fertility resulted in the most turfgrass cover among all the treatment combinations. Mowing at 10 cm as opposed to 6 cm resulted in less smooth crabgrass plants, regardless of nitrogen fertilization rate.

Index words: fertilization, turfgrass, weed control.

Species used in this study: Smooth crabgrass [*Digitaria ischaemum (Schreb.) Schreb. ex Muhl.*]; tall fescue [*Festuca arundinacea* Shreb. synonym *Schedonorus phoenix* (Scop.) Holub].

Significance to the Horticulture Industry

Tall fescue is the predominant cool-season turf species in the transition zone. This study was conducted to determine the impact of mowing height and fertilization rate on the ability of smooth crabgrass to invade tall fescue turf. When the mowing height was reduced from 10 cm (4 in) to 6 cm (2.5 in), smooth crabgrass cover increased significantly. Increasing the nitrogen fertilization rate from 49 to 220 $kg \cdot ha^{-1}$ (44 to 196 $lb \cdot A^{-1}$) did not impact smooth crabgrass density. Tall fescue cover decreased dramatically when mowed at 6 cm, with essentially no turf cover at 18 months after study initiation. Tall fescue cover did not decrease as dramatically when moved at 10 cm, and its cover appeared to be higher at higher nitrogen rates.

Introduction

Tall fescue has many desirable agronomic qualities, including dark green color, that make it a popular turfgrass. Tall fescue has great utility as a turfgrass in the transition zone climate. It can be used in multiple situations such as home lawns, community parks, lower maintenance athletic fields, golf course roughs and other low maintenance turfgrass areas (Watkins and Meyer 2004). Tall fescue exhibits adequate shade tolerance, is adapted to different types of soils, and can be mowed at 4 cm or more, making it a reliable choice for the aforementioned situations. Tall fescue has adequate drought tolerance for a cool-season grass, insect resistance, high turf density, and relatively low fertilizer requirements (Watkins and Meyer 2004).

Tall fescue is resistant to most diseases; however, the fungal pathogen *Rhizoctonia solani* Kuhn (Piper and Coe 1919) can inflict significant damage to this turfgrass species. There is no known cultivar that is highly resistant to brown patch, the disease caused by *R. solani* (Yuen et al., 1994). Nevertheless, tall fescue genotype does influence the degree of tolerance. Tall fescue cultivars with ideal agronomic traits such as narrow blades and dense canopies have been associated with increased susceptibility to brown patch. Other pests that are problematic in tall fescue either by themselves or as the result of brown patch thinning the turf are warm-season weedy grasses. Large, smooth, and southern crabgrass [*Digitaria* sanguinalis (L.) Scop.], *D. ischaemum Schreb*. Ex Muhl, *D. ciliaris R*etz.) Koel.) and bermudagrass [*Cynodon dactylon* (C.) Pers.] are opportunistic and very problematic weeds in tall fescue turf. These C4 grasses may be found in lawns under a range of management conditions, especially where the turf has been thinned. Management strategies can contribute to both disease and weed infestation of a tall fescue stand, including crabgrass (*Digitaria* spp.) infestations (Ferrell et al. 2003). Proper cultural practices and preemergence herbicide application will reduce crabgrass infestations in tall fescue stands.

Cultural management strategies are an important component of a pest control program. Mowing, fertilization, cultivation, irrigation, planting and turfgrass selection are all practices that can impact the quality of a turfgrass stand. Additionally, optimization of these practices can reduce the need for chemical input. In lower maintenance turfgrass, such as tall fescue used in home lawns and parks, the most important cultural practice may be mowing (Busey 2003).

Multiple studies have shown that in general increasing nitrogen levels reduces the stand of crabgrass and broadleaf

[1]Received for publication June 21, 0218; in revised form September 10, 2018.

[2]Former Graduate Research Assistant, Dept. Plant Pathol., Physiol., and Weed Sci., Virginia Tech. Current address: Assistant Professor, Clemson University, Coastal Research and Education Center, 2700 Savannah Hwy, Charleston, SC 29414. Corresponding author mcutull@clemson.edu.

[3]Professor, Virginia Tech, Hampton Roads Ag. Res. & Ext. Center, Virginia Beach, VA 23455.

[4]Assistant Professor, School of Plant and Environmental Sciences, Virginia Tech, Glade Road Research Center, Blacksburg, VA 24061.

[5]Research Assistant, Virginia Tech, Hampton Roads Ag. Res. & Ext. Center, Virginia Beach, VA.

[6]Associate Professor, Plant Science Department, 252 Ellington Plant Science Building, 2431 Joe Johnson Drive, Knoxville, TN 37996.

weeds in multiple cool-season grass species (Voigt et al. 2001, Haley et al. 1985, Dunn et al. 1981, Murray et al. 1983). However, nitrogen application timing does have an effect on weed control. In a tall fescue study, fall fertilization resulted in less crabgrass cover than spring fertilization (Hall 1980). Various studies have shown that applications of nitrogen to tall fescue in the spring and summer increase brown patch (Fry and Huang, 2004). Typically, the ratio of shoot growth to root growth for cool-season grasses is greater during the spring than the fall. Applying a quick-release nitrogen source to tall fescue in the spring will promote succulent shoot growth that a pathogenic fungus such as *Rhizoctonia solani* will parasitize in warm, humid conditions. Any increase in disease could increase turf thinning, thus increasing weed density due to reduced turf competition. The objectives of this research were to determine the impact of mowing height and nitrogen fertilization rate and timing on tall fescue cover and smooth crabgrass infestations.

Materials and Methods

The study was conducted at the Hampton Roads Agricultural Research and Extension Center in Virginia Beach, Virginia in 2008 and 2009. Plots were 3.7 m (12 ft) by 1.5 m (5 ft) in dimension. The experiment was arranged as a split block with 4 replications per treatment combination. The trial was initiated on April 1st for both studies. Treatments consisted of a factorial design with plots being mowed at either 6 or 10 cm with subplots receiving treatments of 49 (low), 171 (medium), and 220 (high) $kg{\cdot}ha^{-1}$rates of nitrogen annually per hectare in each plot within the strip. The low nitrogen treatment consisted of one treatment of 49 $kg{\cdot}ha^{-1}$ of nitrogen in November. Plots in the medium fertility program received 49 $kg{\cdot}ha^{-1}$ of nitrogen in October, 49 kg ha^{-1} of nitrogen in November, 49 $kg{\cdot}ha^{-1}$ of nitrogen in December and 24 $kg{\cdot}ha^{-1}$ in May. The high nitrogen fertility program consisted of 49 $kg{\cdot}ha^{-1}$ of nitrogen in October, 49 $kg{\cdot}ha^{-1}$ of nitrogen in November, 49 $kg{\cdot}ha^{-1}$ of nitrogen in December, 24 $kg{\cdot}ha^{-1}$ in May, 24 $kg{\cdot}ha^{-1}$ in June and 24 $kg{\cdot}ha^{-1}$ in August. All nitrogen applications were made on the 1st of the assigned month with the exception of August application, which was made on the 15th of that month. Smooth crabgrass counts were recorded in June, July and August while percent turfgrass cover was recorded 6, 12, 18, and 24 months after the trial was initiated. All data was subjected to analysis of variances using SAS mixed model methodology (SAS institute, Cary, NC).

Results and Discussion

Impact of mowing height and nitrogen application on smooth crabgrass encroachment in 2008. Mowing height had a significant effect on smooth crabgrass plant counts taken throughout the summer. Nitrogen application did not have a significant effect on smooth crabgrass counts and there were no significant interactions between mowing height and fertility on smooth crabgrass counts. In July of 2008, the most smooth crabgrass plants were observed in plots mowed at 6 cm receiving the highest fertility treatment. These plots contained approximately 14 crabgrass plants (Table 1). Plots mowed at 6 cm receiving low and medium fertility levels contained 8 and 13 crabgrass plants respectively. Minimal smooth crabgrass plants were observed in the plots mowed at 10 cm. All smooth crabgrass counts in the higher mowing height were less than 2 per plot regardless of fertility.

Table 1. Impact of mowing height and fertility on smooth crabgrass plant counts in July, August and September for the 2008 Virginia Beach trial[z].

Mow Height (cm)	N $kg{\cdot}ha^{-1}$	July counts	August counts	September counts
10	49	1.8 b	5.8 b	15.7 b
10	171	0.8 b	6.5 b	18.5 b
10	220	2.3 b	8.5 b	10.5 b
6	49	8.3 ab	42.5 a	52.5 a
6	171	13.3 a	39.5 a	53.5 a
6	220	14.5 a	41.5 a	51.5 a

[z]Means with the same letter within the same column are not significantly different according to the Fisher's protected least significant difference test at the 0.05 level

In August of 2008, mowing tall fescue at 6 cm treated with low, medium or high levels of nitrogen resulted in approximately 41 smooth crabgrass plants per plot (Table 1). Plots mowed at 10 cm contained 6 to 9 smooth crabgrass plants when treated with low, medium or high levels of nitrogen.

September was the last month that smooth crabgrass cover was recorded. In September of 2008, plots mowed at 6 cm receiving the low, medium or high rates of nitrogen were covered with between 51 and 54 smooth crabgrass plants (Table 1). Plots mowed at 10 cm contained approximately 14 smooth crabgrass plants when treated with low, medium or high rates of nitrogen.

Impact of mowing height and nitrogen application on smooth crabgrass encroachment in the 2009 trial. In 2009 mowing height had a significant effect on percent smooth crabgrass cover at every rating date. More smooth crabgrass plants were observed in 2009 versus 2008. In July of 2009, mowing at 6 cm resulted in 30, 27, and 25 smooth crabgrass plants when treated with low, medium and high rates of nitrogen, respectively (Table 2). Mowing at 10 cm resulted in approximately 5 smooth crabgrass plants regardless of nitrogen treatment in July of 2009.

Plots mowed at 6 cm receiving the medium level of nitrogen contained 56 smooth crabgrass plants in August, which was the highest total number of smooth crabgrass plants recorded for August out of all the treatment combinations. Smooth crabgrass plants in plots mowed at 6 cm treated with low and high levels of fertility ranged from 44 to 50. Smooth crabgrass counts in plots mowed at 10 cm receiving the low, medium and high levels or nitrogen was approximately 13. In September, plots mowed at 6 cm were almost completely covered in smooth crabgrass. All plots mowed at 6 cm contained greater than 80 smooth crabgrass plants. Plots mowed at 10 cm receiving low, medium and high levels of fertility contained 20 to 27 smooth crabgrass plants.

Table 2. Impact of mowing height and fertility on smooth crabgrass plant counts in July, August and September for the 2009 Virginia Beach trial[z].

Mow Height (cm)	N kg·ha^{-1}	July counts	August counts	September counts
10	49	5.2 b	15.1 b	35.0 b
10	171	5.4 b	12.4 b	37.2 b
10	220	5.8 b	12.7 b	30.1 b
6	49	30.4 a	44.5 a	93.2 a
6	171	27.3 a	56.1 a	94.5 a
6	220	25.2 a	50.2 a	88.2 a

[z]Means with the same letter within the same column are not significantly different according to the Fisher's protected least significant difference test at the 0.05 level

Impact of mowing height and nitrogen application on turfgrass cover. In the 2008 study, greater tall fescue turf cover was observed in the 10 cm-mowed plots compared to the 6 cm-mowed plots on all evaluation dates (Fig. 1). Reduction in turfgrass cover was observed between 12 and 18 months after establishment. During the latter part of the study, a fertility effect was noticeable. Twenty-four months after the trial was established, tall fescue mowed at 10 cm treated with the high nitrogen treatment contained significantly more turf when compared to all other treatment combinations. Turfgrass cover decreased at least 20% in all treatments between 6 and 24 months after trial establishment. Similar trends were observed in the 2009 study, though the turfgrass coverage was not as high as was seen in the 2008 study. Mowing at 10 cm resulted in greater turfgrass cover compared to 6 cm until 18 months after establishment (Figure 2). No fertility effect was observed in the 2009 study. A large reduction of turfgrass cover was observed between 12 and 18 months after the study was established. Twenty four months after establishment, mowing at 10 cm resulted in approximately 10% turf cover while mowing at 6 cm resulted in approximately 5% turf cover.

Brown patch ratings were of little importance and severity because of the limited tall fescue cover in these studies. Brown patch infestations may have aided the infestation of crabgrass due to turf thinning. But analysis of brown patch epidemics as impacted by the mowing and fertility treatments are difficult to analyze with low tall fescue cover. Previous studies using a preemergence herbicide have

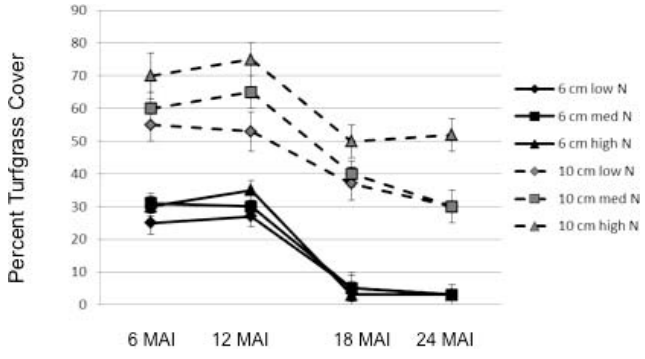

Fig. 1. Impact of mowing height and nitrogen fertility on percent turf cover 6 to 24 months after the trial was initiated (MAI) in the 2008 trial.

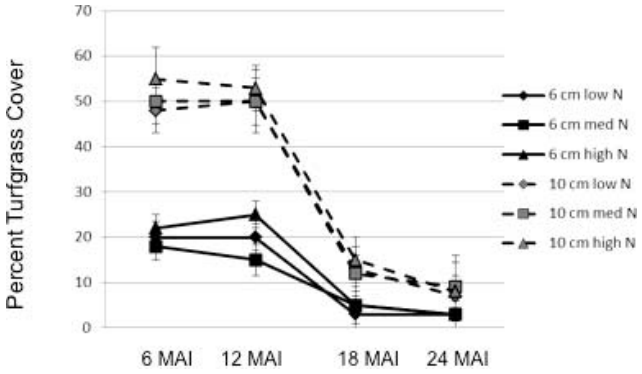

Fig. 2. Impact of mowing height and nitrogen fertility on percent turfgrass cover 6 to 24 months after the trial was initiated (MAI) in the 2009 trial.

shown that mowing low led to more brown patch at the end of the epidemic, but not necessarily the beginning (Cutulle et al. 2014). In some years brown patch was correlated with weed species encroachment (Cutulle et al. 2013).

Growing tall fescue in the hot, humid summers of southeastern Virginia is difficult. Optimizing cultural practices is important for maintaining the integrity of tall fescue stands. Based on this study, mowing at 10 cm with higher fertility will limit crabgrass infestations. Additionally, tall fescue cover was higher in the plots mowed at 10 cm. These results compliment the studies cited in the review by Busey (2003). After two years, none of the plots in the current studies had desirable turf cover, which means chemical input is likely necessary. Therefore, a preemergence herbicide applied in the spring with implementation of a 10 cm high mowing program and high nitrogen fertility in fall for tall fescue would be optimal for reducing crabgrass infestations and maintaining acceptable turfgrass cover in the transition zone. One of the major difficulties about implementing this strategy is the lack of commercially available mowers for homeowners that can adjust to a 10 cm height of cut. Most mowers available to homeowners cut below 10 cm, probably due to safety and lack of demand for mowers with a raised height of cut. This research suggests that more mowers with increased range of cut height should be manufactured in order to effectively manage tall fescue grown in stressful summer conditions.

Literature Cited

Busey, P. 2003. Cultural management of weeds in turfgrass: A review. Crop Sci. 43:1899–1911.

Cutulle, M.A., J.F. Derr, D. McCall, B. Horvath, and A.D. Nichols. 2013. Impact of hybrid bluegrass and tall fescue seeding combinations on brown patch severity and weed encroachment. HortScience. 48:493–500.

Cutulle, M.A., J.F. Derr, D. McCall, B. Horvath, and A.D. Nichols. 2014. Effect of mowing height and fertility on bermudagrass (*Cynodon dactylon*) encroachment and brown patch severity in tall fescue. Wed Technol. 28:225–232.

Dunn, J.H., C.J. Nelson, and R.D. Winfrey. 1981. Effects of mowing and fertilization on quality of ten Kentucky bluegrass cultivars. p.293–301 *In* R.W. Sheard (ed.) Proc. 4th Int. Turfgrass Res. Conf., Guelph, ON, Canada. 19–23 July 1981. Ontario Agric. College, Univ. Guelph and Int. Turfgrass Soc., Guelph, ON, Canada.

Ferrell, J.A., T.R. Murphy, L.L Burpee, and W.K. Vencill. 2003. Effect of brown patch (Caused by *Rhizoctonia solani*) control on preemergence

herbicide efficacy in tall fescue (*Festuca arundinacea*). Weed Technol. 17:747–750.

Fry, J and B, Huang. 2004. Applied Turfgrass and Physiology. 236 p.

Gray, E., and N.M. Call. 1993. Fertilization and mowing on persistence of Indian mockstrawberry (*Duchesnea indica*) and common blue violet (*Viola papilionacea*) in a tall fescue (*Festuca arundinacea*) lawn. Weed Sci. 41:548–550.

Haley, J.E., D.J. Wehner, T.W. Fermanian, and A.J. Turgeon. 1985. Comparison of conventional and mulching mowers for Kentucky bluegrass maintenance. HortScience 20:105–107.

Hall, J.R., III. 1980. Effect of cultural factors on tall fescue-Kentucky bluegrass sod quality and botanical composition. p. 367–377 *In* J.B. Beard (ed.) Proc. 3rd Int. Turfgrass Res. Conf., Munich, West Germany, July 11-13, 1977. ASA, CSSA, SSSA, and Int. Turfgrass Soc., Madison, WI.

Murray, J.J., D.L. Klingman, R.G. Nash, and E.A. Woolson. 1983. Eight years herbicide and nitrogen fertilizer treatments on Kentucky bluegrass (*Poa pratensis*) turf. Weed Sci. 31:825–831.

Piper, C.V. and H.S. Coe. 1919. *Rhizoctonia* in lawns and pastures. Phytopathology. 9:89–92.

Voigt, T.B., T.W. Fermanian, and J.E. Haley. 2001. Influence of mowing and nitrogen fertility on tall fescue turf. Int. Turfgrass Soc. Res. J. 9:953–956.

Watkins, E. and W.A. Meyer. 2004. Morphological characterization of turf type tall fescue genotypes. HortScience. 39: 615–619.

Yuen, G. Y., L. J. Giesler, and G. L. Horst. 1994. Influence of canopy structure on tall fescue cultivar susceptibility to brown patch disease. Crop Prot. 13:439–442.