International Turfgrass Society
Research Journal Volume 11, 2009

CULTURAL PRACTICE EFFECTS ON THE SPRING TRANSITION OF OVERSEEDED MEADOW FESCUE AND TETRAPLOID PERENNIAL RYEGRASS SPORTS FIELDS

Joshua A. Summerford*, Douglas E. Karcher, Michael D. Richardson, Aaron J. Patton, and John W. Boyd

ABSTRACT

Overseeding is a common practice used by turf managers in the southern United States to provide actively growing, green turfgrass surfaces during winter dormancy of warm-season grasses such as bermudagrass (*Cynodon dactylon* Pers., *C. dactylon x transvaalensis* Burtt-Davy). The most commonly used turfgrass species for overseeding is perennial ryegrass (*Lolium perenne* L.) due to its excellent turfgrass quality and rapid establishment. Continued breeding improvements in heat, disease, and drought tolerance of perennial ryegrasses have resulted in cultivars that persist into the summer and interfere with the spring green-up of bermudagrass. Two new turfgrass species, meadow fescue (*Festuca pratensis* Huds.) and tetraploid perennial ryegrass (*Lolium perenne* L. 2n=4x=28), have demonstrated good turfgrass characteristics in overseeding as well as easier spring transition to bermudagrass. Turf managers often employ various cultural practices to hasten the spring transition of an overseeded species back to bermudagrass. The objective of this study was to determine the effect of some commonly used cultural practices, including core aerification, scalping, vertical mowing, and a combination of scalping and vertical mowing, on the spring transition of these new species. Cultural practice treatments were applied to bermudagrass sports turf overseeded with meadow fescue, diploid perennial ryegrass, or tetraploid perennial ryegrass plots at two experimental sites during the spring of 2007 Aggressive cultural practices showed slight increases in bermudagrass presence on some evaluation dates in meadow fescue and tetraploid perennial ryegrass overseeded turfgrass; however, cultural practices did not hasten the complete transition back to bermudagrass, regardless of species.

Keywords: score aerification, overseeding, scalping, vertical mowing

J.A. Summerford, D.E. Karcher, M.D. Richardson, and A.J. Patton, Dep. of Horticulture, Univ. of Arkansas, 316 Plant Sciences Bldg., Fayetteville, AR 72701 USA;
J.W. Boyd, Cooperative Extension Service, Little Rock, AR, 2301 S University, Little Rock, AR 72204 USAReceived __________. *Corresponding author (jasummer@uark.edu).

INTRODUCTION

The practice of overseeding is common in the southern United States and is necessary to meet the demand for high quality sports turf surfaces year round (Horgan and Yelverton, 2001). Overseeding is commonly used in areas where warm-season grasses go dormant in the winter months. Cool-season turfgrasses are used for overseeding in the fall to provide actively growing turfgrass during the winter, provide green color, and to maintain good playing surfaces by preventing wear on the dormant warm-season grass (Schmidt, 1970; Ward et al., 1974).

Successful overseeding depends on many variables such as seedbed preparation, seeding rate, seeding date, fertility, irrigation, mowing practices, and geographic location (Meyers and Horn, 1968; Meyers and Horn, 1970; Schmidt, 1970; Ward et al., 1974). Although cultural practices are important to the success of an overseeding program, the most important decision is likely the selection of the turfgrass species to use for overseeding. The best overseeding species provide good density and color during the cold winter months, good wear tolerance, and transition times that are concurrent with the spring green-up of bermudagrass (Meyers and Horn 1970; Schmidt 1970; Schmidt and Blaser, 1962; Ward et al., 1974). Although all of these characteristics are important, the selection of a particular species also depends on the turfgrass use (Batten et al., 1981; Dudeck and Peacock, 1981).

Many turfgrasses have been used successfully in overseeding programs, including annual ryegrass (*Lolium multiflorum* Lam.), perennial ryegrass (*L. perenne* L.), intermediate ryegrass (*L. multiflorum* x *L. perenne*), creeping bentgrass (*Agrostis stolonifera* L.), rough bluegrass (*Poa trivialis* L.), and fine fescue (*Festuca* spp.) (Batten et al., 1981; Meyers and Horn, 1970; Schmidt and Blaser, 1962; Schmidt and Shoulders, 1980; Ward et al., 1974). Perennial ryegrass is the most commonly used turfgrass species for overseeding applications, due to its rapid establishment rate, high wear tolerance, ability to tolerate close mowing, medium to fine leaf texture, and a gradual spring transition (Batten et al., 1981; Ward et al., 1974). Perennial ryegrass is the predominant species used to overseed taller turfgrass areas such as sports fields (Schmidt and Shoulders, 1980). Recently developed perennial ryegrass cultivars have improved heat tolerance, drought tolerance, and disease resistance (Horgan and Yelverton, 2001). These improved traits are important for survival in the cool-humid and cool-arid regions of the U.S., but improved perennial ryegrass may persist throughout the summer when used as an overseeded turfgrass, causing problems during transition back to bermudagrass. Problems with spring transition have spurred the development of alternative species such as intermediate ryegrass (Schmitz, 1999; Richardson, 2004) and have increased the need to use of herbicides for chemical transition (Horgan and Yelverton, 1998). Intermediate ryegrass is a hybrid obtained by crossing annual ryegrass and perennial ryegrass, which has better density than annual ryegrass and has been documented to have better transition characteristics than perennial ryegrass (Richardson, 2004). Unfortunately, the quality of intermediate ryegrass is inferior to perennial ryegrass.

There is still a need for improvement and development of new species and cultivars with improved overseeding characteristics. Recently, two species, meadow fescue (*Festuca pratensis* Huds.) and tetraploid perennial ryegrass (*L. perenne* L., $2n = 4x = 28$) have been studied for use in turfgrass overseeding programs (Richardson et al., 2007). Historically, both meadow fescue and tetraploid perennial ryegrass have been used extensively as forage grasses, but have received little interest in turfgrass applications.

Meadow fescue has been used for forage production in North America for over 200 years, and its use was widespread throughout the nineteenth century (Casler and van Santen, 2001). In recent trials, potential was shown for the use of meadow fescue for overseeding dormant bermudagrass due to its good germination, seedling vigor, color, quality, and improved transition characteristics compared to perennial ryegrass (Richardson et al., 2007).

Currently, all major turfgrass cultivars are natural diploids (2n = 2x = 14). However breeders have created tetraploid cultivars (2n = 4x = 28) of perennial ryegrass with improved characteristics, such as vigor, biomass production, and forage quality (Warnock et al., 2005; Sanderson and Elwinger, 2004; Jensen et al., 2003; Smith et al., 2001). A recent study examined the use of a tetraploid perennial ryegrass cultivar developed from turfgrass germplasm, for overseeding dormant bermudagrass (Richardson et al., 2007). This study documented a potential use of tetraploid perennial ryegrass for overseeding due to its satisfactory turfgrass quality and improved spring transition characteristics compared to diploid cultivars of perennial ryegrass.

During the spring transition of an overseeded turfgrass back to bermudagrass, various cultural techniques may be employed to aid in the process. Lowering the mowing height, or scalping, may reduce the shading on emerging bermudagrass from the overseeded species, warm the soil, and inhibit the growth of overseeded grasses (McCarty, 2004). Verticutting is another common practice used during the spring transition period. Verticutting is the use of vertically oriented blades to cut through the turfgrass surface and thatch into the soil. In the case of verticutting during transition, it is usually a non-aggressive method that only removes the surface leaves and thins the overseeded species to allow more sunlight and warmth to penetrate through the canopy to the soil resulting in earlier more rapid growth of the bermudagrass (McCarty, 2004). Core-aerification is another commonly used cultural practice during the spring transition. Removing cores and opening holes in the rootzone allows the soil to warm more quickly, and thereby stimulating bermudagrass green-up. Core-aerification also removes a portion of the overseeded turfgrass canopy reducing competition for sunlight, nutrients, and water with bermudagrass. Scalping, verticutting, and core-aerification are cultural methods that have been commonly used to aid in the transition of overseeding species back to bermudagrass with varying results, (Horgan and Yelverton, 2001) and should be examined for their effects on the transition of tetraploid perennial ryegrass and meadow fescue.

The use of turfgrass species with improved transition characteristics in conjunction with cultural practices to hasten transition could minimize the need for transition herbicides during spring green-up of bermudagrass. The objective of this study was to determine the effects of common cultural practices on the spring transition of overseeded meadow fescue and tetraploid perennial ryegrass to bermudagrass.

MATERIALS AND METHODS

Experimental area

This study was conducted at the University of Arkansas Research and Extension Center in Fayetteville, Arkansas from October 2006 through July 2007, and was replicated on two diverse sites at this location. The first site was on a Captina silt loam (fine-silty, siliceous, active, mesic Typic Fragiudult) with an average pH of 6.2. The other site was on a 13 cm, sand-capped (sand meeting USGA specs., USGA, 2004) Captina silt loam with an average pH of 6.7. A mature sward of ‘Tifway’ hybrid bermudagrass was present on the native soil site and a mature sward of ‘Riviera’ bermudagrass was present on the sand-capped site. Prior to overseeding, trinexapac-ethyl was applied on 12 Sep 2006 to plot areas at a rate of 0.008 g a.i. m^{-2} to slow bermudagrass growth and aid in the establishment of the species to be overseeded. On 15 Sep 2006, the existing bermudagrass was verticut in two directions using a vertical mower set at a depth of 0.7 cm. Following debris removal, plots were scalped to a height of 1.2 cm, and soil was amended with a 10-20-20 starter fertilizer applied at a rate of 50 g N m^{-2}.

All plots were overseeded on 20 Sep 2006 and irrigation was applied two to three times per day during establishment to maintain adequate soil moisture for seed germination. After establishment, irrigation was applied three times per week in the absence of natural rainfall during growing months for an average weekly rate of 3 cm at the sand site and 2 cm at the soil site. The irrigation system was drained from Dec 2006 through mid Feb 2007 to prevent freezing; therefore, no irrigation was applied during that time. When plots were fully established, they were mowed three times weekly at a 1.2 cm height, and fertilized with urea (46-0-0) at a rate of 49.0 kg N ha^{-1} per growing month.

Treatments

Diploid perennial ryegrass, tetraploid perennial ryegrass, meadow fescue and an unseeded control were established in four replicate, 1.8 by 6.1 m strip plots on 20 Sep 2006. The overseeded species were planted at an equivalent pure live seeding rate of 34000 pure live seeds (PLS) m^{-2} (60.8 g m^{-2} 'Integra' diploid perennial ryegrass, 114.3 g m^{-2} 'T3' tetraploid perennial ryegrass, and 63.7 g m^{-2} 'AMF29' meadow fescue). The following spring, five cultural practice treatments including aerification, scalping, vertical mowing, vertical mowing plus scalping, and an untreated control were applied to 1.2 by 7.3 m strip plots perpendicular to the species strip plots. Cultural practice treatments commenced as bermudagrass broke dormancy on 22 Mar. 2007. Hollow-tine aerification was performed using a Toro Greens-Air (The Toro Company, Bloomington, IL) with 1.9 cm diameter, 7.6 cm long hollow tines on a 5.1 by 5.1 cm coring pattern. Scalping was applied using a Toro Greensmaster 1000 (The Toro Company, Bloomington, IL), set at a mowing height of 0.64 cm. Vertical mowing was performed using a Graden GS04 verticutter (Graden Company, Victoria, AU), with 2 mm vertical blades spaced at 2.5 cm and set to penetrate 5 mm into the soil. To apply the scalping plus vertical mowing treatments, plots were vertically mowed then scalped to remove debris from the plots using the reel mower. Cores from aerification were broken up and drug into holes using a drag mat. Debris from vertical mowing was removed after each treatment was applied. Cultural treatments were applied every two weeks until the conclusion of the study on 29 June 2007.

Evaluation

Plots were evaluated every two weeks following when bermudagrass broke dormancy in the unseeded control plots. Bermudagrass initially broke winter dormancy on 5 April 2007; however, due to temperatures falling below -7 C, bermudagrass returned to a dormant state until May. Plots were evaluated for bermudagrass presence using visual ratings to estimate the percentage of each plot that consisted of bermudagrass.

Statistical analysis

The experimental design was a two factor, repeated measures, strip-plot design, replicated four times at each site. All data were analyzed using analysis of variance for a strip-plot design, testing the main effects of species, cultural practice treatment, and evaluation date and their interactions using SAS PROC MIXED (SAS, 2002). When effects or interactions were significant ($P < 0.05$) means were separated using Fisher's protected least significant difference (LSD, $\alpha = 0.05$).

RESULTS AND DISCUSSION

The main effects of species and evaluation date were significant for bermudagrass presence at both sites. The main effect of cultural practice treatment was significant for the sand site; however, it was not significant for the soil site. Main effects will not be discussed due to the presence of significant species x cultural practice x evaluation date interactions at both sites.

There were no consistent effects of cultural practices on bermudagrass transition for any overseeding species throughout the trial. However, data from the 6 June and 29 June 2007 evaluations will be discussed due to the presence of significant treatment effects on those dates. On the 6 June 2007 evaluation date at the sand site, the unseeded control had nearly 95% bermudagrass coverage where no cultural treatments had been applied (Fig.1). This was approximately 5 weeks following green up initiation after the hard freeze in April 2007.

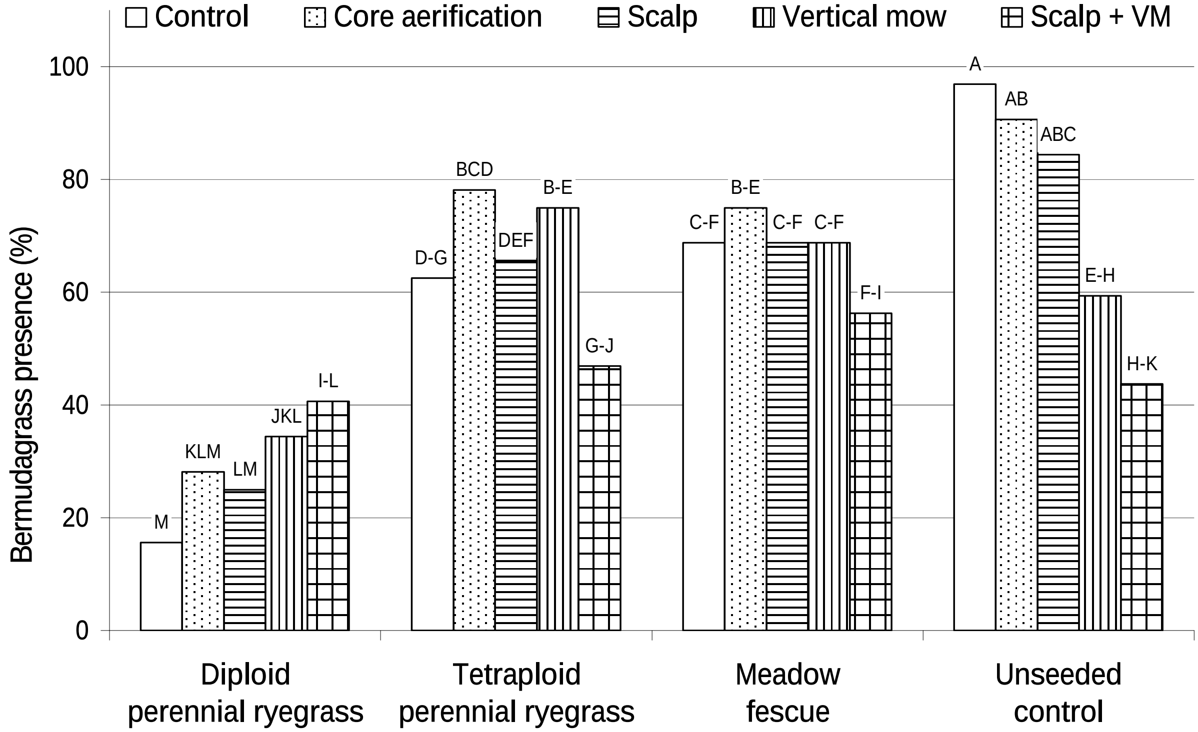

Figure 1. Bermudagrass presence in overseeded turf on a sand based field as affected by cultural practice, 6 June 2007. Bars not sharing a letter are significantly different according to Fisher's LSD test (□ = 0.05).

At that time the meadow fescue and tetraploid perennial ryegrass plots had significantly more bermudagrass presence than diploid perennial ryegrass where no cultural treatments were applied. This is similar to previous results that have demonstrated meadow fescue and tetraploid perennial ryegrass to have significantly improved transition characteristics compared to diploid perennial ryegrass (Richardson et al., 2007). The scalping + vertical mowing and vertical mowing treatments reduced bermudagrass presence on the unseeded control plots compared to all other treatments (Fig. 1). These more aggressive cultural practice treatments caused more injury to the bermudagrass in the unseeded control plots, which delayed green-up. Similarly the scalping + vertical mowing treatment resulted in the least amount of bermudagrass in the tetraploid perennial ryegrass and meadow fescue plots. In contrast, the aggressive treatments (those including vertical mowing) resulted in the most bermudagrass presence in the diploid perennial ryegrass plots. The aerification and scalping treatments resulted in no significant increase in bermudagrass presence compared to the untreated control within each overseeding species treatment.

On the 6 June 2007 evaluation date at the soil site, scalping + vertical mowing and vertical mowing treatments had lower bermudagrass presence than any other treatment on unseeded control plots due to the aggressive and injurious nature of these treatments (Fig. 2). However, these treatments significantly increased the bermudagrass presence compared to the untreated control on tetraploid perennial ryegrass and meadow fescue plots. In addition, scalping also had higher bermudagrass presence compared to the untreated control on meadow fescue. These results contrast those at the sand site, where the aggressive cultural practice treatments reduced bermudagrass presence on tetraploid perennial ryegrass and meadow fescue (Fig. 1). It is possible that the relatively loose nature of the rootzone at the sand site resulted in more injury to the underlying bermudagrass when subjected to the aggressive scalping + vertical mowing treatment, which delayed transition compared to the soil site.. Similar to the sand site, there was significantly less bermudagrass presence in diploid perennial ryegrass plots compared to tetraploid perennial ryegrass and meadow fescue at the soil site.

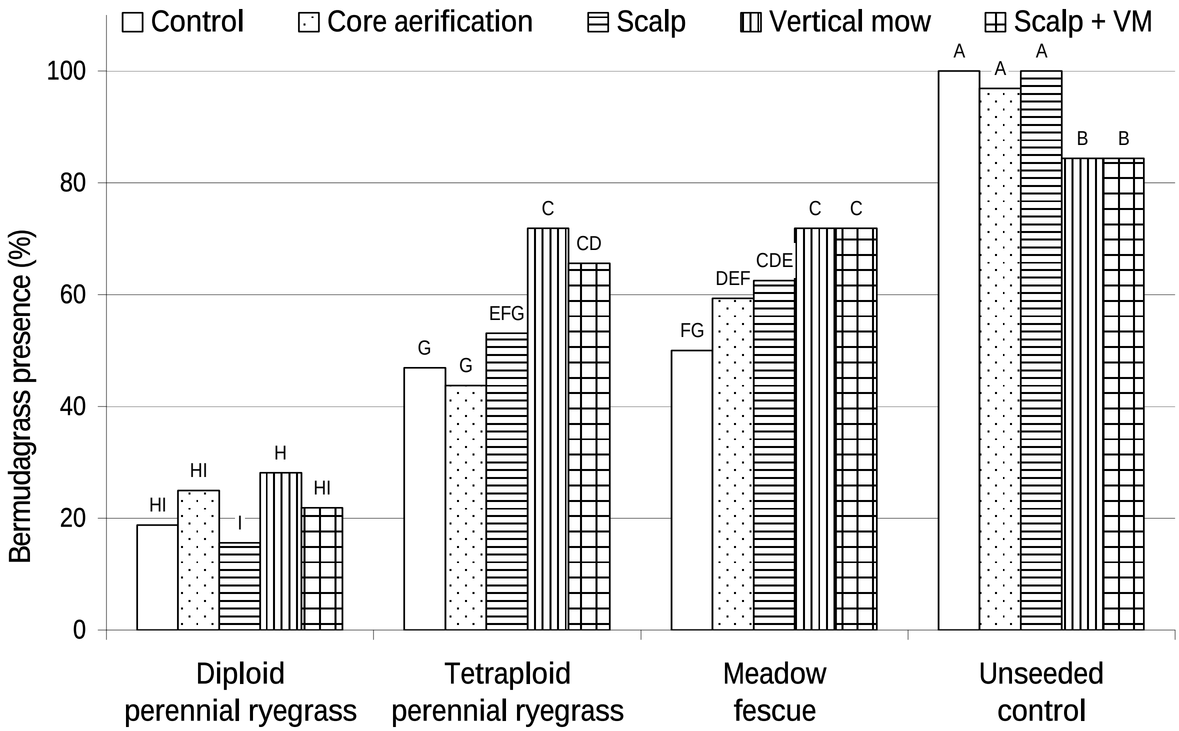

Figure 2 Bermudagrass presence in overseeded turf on a soil based field as affected by cultural practice, 6 June 2007. Bars not sharing a letter are significantly different according to Fisher's LSD test (□ = 0.05).

On the 29 June 2007 evaluation date, approximately 9 weeks following bermudagrass green-up initiation, no cultural practice treatment significantly increased bermudagrass presence compared to the untreated control, within species at the sand site (Fig. 3). Bermudagrass presence on diploid perennial ryegrass was significantly lower than bermudagrass presence on any other species within cultural practice treatments, with the exception of vertical mowing on tetraploid perennial ryegrass. Within cultural practice treatments there were no differences in bermudagrass presence among tetraploid perennial ryegrass, meadow fescue, and the unseeded control. Furthermore, all meadow fescue and tetraploid perennial ryegrass turf had bermudagrass presence similar to the non treated, unseeded control, except for tetraploid perennial ryegrass receiving vertical mowing. These results suggest that although cultural practices may affect bermudagrass presence shortly after spring green-up initiates, their overall effect on complete transition to bermudagrass may be limited.

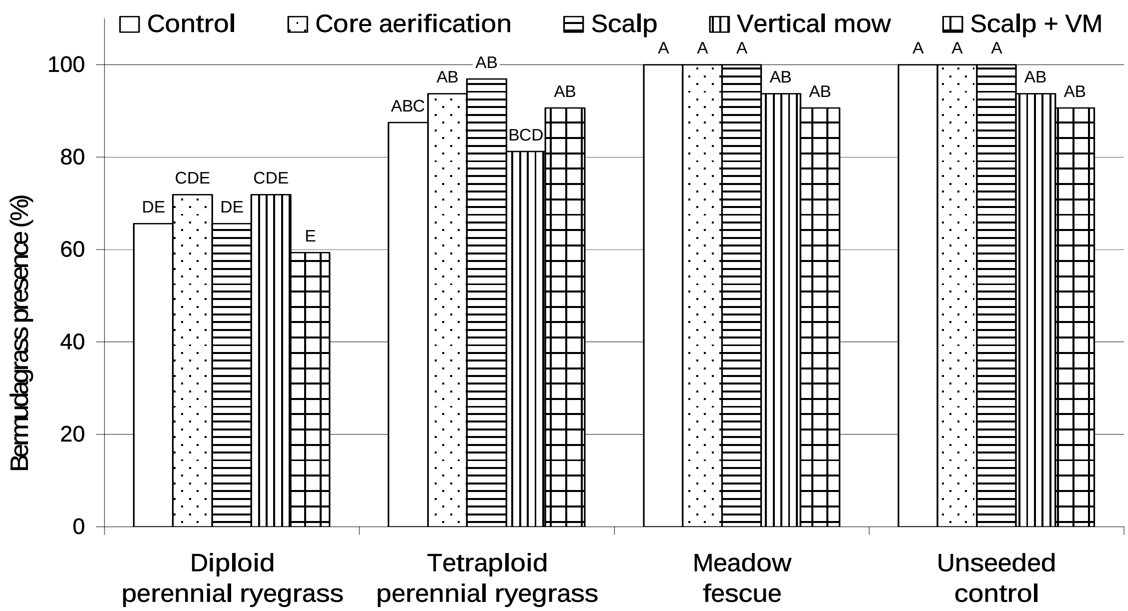

Figure 3 Bermudagrass presence in overseeded turf on a sand based field as affected by cultural practice, 29 June 2007. Bars not sharing a letter are significantly different according to Fisher's LSD test (= 0.05).

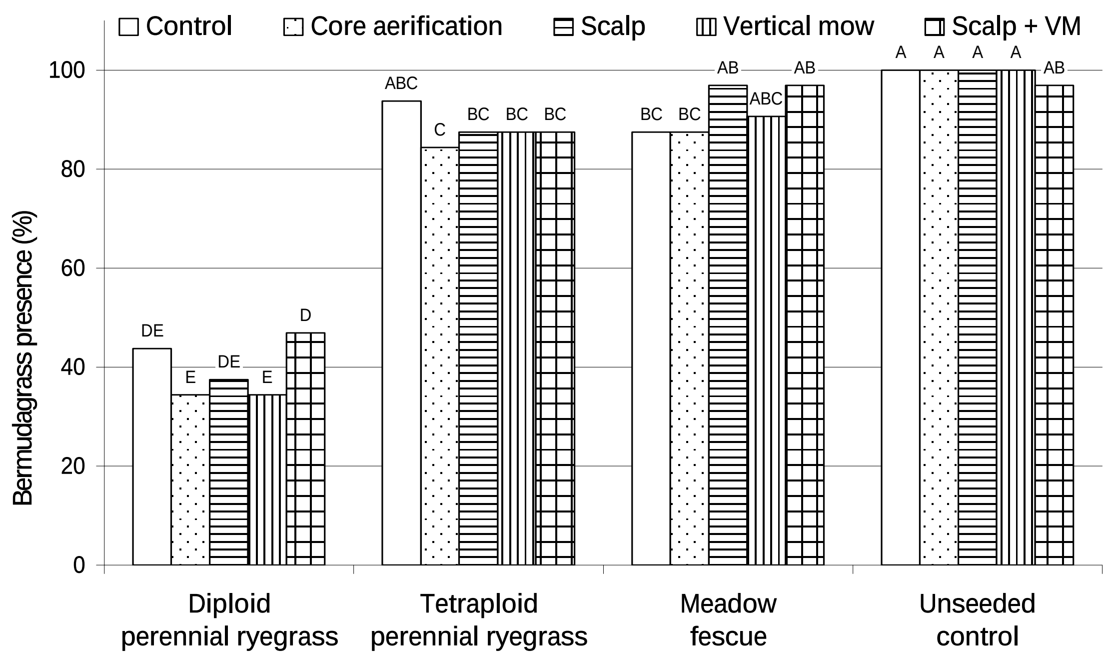

Figure 4 Bermudagrass presence in overseeded turf on a soil based field as affected by cultural practice, 29 June 2007. Bars not sharing a letter are significantly different according to Fisher's LSD test (= 0.05).

On the 29 June 2007 evaluation date at the soil site, there were no significant differences in bermudagrass presence among cultural practice treatments within any species, except for diploid perennial ryegrass (Fig. 4). On diploid perennial ryegrass, the aggressive scalping + vertical mowing had higher bermudagrass presence compared to aerification and vertical mowing. Diploid perennial ryegrass had significantly lower bermudagrass presence than the other species regardless of treatment at this evaluation date, whereas untreated tetraploid perennial ryegrass and meadow fescue receiving a scalping treatment had bermudagrass presence near 100% and similar to the unseeded control.

CONCLUSIONS

Considering that the aggressive cultural practice treatments did not hasten the complete removal of the overseeded species, it appears that the use of cultural practices as a means of speeding up spring transition does not justify the effort required to implement the treatments. When attempting to speed up spring transition, the selection of an overseeding turfgrass species or cultivar that is less heat and drought tolerant, such as tetraploid perennial ryegrass or meadow fescue, is more important than implementing cultural practices. Furthermore, it is likely that a selective herbicide application will be necessary if a very rapid spring transition (< 3 weeks) to bermudagrass is required.

REFERENCES

Batten, S.M., J.B. Beard, D. Johns, A. Almodares, and J. Eckhardt. 1981. p. 83-94. *In* R.W. Sheard (ed.) Proc. 4th Int. Turfgrass Res. Conf., Guelph, ON, Canada. 19-23 July. Int. Turfgrass Soc., Ontario Agric. Coll., Univ. of Guelph, Guelph, ON.

Casler, M.D., and E. van Santen. 2001. Performance of meadow fescue accessions under management-intensive grazing. Crop Sci. 41:1946-1953

Dudeck, A.E., and C.H. Peacock. 1981. Effects of several overseeded ryegrasses on turf quality, traffic tolerance and ball roll. p. 75-82. *In* R.W. Sheard (ed.) Proc. 4th Int. Turfgrass Res. Conf., Guelph, ON, Canada. 19-23 July. Int. Turfgrass Soc., Ontario Agric. Coll., Univ. of Guelph, Guelph, ON.

Horgan, B.P. and F.H.Yelverton. 1998. How to kill perennial ryegrass in overseeded fairways: seeding in fall means headaches next spring if cool temperatures linger on your golf course. Golf Course Mgmt. August 66(8): p. 49-52

Horgan, B.P. and F.H. Yelverton. 2001. Removal of perennial ryegrass from overseeded bermudagrass using cultural methods. Crop Sci. 41:118-126.

Jensen, K.B., B.L. Waldron, K.H. Asay, D.A. Johnson and T.A. Monaco. 2003. Forage nutritional characteristics of orchardgrass and perennial ryegrass at five irrigation levels. Agron. J. 95:668-675.

McCarty, L.B. 2004. Overseeding. p. 465-483. *In* L.B. McCarty (ed.) Best golf course management practices. 2nd ed. Pearson Education Inc., Upper Saddle, NJ.

Meyers, H.G., and G.C. Horn. 1968. Selection of grasses for overseeding. p. 15-47. *In* Proc. Univ. Florida Turfgrass Management Conf.

Meyers, H.G., and G.C. Horn. 1970. The two-grass system in Florida. p. 110-117. *In* J.R. Escritt (ed.) Proc. 1st Int. Turfgrass Res. Conf., Harrogate, England. 15-18 July 1969. Sports Turf Res. Inst., Bingley, England.

Richardson, M.D. 2004. Morphology, turf quality, and heat tolerance of intermediate ryegrass (*Lolium perenne x L. multiflorum*). HortScience 39:170-173.

Richardson, M.D., K.W. Hignight, R.H. Walker, C.A. Rodgers, D. Rush, J.H. McCalla, and D.E. Karcher. 2007. Meadow fescue and tetraploid perennial ryegrass – two new species for overseeding dormant bermudagrass turf. Crop Sci. 47:83-90.

Sanderson, M.A. and G.F. Elwinger. 2004. Emergence and seedling structure of temperate grasses at different planting depths. Agron. J. 96:685-691.

SAS Institute. 2002. The SAS system for Windows. Release 6.12. SAS Inst., Cary, NC.

Schmidt, R.E. 1970. Overseeding cool season turfgrasses on dormant bermudagrass for winter. p. 124-129. *In* J.R. Escritt (ed.) Proc. 1st Int. Turfgrass Res. Conf., Harrogate, England. 15-18 July 1969. Sports Turf Res. Inst., Bingley England.

Schmidt, R.E. and R.E. Blaser. 1962. Establishing winter bermuda putting turf. USGA J. Turf Manage. 15(5):30-32.

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Schmidt, R.E., and J.F. Shoulders. 1980. Seasonal performance of selected temperate turfgrasses overseeded on bermudagrass turf for winter sports. p 75-86. *In* J.B. Beard (ed.) Proc. 3rd Int. Turf. Res. Conf., Munich, Germany. 11-13 July 1977. Int. Turfgrass Soc., and ASA, CSSA, and SSSA, Madison, WI.

Schmitz, J. 1999. A smooth transition. Golf Course Mgmt. 67 (7): 108.

Smith, K.F., R.J. Simpson, R.A. Culvenor, M.O. Humphreys, M.P. Prud'homme, and R.N. Oram. 2001. The effects of ploidy and phenotype conferring a high water-soluble carbohydrate concentration on carbohydrate accumulation, nutritive value and morphology of perennial ryegrass. J. Agric. Sci. (Cambridge) 117:1-8.

USGA Green Section Staff. 2004. USGA recommendations for a method of putting green construction [Online]. Available at http://www.usga.org/turf/course_construction/ green_articles/putting_green_guidelines.html (verified 27 Mar. 2008).

Ward, C.Y., E.L. McWhirter, and W.R. Thompson, Jr. 1974. Evaluation of cool-season turf species and planting techniques for overseeding bermudagrass golf greens. *In*: E.C. Roberts (ed.) Proc. Second Int. Turf Res Conf., Blacksburg, W.V., Amer. Soc. Agron., Madison, WI., 480-495.

Warnock, D.L., R.H. Leep, S.S. Bughrara, and D.H. Min. 2005. Cold tolerance evaluation of improved diploid and tetraploid cultivars of perennial ryegrass. Online. Crop Mgmt. doi:10.1094/CM-2205-0221-01-RS.