Winter Survival of Seeded Bermudagrasses

The recent development of high-quality seeded bermudagrasses makes the choice of this species for fairways even more appealing.

BY MICHAEL D. RICHARDSON, DOUGLAS E. KARCHER, AND JOHN W. BOYD

Bermudagrass is a widely adapted warm-season turfgrass that is used in numerous golf course applications from transition zone to tropical regions of the world.[3] Most of the bermudagrass cultivars that have been developed for golf course fairways and tees are sterile hybrids of *C. dactylon* and *C. transvaalensis*. While these hybrids produce a uniform, dense surface, they must be planted vegetatively by either sprigs or sod, which can add significant cost to construction or renovation projects.

Seeded bermudagrass has been available for many years, but the typical "common" bermudagrass has not offered the quality or performance of the vegetative hybrids (Table 1). Although lower-quality seeded bermudagrass cultivars provided a turf adequate for home lawns and utility areas, they did not produce an acceptable turf for golf courses, sports fields, or other high-maintenance applications.

A renewed interest in seeded bermudagrass breeding since the early 1980s has yielded several new seeded cultivars that perform much better than older seeded types and also perform as well as the established vegetative hybrids (Table 1). Of the new seeded cultivars, Princess-77, Yukon, and Riviera are being widely utilized due to their high shoot density and dark green genetic color.[6] These major improvements in turf quality have stimulated considerable interest from the turfgrass industry, as a high-quality bermudagrass turf is now possible using a seeded cultivar.

A potential limitation to seeded bermudagrasses, especially in the upper transition zone, is the potential for winterkill following the establishment year. Winter survival of bermudagrass has always been an important issue in this region, with major emphasis on cultivar variability,[2,13] fertility management,[10] and the underlying physiology associated with cold tolerance.[4,12] Unfortunately, most of the research in the literature has focused on established bermudagrass turf with particular emphasis on vegetatively propagated hybrids.

Preliminary studies at this location[5] and at others[8,9] have suggested that bermudagrass seeding methods will impact both the speed at which a full turfgrass stand is attained as well as the ability of the seedling turf to withstand the first critical winter. One factor that is very important is the maturation of the turf before it goes into the first dormant season. The objective of this study was

Table 1
Turfgrass quality of selected seeded and vegetative bermudagrass entries in the past three National Turfgrass Evaluation Bermudagrass Trials.

	Turfgrass Quality		
Selected Entries	**1986 Trial**	**1992 Trial**	**1997 Trial**
Vegetative			
Tifway	6.6	6.0	6.4
Midlawn	6.0	6.0	5.8
Tifsport	na	na	6.5
Seeded			
Arizona Common	4.4	4.2	4.7
Guymon	4.4	5.0	na
NuMex-Sahara	4.9	4.5	5.0
Mirage	na	5.4	5.1
Yukon	na	5.3	na
Riviera	na	na	6.4
Princess-77	na	na	6.5
LSD (0.05)	0.2	0.2	0.2
Total no. of seeded entries	8	16	18
Total no. of vegetative entries	20	10	10

na — entry not available in that trial

to assess the effects of the seeding date on the establishment and winter survival of several seeded bermudagrass cultivars in a transition-zone environment.

HOW THE STUDY WAS CONDUCTED

A field study was conducted over two growing seasons (2000 and 2001) at the University of Arkansas Research and Extension Center, in Fayetteville, Arkansas. The soil at the site is captina silt loam with an average pH of 6.2. Prior to planting, the site was fumigated with methyl bromide (67%) and chloropicrin (33%) at 350 lb. per acre.

Six bermudagrass cultivars were tested in these trials, including NuMex-Sahara, Princess-77, Mirage, Jackpot, Yukon, and Mohawk. Four seeding dates were tested each season and included April 15, May 15, June 15, and July 15. During the 2001 season, a severe storm caused the loss of the June 15 seeding date, and no data were collected for that date. All plots were seeded by hand at 1.00 lb. PLS per 1,000 sq. ft. based on a germination test.

The fungicide Subdue® (mefenoxam) was applied at planting to prevent development of any seedling diseases and pathogens such as *Pythium spp.* The site was irrigated with an automated irrigation system to provide optimum moisture conditions for germination and establishment of the seed and to minimize water stress. Plots were fertilized with phosphorus and potassium prior to planting according to soil test recommendations. Nitrogen was applied, beginning five days after first emergence, as urea (46-0-0) and reapplied every two weeks during the test at a rate of 0.5 lb. N per 1,000 sq. ft. Plots were mowed three times per week with a reel mower set to a bench height of 0.5 inch with grass clippings returned.

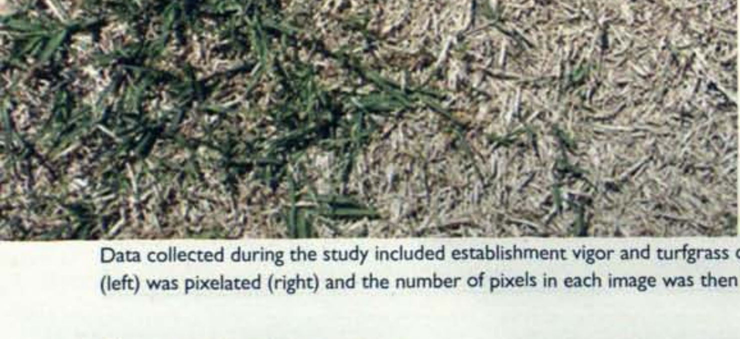
Data collected during the study included establishment vigor and turfgrass cover rates (data not shown). During the dormant season following planting, two 2.4-inch plugs were pulled from each plot and the turf was analyzed for morphological characteristics, including rhizome density, stolon density, and weight per stolon.

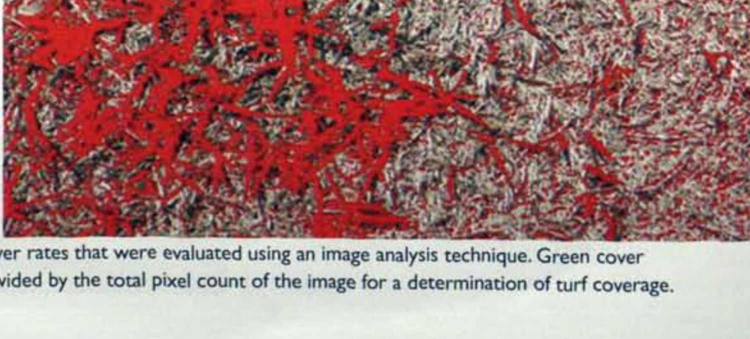
Turf recovery from winter dormancy was monitored on three dates during the spring using digital image analysis techniques.[11] Digital images were obtained using a digital camera and analyzed individually using SigmaScan Pro software. The color threshold feature in the SigmaScan software allows the user to search a digital image for a specific color or a range of color tones. The settings used to identify green areas in the image included a hue range from 57 to 107 and a saturation range from 0 to 100. After developing a fingerprint of the green areas of the image, the measurement tools in the software package were used to count the total number of selected green pixels. The number of green pixels in each image was then divided by the total pixel count of the image for a determination of turf coverage percentage in the image.

Each cultivar was replicated four times within each planting date for each season. The two years were considered repeats of an experiment and the data were analyzed by year as a randomized complete block design.

WHAT WE FOUND DURING THE STUDY

Cultivar and seeding date had a major effect on winter survival in both years of the trial, and there was a significant interaction between cultivar and seeding date in both years. The winter of 2000-2001 was more severe than the 2001-2002 winter, but winter injury was observed in the late-seeded plots for both growing seasons (Table 2). Yukon had the greatest winter survival among the cultivars in both 2001 and 2002, with Princess-77 exhibiting the poorest recovery in the spring following establishment (Table 2). Other cultivars were intermediate for





Data collected during the study included establishment vigor and turfgrass cover rates that were evaluated using an image analysis technique. Green cover (left) was pixelated (right) and the number of pixels in each image was then divided by the total pixel count of the image for a determination of turf coverage.

Table 2

Recovery of bermudagrass from winter injury, as affected by cultivar and seeding date. Recovery was measured near May 1 in the spring following establishment.

Seeding Date	Jackpot	Mirage	Mohawk	NuMex-Sahara	Princess-77	Yukon	*LSD (0.05)*
	% Recovery from Winter Injury						
				2000			
April 15	58	43	43	48	27	100	*17*
May 15	65	47	32	43	23	100	*11*
June 15	24	30	25	17	12	100	*8*
July 15	7	5	5	6	4	80	*6*
LSD (0.05)	*17*	*12*	*14*	*10*	*7*	*8*	
				2001			
April 15	65	61	64	73	48	81	*15*
May 15	59	63	54	67	63	63	*18*
June 15	nd†	nd	nd	nd	nd	nd	
July 15	39	33	45	41	23	83	*30*
LSD (0.05)	*25*	*20*	*ns‡*	*21*	*26*	*ns*	

† - nd — not determined for that seeding date due to a loss of stand as a result of a thunderstorm

‡ - *ns* — no significant difference due to treatment

winter survival. It should be noted that all cultivars eventually recovered to 100% turfgrass coverage, but it took several months for cultivars such as Princess-77 to reach full coverage.

Seeding date also had a significant effect on winter recovery, with April and May planting dates having significantly more recovery compared to June and July seeding dates for all cultivars except Yukon (Table 2). Yukon had good recovery at all seeding dates, even though there was a slight, significant decline in winter recovery with the July seeding date.

Another significant aspect of spring recovery of these plots was the difference in spring green-up among cultivars. Across these and other studies in this location, Yukon exhibited consistently earlier green-up than other cultivars, while Princess-77 was always the last cultivar to initiate spring growth (Table 3). This could be a significant factor if early spring activities were planned for the turf, as cultivars such as Yukon would provide much earlier spring growth than other seeded cultivars. Other cultivars were intermediate to Yukon and Princess-77 regarding spring green-up and were not different from each other (Table 3).

Table 3

Dates of initial spring green-up among seeded bermudagrass cultivars.

Cultivar	2001	2002
	Date First Green-up Was Observed	
Yukon	2 April	5 April
Mohawk	11 April	15 April
Jackpot	13 April	15 April
Mirage	13 April	14 April
NuMex-Sahara	14 April	16 April
Princess-77	22 April	24 April

True rhizomes were not produced during the first season after establishment in any of the seeded cultivars. This is in contradiction to work by Philley and Krans,[9] who reported rhizome production during the establishment of several seeded bermudagrass cultivars. However, Munshaw et al.[7] also reported no rhizome production during the establishment year and suggested that stolons were the primary over-wintering structure of new bermudagrass seedings. The differences in rhizome analysis between these studies may be a reflection of varying methodology or the actual means by which a rhizome is identified.

Stolon density (Figure 1) and weight per stolon (data not shown) were affected by both cultivar and planting date across both years of the study. Yukon had the highest stolon density in both years of the test, with Princess-77 having the lowest stolon density (Figure 1). Seeding date also had a significant effect on stolon density in the 2002 trial, with higher stolon densities observed in April and May seeded plots compared to the July seeding. Regression analysis was used to determine if stolon density was related to winter recovery, as it was observed that Yukon had both the highest recovery from winter injury and the highest stolon density. However, when regressed across all planting dates and cultivars, there was no significant relationship between stolon density and winter recovery (data not shown).

The data from this study show conclusively that some cultivars of seeded bermudagrass will be adapted for use in transition-zone environments, where winter injury can cause a severe loss of stand. These data are corroborated by other studies from Mississippi,[9] Indiana,[8] and Kentucky,[7] where other researchers have associated increased stand fitness with first-year winter survival of seeded bermudagrasses. Munshaw et al.[7] found that stolon density and stolon diameter were enhanced by low seeding rates, and they speculated that these parameters were important in winter survival. However, they did not report winter injury in that study. Philley and Krans[9] also observed significant first-year winter injury in several seeded bermudagrass cultivars, especially from late planting dates. The exception in this study was Yukon, which survived the first winter even when planted later in the season.

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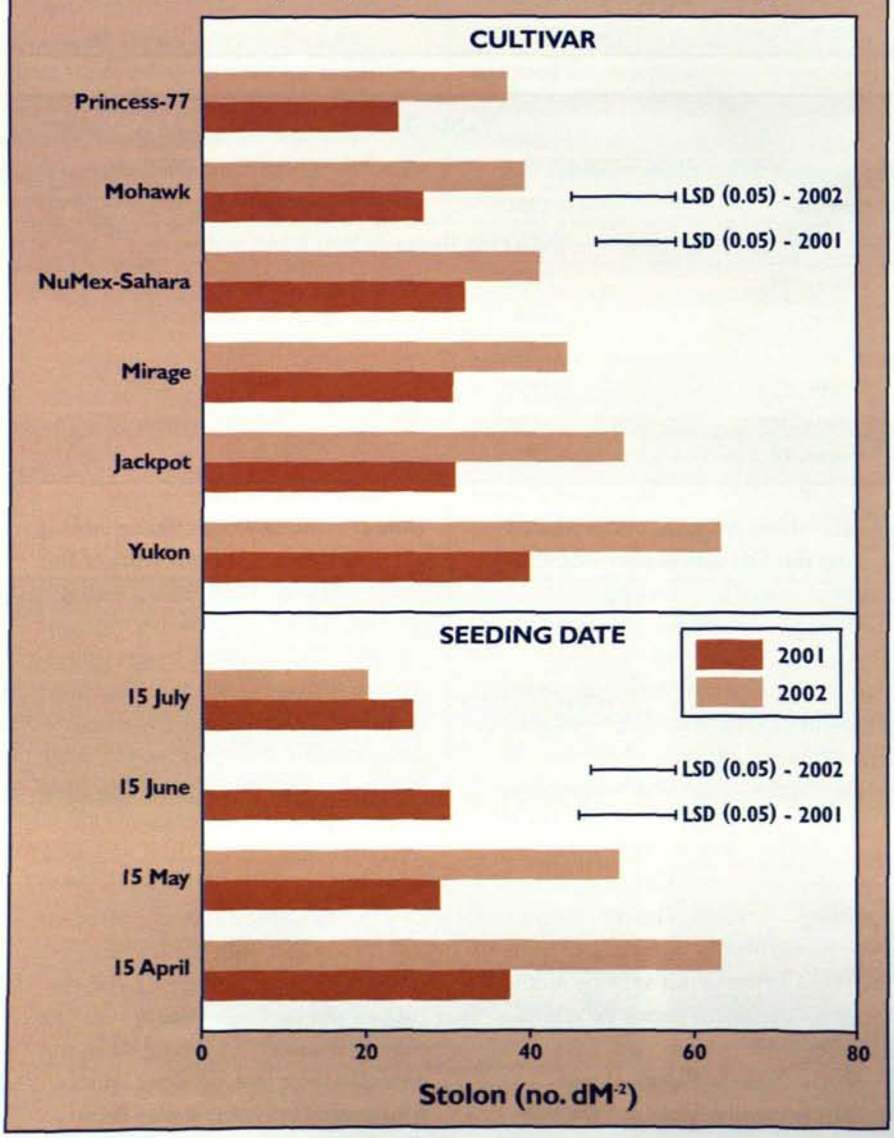
Figure 1

Effects of cultivar and planting date on stolon density of seeded bermudagrasses.



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DR. MICHAEL D. RICHARDSON, PH.D., *Associate Professor, Dept. of Horticulture, University of Arkansas, Fayetteville;* DR. DOUGLAS E. KARCHER, *Assistant Professor, Dept. of Horticulture, University of Arkansas, Fayetteville;* DR. JOHN W. BOYD, *Extension Weed Scientist, Cooperative Extension Service, University of Arkansas, Little Rock.*