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Researchers at the University of Arkansas investigated the cold tolerance of several seeded bermudagrasses and determined the effect of seeding date on the ability of seeded cultivars to survive and recover from the following winter.

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PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 290 projects at a cost of \$25 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

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Seeding Date and Cultivar Affect Winter Survival of Seeded Bermudagrasses

Michael D. Richardson, Douglas E. Karcher, and John W. Boyd

SUMMARY

Improved seeded bermudagrass cultivars have been developed and released in recent years and there is much interest in the turfgrass industry in applying these cultivars to high-maintenance turf situations. One of the major questions that has been raised concerning seeded cultivars is the cold tolerance of these cultivars, especially during the establishment period. The objective of this project was to determine the effects of seeding date and cultivar on the establishment and cold tolerance of seeded bermudagrass in a transition-zone environment. The major conclusions from this work included:

- Early planting dates (April and May) yielded greater winter recovery than late planting dates (June and July). For this Arkansas location, a May planting date would provide approximately 120 days of optimum growing conditions for bermudagrass.
- Plots from early seeding dates had more developed stolons than the later seeding dates.
- First-year bermudagrass seedlings do not produce true rhizomes, so all winter recovery occurs from stolon and crown tissue.
- The cultivar 'Yukon' exhibited excellent recovery from winter injury at all seeding dates and had earlier spring green-up than other cultivars.
- The cultivar 'Princess' had the slowest spring green-up and also was damaged most extensively by a cold winter after establishment.
- When selecting a seeded bermudagrass cultivar for a transition-zone location, data on winter survival should be a key factor in decision-making.

Bermudagrass (*Cynodon spp.* L.) 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

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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 do not produce an acceptable turf for golf courses, sports field, 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



that perform much better than older seeded types and also perform as well as the established vegetative hybrids.

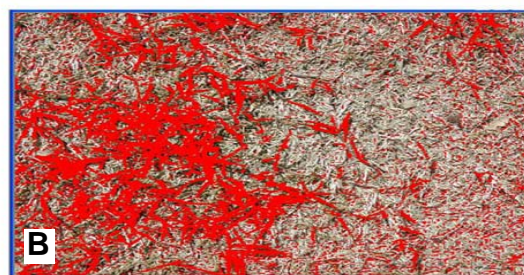
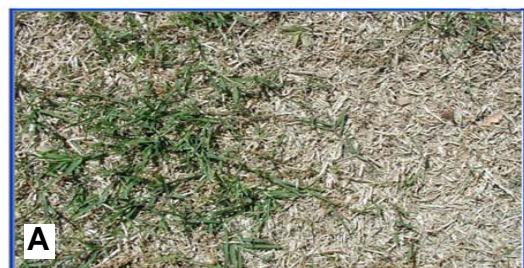
Selected Entries	1986 Trial	1992 Trial	1997 Trial
<u>Vegetative</u>	----- Turfgrass Quality -----		
Tifway	6.6	6.0	6.4
Midlawn	6.0	6.0	5.8
Tifsport	na	na	6.5
<u>Seeded</u>			
Arizona Common	4.4	4.2	4.7
Guymon	4.4	5.0	na
NuMex Sahara	4.9	4.5	5.0
Mirage	na	5.4	5.1
Yukon	na	5.3	na
Riviera	na	na	6.4
Princess-77	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			

Table I. Turfgrass quality of selected seeded and vegetative bermudagrass entries in the past three National Turfgrass Evaluation Program bermudagrass trials

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



Data collected during the study included establishment vigor and turfgrass cover rates that were evaluated using image analysis technique. Green cover (A) was pixelated (B) 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.

first critical winter. One factor that is very important is the maturation of the turf before it goes into the first dormant season. The objectives of this study were to assess the effects of 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, Fayetteville, AR. 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/acre.

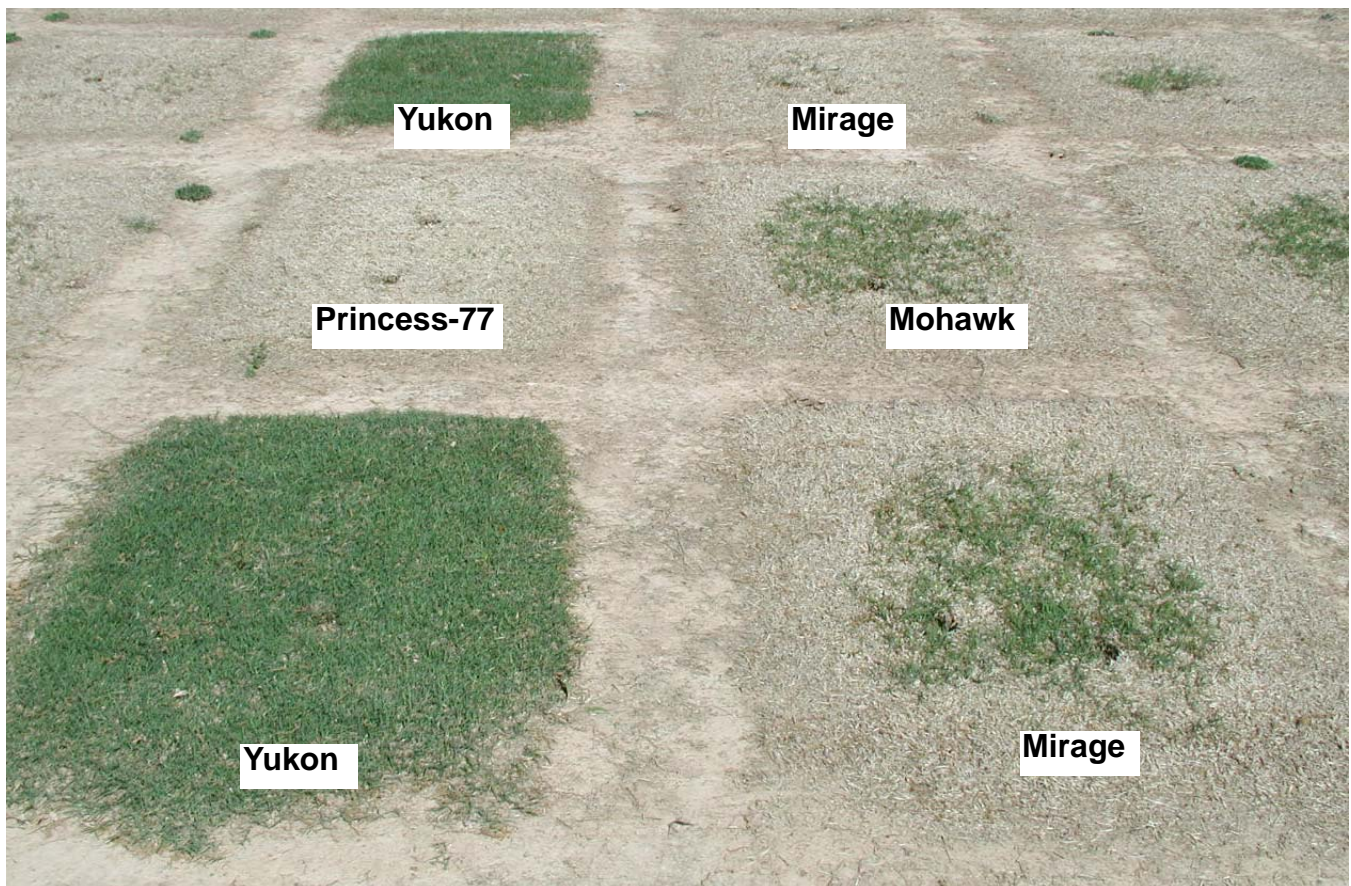
Six bermudagrass cultivars were tested in these trials including 'Numex-Sahara', 'Princess-

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 1.0 lb PLS / 1000 ft² 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 prevent water stress. Plots were fertilized with phosphorous and potassium prior to planting according to soil test recommendations. Nitrogen was applied, beginning 5 days after first emergence, as urea (46-0-0) and re-applied every 2 weeks during the test at a rate of 0.5 lb N / 1000

Seeding Date	Jackpot	Mirage	Mohawk	Numex-Sahara	Princess-77	Yukon	LSD _(0.05)
----- % recovery from winter injury ----- <u>2000</u>							
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	
<u>2001</u>							
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							

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.



'Yukon' had the great winter survival among the cultivars in both 2001 and 2002, with 'Princess-77' exhibiting the poorest recovery in the spring following establishment.

ft². Plots were mowed three times per week with a reel mower set to a bench height of 0.5 inches 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 an Olympus C3030Z (Olympus Optical Co., London, UK) digital camera and analyzed individually using SigmaScan Pro (v. 5.0, SPSS, Inc., Chicago, IL, 60611). 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. All data were analyzed by analysis of variance procedures and means separated using Fisher's Protected LSD (P= 0.05). 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 effects on winter survival in both years of the trial

Cultivar	2001	2002
----- Date of first green-up -----		
Yukon	April 2	April 5
Mohawk	April 11	April 15
Jackpot	April 13	April 15
Mirage	April 13	April 14
NuMex Sahara	April 14	April 16
Princess-77	April 22	April 24

Table 3. Dates of initial spring green-up among seeded bermudagrass cultivars

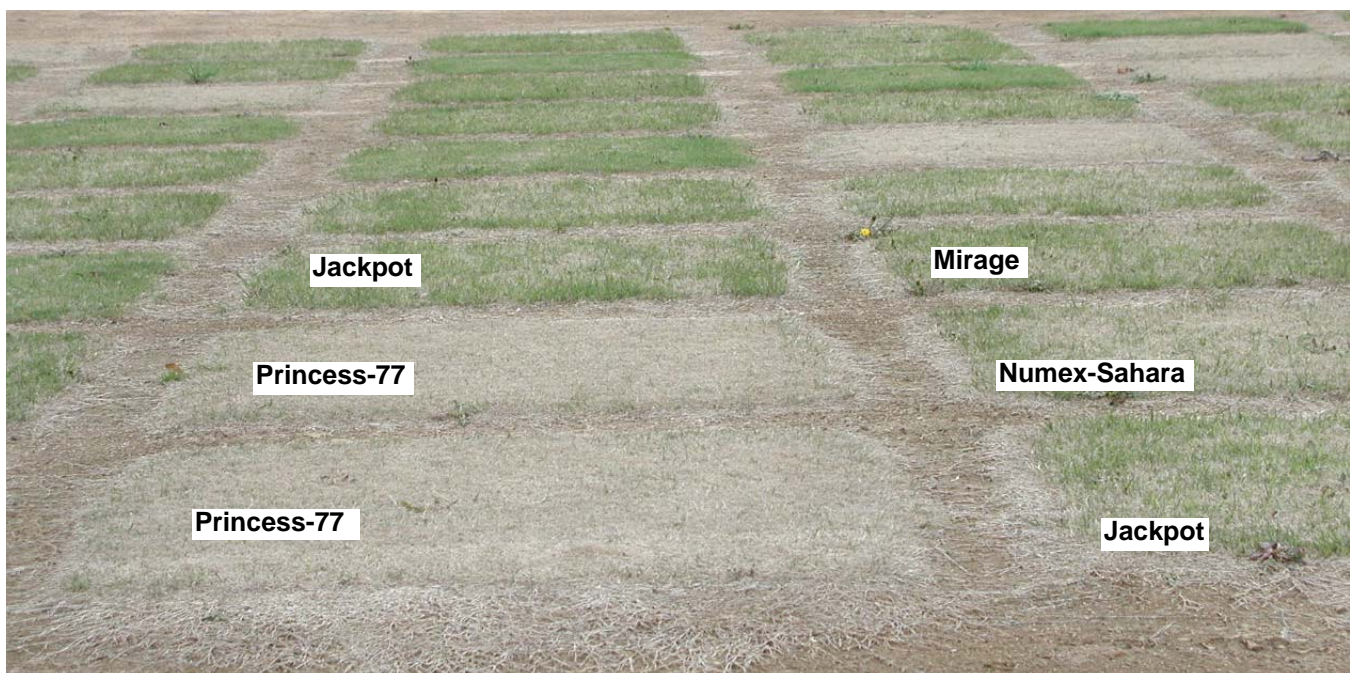
and there was a significant interaction between cultivar and seeding date in both years. The winter of 2000-2001 was more severe than the 2001-2002 winter, but winter injury was observed in the late-seeded plots for both growing seasons (Table 2). 'Yukon' had the greatest winter survival among the cultivars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

It should be noted that all cultivars eventu-

ally recovered to 100% turfgrass coverage (data not shown), 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 at 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).

True rhizomes were not produced during the first season after establishment in any of the



'Yukon' exhibited consistently earlier green-up than other cultivars, while 'Princess-77' (shown above) was always the last cultivar to initiate spring growth

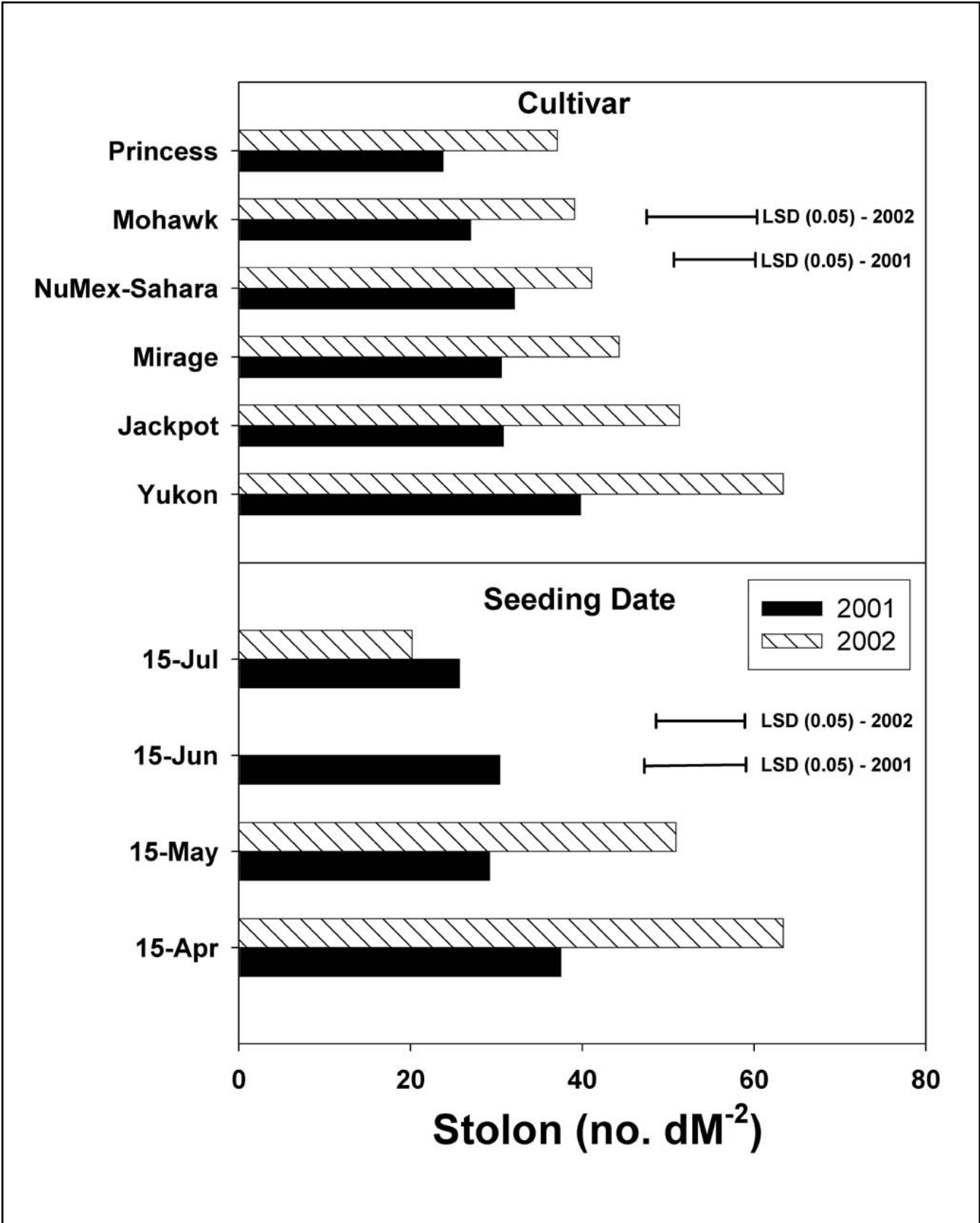


Figure 1. Stolon density and wt. per stolon (data not shown) were affected by both cultivar and planting date across both years of the study. 'Yukon' had the highest stolon density in both years of the test and 'Princess-77' had the lowest stolon density. Stolon density was highest for the early seeding dates.

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 wt. 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 correlated 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), Kentucky (7), and Indiana (8) 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.

Acknowledgement

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