Environmental Institute for Golf
This study was funded in part by the Environmental Institute for Golf.

Establishing seeded bermudagrass

Seeding bermudagrass instead of sprigging or sodding allows superintendents to establish bermudagrass quickly and at minimal cost.

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Bermudagrass (*Cynodon* species) is a warm-season grass that is popular in the transition zone and southern United States because it provides an excellent surface for golf. New cultivars of seeded bermudagrass that exhibit characteristics similar to vegetatively established cultivars are now commercially available. These seeded cultivars can be up to $5,000/acre less expensive to establish than sod.

Because improved seeded bermudagrass cultivars are relatively new, little is known about their establishment. To determine how to optimize establishment of seeded bermudagrass, we researched optimal seeding dates and rates for successful establishment and winter survival, the safety of herbicides for annual grassy weed control on bermudagrass seedlings, and post-seeding nitrogen applications for accelerating establishment.

Seeding date

To allow the longest period of warm soil temperatures necessary for adequate establishment, late-spring to early-summer plantings are generally preferred for warm-season grasses (9). Thus, we attempted to define both optimal and acceptable seeding dates for bermudagrass establishment and winter survival.

Methods

Research was initiated at the W.H. Daniel Turfgrass Research and Diagnostic Center, West Lafayette, Ind., and the University of Kentucky Agriculture Experimental Station, Lexington. Experimental areas were fumigated with methyl bromide before establishment to minimize weed competition.

Plots were seeded in 2000 and 2001 with Mirage bermudagrass at 0.5 pound pure live seed/1,000 square feet (24 kilograms/hectare) on June 1 and 15, July 1 and 15, Aug. 1 and 15, and Sept. 1 plus or minus two days. Plots received 1.0 pound nitrogen/1,000 square feet (49 kilograms/hectare) from urea (46-0-0) at seeding and every 15 days after seeding with the last application on Sept. 15.

Before seeding, soil in the appropriate plots was prepared using a garden rake and hoe. Plots were lightly raked after seeding to improve seed-to-soil contact. Areas were irrigated to encourage germination and establishment, and mowed at 1.0 inch (25.4 millimeters). Bermudagrass coverage was rated visually every two weeks after seeding.

Results

When seeded by July 15 in Indiana and Kentucky, bermudagrass coverage reached 95% in October of each year (Figure 1). When seeded from June 1 to Aug. 1 in Indiana, bermudagrass reached 95% coverage in 30 to 60 days after seeding. To determine whether bermudagrass seeded earlier than

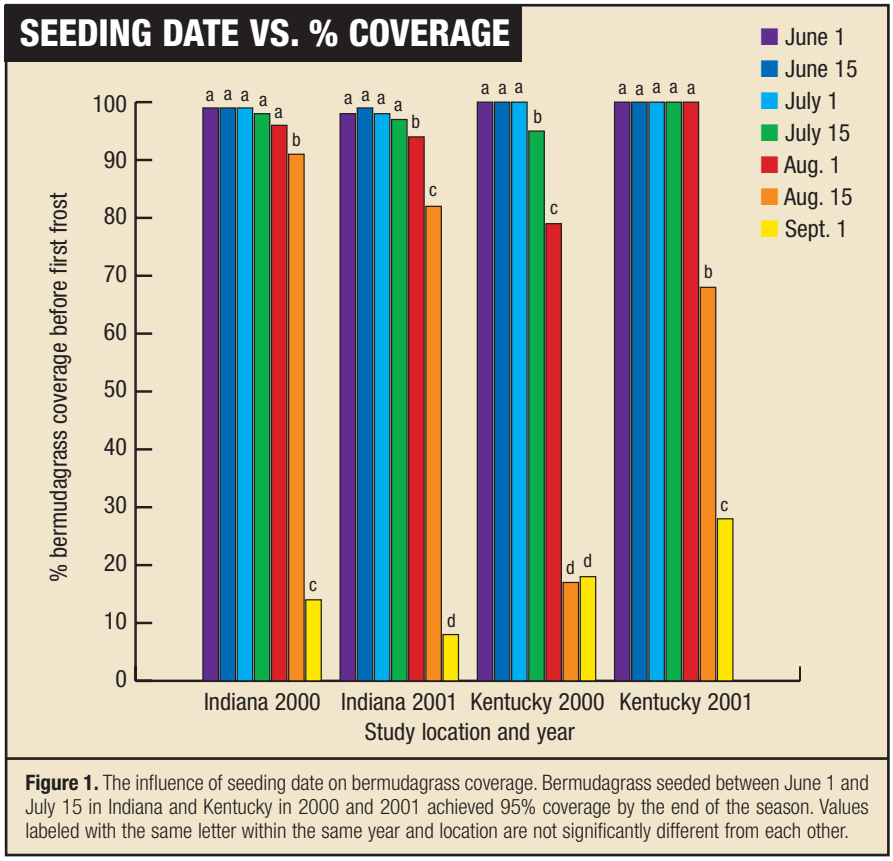

Figure 1. The influence of seeding date on bermudagrass coverage. Bermudagrass seeded between June 1 and July 15 in Indiana and Kentucky in 2000 and 2001 achieved 95% coverage by the end of the season. Values labeled with the same letter within the same year and location are not significantly different from each other.

June 1 would provide adequate coverage by the first frost, an additional seeding date of May 15 was added in Indiana in 2001. Bermudagrass coverage at the end of the growing season was similar for plots seeded May 15, June 1 or June 15 (data not shown). However, seeding bermudagrass before June 1 in the transition zone increases the chance of competition from annual bluegrass (*Poa annua* L.) seedlings and therefore should be avoided in areas with annual bluegrass.

No bermudagrass survived either winter in Indiana, but bermudagrass survived both winters in Kentucky (data not shown). In agreement with previous research (1,7,12,17), data from both years in Kentucky suggest earlier seeding dates improve survival the first winter after seeding. Mirage bermudagrass produces few rhizomes during the initial year of planting (13), and stolons are the principal overwintering storage organ for bermudagrass (6). Therefore, winterkill in later seeding dates was most likely caused by inadequate stolon fitness.

Seeding rate

Suggested seeding rates currently vary for bermudagrass. It is important to determine proper seeding rates to maximize winter hardiness because bermudagrass is often killed in the first winter after seeding (16). We wanted to identify the acceptable range of seeding rates, potential benefits of higher seeding rates for accelerating establishment, and the effect of seeding rate on winter survival.

Methods

This research was completed at the W.H. Daniel Turfgrass Research and Diagnostic Center. Plots were prepared and irrigated like those in the seeding date study. Mirage bermudagrass was seeded on June 22 in 2001 and 2002 at 0.25, 0.5, 1.0, 1.5, 2.0 and 3.0 pounds pure live seed/1,000 square feet (12, 24, 49, 73, 98 and 147 kilograms/hectare). Plots were covered with a germination blanket for two weeks after seeding to prevent contamination on adjacent plots. Plots received 1.0 pound nitrogen/1,000 square feet (49 kilograms/hectare) with urea once every month after seeding, with the last application on Aug. 22 in both years. Plots were mowed at 0.5 inch (13 millimeters) with a reel mower, and percent bermudagrass coverage was visually rated and tiller density counts were made every 14 days. Tiller density was determined by counting the number of tillers in three plugs 2 inches (5.1 centimeters) in diameter that were removed from each plot.

Results

Higher seeding rates of bermudagrass initially produced higher tiller densities and coverage (data not shown), which is similar to the response of cool-season grasses (10,15). Tiller densities at higher seeding rates decreased as the bermudagrass stands approached full coverage. Most likely, increased competition among plants caused self-thinning (5), which in turn decreased tiller density. Eventually all seeding rates produced similar tiller densities.

During establishment, seeded bermudagrass had strong stoloniferous growth that facilitated rapid turf coverage (Figure 2). Bermudagrass coverage 14 days after seeding was not improved by seeding more than 1.0 pound/1,000 square feet (49 kilograms/hectare), and all seeding rates produced similar coverage 56 days after seeding (Figure 3). If rapid coverage and higher densities are desired, seeding 1.0 pound/1,000 square feet (49 kilograms/hectare) will provide coverage similar to higher seeding rates and significantly higher tiller densities than either 0.25 or 0.5 pound/1,000 square feet (12-24 kilograms/hectare) until 70 days after seeding. Conversely, if cost is a more important consideration than rapid coverage, seeding 0.25 to 0.5 pound/1,000 square feet (12-24 kilograms/hectare) is adequate since there was no difference in bermudagrass coverage among seeding rates by 56 days after seeding.

Only 2% or less bermudagrass survived the winters in the Indiana seeding rate study (data not shown), indicating no clear relationship between seeding rate and winter survival. Research published in 2001 (13) recommends seeding 0.25 to 0.5 pound/1,000 square feet (12-24 kilograms/hectare) to maximize stolon size and production and possibly reduce winterkill, but a 1994 paper (4) reported the greatest winter survival occurred when seeding 3.1 pounds/1,000 square feet (151 kilograms/hectare). Unfortunately, the winters during our study were too extreme for Mirage bermudagrass to survive, and we were unable to determine whether seeding rate affects bermudagrass winter survival.

Both seeding rate and seeding date are important factors in determining how much winter injury might occur the first winter after planting. Moreover, possibly the greatest

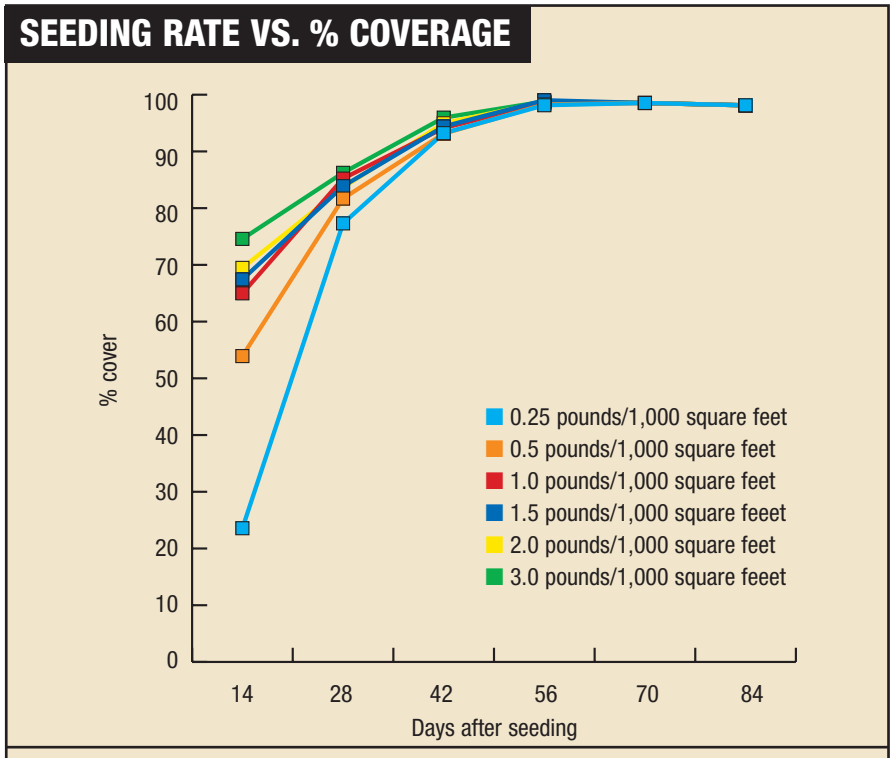

Figure 2. The effect of seeding rate on bermudagrass coverage. Bermudagrass coverage at 14 days after seeding was not improved by seeding more than 1.0 pound/1,000 square feet (49 kilograms/hectare). All seeding rates produced similar coverage 56 days after seeding.

Photo courtesy of A. Patton

Figure 3. All bermudagrass seeding rates produced similar coverage 42 days after seeding.

factor in determining first-year overwintering is cultivar selection. As researchers, we are still trying to understand the mechanisms of winter hardiness, but information on hardiness of individual cultivars is already available (2,14,17). Cultivars such as Yukon and Riviera have consistently shown higher winter survival rates than other seeded cultivars.

Herbicide safety

Summer annual grassy weeds such as crabgrass (*Digitaria* species) germinate in late spring to early summer at the same time we recommend seeding bermudagrass. Therefore, weed control is essential for bermudagrass establishment because competition with summer annual grassy weeds will significantly reduce establishment rates (8). There are few data on the use of herbicides on seedling bermudagrass, and current label recommendations specify use on established bermudagrass turf only.

Methods

This study was initiated at the W.H. Daniel Turfgrass Research and Diagnostic Center on July 6 in 2000 and 2001. Seeding date and rate and plot preparation were the same as for the seeding date study (above). Treatments included quinclorac (Drive 75DF) applied at 0.75 pound of active ingredient/acre (0.84 kilograms/hectare) and dithiopyr (Dimension 1EC) applied at 0.50 pound of active ingredient/acre (0.56 kilograms/hectare) with applications immediately following seeding or zero, one, two, three or four weeks after emergence plus or minus one day. (The 10th day after seeding is zero weeks after emergence.)

For comparison, we included an untreated check and Tupersan (siduron) applied immediately after seeding at 6.0 pounds of active ingredient/acre (6.7 kilograms/hectare).

Plots were prepared, seeded, irrigated, fertilized and mowed as in the seeding date study.

For both years, emergence was defined as a uniform stand of 0.5-inch- (13-millimeter) tall seedlings that occurred 11 days after seeding in 2000 and nine days after seeding in 2001. Herbicides were applied with a 5-foot (1.5-meter) boom with three flat-fan nozzles in 2 gallons of water/1,000 square feet (815 liters/hectare) with a carbon dioxide-pressurized sprayer at 30 pounds/square inch (207 kiloPascals). Bermudagrass coverage was rated visually every week after emergence until seven weeks after emergence.

Results

Bermudagrass coverage three weeks after emergence in 2000 was reduced by an application of quinclorac immediately following seeding, but this was a short-term effect (Table 1). Quinclorac did not have a negative effect on bermudagrass coverage regardless of application timing in 2001. Therefore, quinclorac can be applied to bermudagrass at emergence or later without risk of damage, which agrees with recent greenhouse and field studies (3,11). Because quinclorac controls crabgrass as well as broadleaf weeds like clover, it is a useful establishment tool for superintendents.

Dithiopyr reduced bermudagrass coverage three weeks after emergence when applied immediately after seeding or at emergence in both years of the study, but had no effect when applied one week after emergence or later. Therefore, dithiopyr can safely be applied to bermudagrass seedlings one week after emergence or later. The siduron standard treatment reduced bermudagrass coverage by 32% or more at three weeks after emergence when compared to the untreated control and should not be used when seeding bermudagrass.

Nitrogen fertility

Rapid establishment of bermudagrass is desirable, and nitrogen fertilization is often increased to accelerate vegetative establishment. Increasing monthly nitrogen fertilization from 0 to 1.0 pound nitrogen/1,000 square feet (0-49 kilograms/hectare) during establishment increased coverage of Tifway bermudagrass by 17% (8). However, the effect of nitrogen fertilization on seeded bermudagrass coverage has not been reported.

Methods

Research at the University of Kentucky Agriculture Experimental Station evaluated the influence of post-seeding nitrogen fertility. Plots were established on a Maury silt loam soil with a pH of 6.3, 504 pounds phosphorus/acre (565 kilograms/hectare) and 350 pounds potassium/acre (392 kilograms/hectare). Plots were prepared, seeded, irrigated and mowed as in the seeding date study. As subplots of the seeding date study, bermudagrass received 1.0 pound nitrogen/1,000 square feet (49 kilograms/hectare) using urea at seeding and applied every 15 or 30 days after seeding, with the final application on Sept. 30.

Results

Results of this study indicate that increasing monthly nitrogen fertilization from 1.0 to 2.0 pounds nitrogen/1,000 square feet (49-98 kilograms/hectare) does not improve seeding

establishment of Mirage bermudagrass (Figure 4). In addition, nitrogen treatments did not affect winter survival of bermudagrass (data not shown). Our results on Mirage bermudagrass were similar to those reported for Tifway bermudagrass sprigs where establishment was not encouraged by increasing the monthly post-planting nitrogen applications from 1.0 to 2.0 pounds/1,000 square feet (49-98 kilograms/hectare) (8). To maximize winter survival during the first winter following seeding of bermudagrass, some researchers have recommended using 1.0 pound nitrogen/1,000 square feet (49 kilograms/hectare) twice monthly early in the growing season, then once monthly starting July 1, and terminating nitrogen applications by the end of August (13). However, bermudagrass coverage following winter in May or June was not decreased in our study when 1.0 pound nitrogen/1,000 square feet (49 kilograms/hectare) was applied twice monthly until Sept. 30.

Summary

In our studies, optimal bermudagrass establishment occurs when seeding from June 1 to July 15 in the transition zone at 0.25 to 1.0 pound/1,000 square feet (12-49 kilograms/hectare), and when applying 1.0 pound nitrogen/1,000 square feet (49 kilograms/hectare) each month. Earlier seeding dates provide more bermudagrass cover following the first winter. For weed control in seedling bermudagrass, quinclorac after emergence or later, or dithiopyr one week after emergence or later can be used safely to control crabgrass without reducing bermudagrass coverage. Siduron should not be used for weed control when seeding bermudagrass. Although seeding rate, seeding date, fertilization and weed control are important for proper establishment, cultivar selection is also key for successful establishment.

A great deal of research has been conducted in the past five years on the establishment of seeded bermudagrass. With this new information and the increased availability of improved seeded bermudagrass cultivars, superintendents will now have the option of seeding instead of sprigging or sodding to establish bermudagrass. Correct seeding protocols, cultivar selection and proper herbicide choice can almost assure quick, successful establishment of bermudagrass fairways at a minimal cost.

% BERMUDAGRASS COVERAGE

Herbicide	Application timing	2000			2001		
		Weeks after emergence (WAE)					
		3	5	7	3	5	7
Quinclorac	PRE*	98 b†	99 a	100 a	91 a	94 a	97 a
	0 WAE‡	100 a	100 a	100 a	97 a	96 a	99 a
	1 WAE	100 a	100 a	100 a	94 a	97 a	100 a
	2 WAE	98 ab	99 a	100 a	94 a	94 a	98 a
	3 WAE		100 a	100 a		95 a	99 a
	4 WAE		100 a	100 a		95 a	99 a
Dithiopyr	PRE*	1 c	7 c	45 b	0 c	4 b	26 b
	0 WAE	73 b	93 b	98 a	82 b	91 a	99 a
	1 WAE	97 a	98 a	99 a	94 a	95 a	100 a
	2 WAE	99 a	99 a	100 a	93 a	95 a	98 a
	3 WAE		98 a	100 a		94 a	98 a
	4 WAE		98 a	99 a		97 a	100 a
Siduron control		4	60	94	64	89	98
Untreated control		99	100	100	96	98	100

*PRE, pre-emergence application immediately following seeding.
†Within columns, means followed by the same letter are not significantly different.
‡WAE, weeks after bermudagrass seedling emergence.

Table 1. Percent coverage of Mirage bermudagrass treated with quinclorac or dithiopyr at various times before and after seeding. For weed control in seedling bermudagrass, it is safe to apply quinclorac after emergence or later or dithiopyr one week after emergence or later to control crabgrass without reducing bermudagrass coverage. Siduron should not be used for weed control when seeding bermudagrass.

Acknowledgments

We gratefully acknowledge The Environmental Institute for Golf, the Midwest Regional Turfgrass Foundation and the Kentucky Turfgrass Council for their funding of these projects.

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THE RESEARCH says . . .

- **Using seeded bermudagrass** is less costly than sod.
- **In Kentucky, earlier** seeding dates improved survival in the first winter after seeding, but seeding bermudagrass before June 1 in the transition zone increases the chance of competition from annual bluegrass and should be avoided.
- **For rapid coverage** and higher density, seeding 1 pound/1,000 square feet (98 kilograms/hectare) will provide coverage similar to that of higher seeding rates. If cost is a more important consideration, seeding 0.25 to 0.5 pound/1,000 square feet (24-49 kilograms/hectare) is adequate because there was no difference in coverage among seeding rates by 56 days after seeding.
- **For weed control,** quinclorac can be applied to bermudagrass at emergence or later without damage, and dithiopyr can be applied one week after emergence or later. Siduron should not be used when seeding bermudagrass.
- **Increasing monthly nitrogen** applications above 1 pound/1,000 square feet (49 kilograms/hectare) does not increase bermudagrass establishment.

NITROGEN VS. ESTABLISHMENT

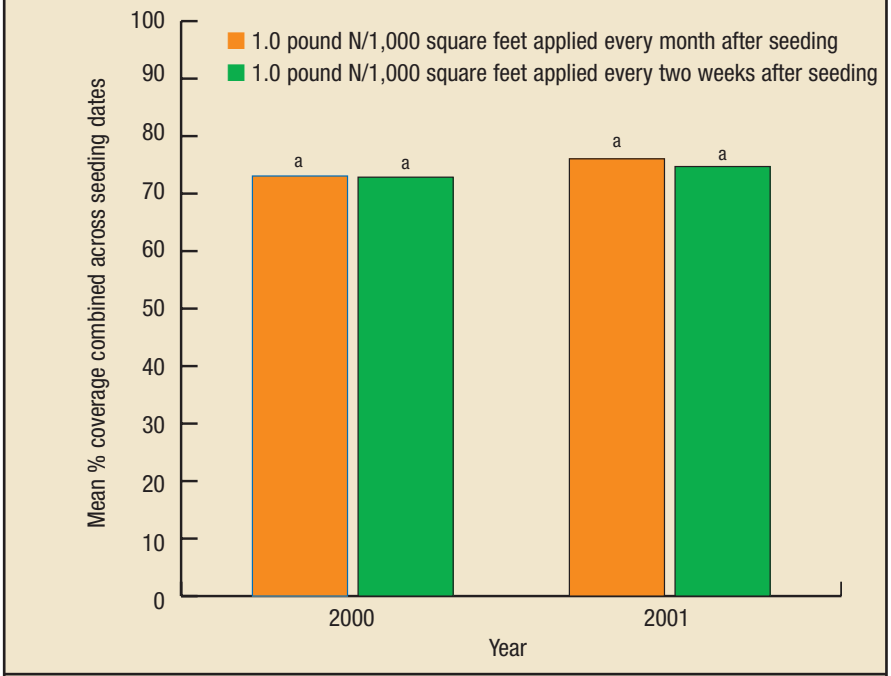

Figure 4. The influence of nitrogen fertility on bermudagrass establishment. Increasing monthly nitrogen fertilization from 1.0 to 2.0 pounds nitrogen/1,000 square feet (from 49 to 98 kilograms/hectare) did not improve establishment of Mirage bermudagrass by seed. Values labeled with the same letter within years are not significantly different from each other.

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