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...Using Science to Benefit Golf

Researchers from Kansas State University and Oklahoma State University team up with a savvy golf course superintendent to evaluate how effectively a perennial ryegrass turf could be converted to 'Riviera' bermudagrass in small plots. Then they developed a strip seeder that would allow the conversion to be accomplished on a larger scale. Shown above is dormant 'Riviera' bermudagrass (straw brown) in December, 2006 that was strip seeded the previous June into cool-season turf at the River Oaks Golf Course in Grandview, Missouri.

Volume 6, Number 4
February 15, 2007

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***.

Editor

Jeff Nus, Ph.D.
1032 Rogers Place
Lawrence, KS 66049
jnus@usga.org
(785) 832-2300
(785) 832-9265 (fax)

Research Director

Michael P. Kenna, Ph.D.
P.O. Box 2227
Stillwater, OK 74076
mkenna@usga.org
(405) 743-3900
(405) 743-3910 (fax)

Strip Seeding: A New Approach for Converting Cool-season Turf to Warm-Season Grasses

Jack Fry, Randy Taylor, Bob Wolf, Dick Stuntz, and Alan Zuk

SUMMARY

Researchers from Kansas State University and Oklahoma State University team up with a savvy golf course superintendent to evaluate how effectively a perennial ryegrass turf could be converted to 'Riviera' bermudagrass in small plots, and then develop a strip seeder that would allow the conversion to be accomplished on a larger scale. The study's findings include:

- Perennial ryegrass plots that were broadcast seeded with 'Riviera' had 12% bermudagrass coverage at the end of the first year and 60% coverage at the end of the second.
- The strip-seeding method, although disturbing only 11% of the plot area at planting, resulted in 41% bermudagrass coverage by Oct. 2002 and 71% coverage by Oct. 2003.
- Two primary advantages of strip seeding bermudagrass are: 1) there is little interruption in use of the turf, and on a golf course this would allow for revenue flow to continue during the conversion process; and 2) as much as to 80% less seed (on a weight basis) is required, compared with converting the perennial ryegrass turf by broadcasting bermudagrass seed. Savings are also realized on other practices associated with seedbed preparation prior to a broadcast application of seed.
- A U.S. patent is pending on the strip seeding method and equipment.

With the cost of maintaining cool-season sports turfs increasing in the transition zone due to expenses associated with water and fungicide applications, there is interest in converting these areas to cold-tolerant warm-season grasses. Bermudagrass is used extensively in the transition zone, but, until recently, there were no turf-type cultivars that had acceptable freezing tolerance. 'Yukon' bermudagrass was released in 2002, and 'Riviera' bermudagrass shortly thereafter, by Oklahoma State University. 'Zenith' zoysiagrass has also been used effectively on golf courses in the transition zone of the U.S. and can be established more cheaply than 'Meyer' zoysiagrass, which requires vegetative establishment.

Converting an existing stand of perennial ryegrass to a seeded warm-season grass would commonly be done by treating the perennial ryegrass sward with a nonselective herbicide before seeding. This may require that the area be closed during the establishment period, however, resulting in a significant loss of revenue. In addition, costs associated with purchase of herbicide and seed may be prohibitive for some operations.

To avoid the expense associated with sodding golf course fairways and tees, 'Meyer' zoysiagrass is routinely strip sodded into cool-season golf course fairways. During this process, zoysiagrass strips measuring six to 12 inches wide are laid into voids of the same width that have been cut in the existing cool-season turf, and spaced

Figure 1. One of four rotating tiller blades mounted on a modified seeder and used to create the 2-inch-wide strip-seeded rows in perennial ryegrass plots and evaluate conversion to seeded 'Riviera' bermudagrass.

JACK FRY, Ph.D. Professor; and ALAN ZUK, Ph.D., Research Associate; Department of Horticulture, Forestry and Recreation Resources, Kansas State University, Manhattan; RANDY TAYLOR, Ph.D., Professor, Department of Biosystems and Agricultural Engineering, Oklahoma State University, Stillwater; BOB WOLF, Ph.D., Associate Professor, Department of Biological and Agricultural Engineering, Kansas State University, Manhattan; DICK STUNTZ, CGCS, President of Alvamar Inc., Lawrence, KS.

USGA Turfgrass and Environmental Research Online 6(4):1-6.
TGIF Record Number: 123335

anywhere from one to two feet apart; closer spacing results in faster zoysiagrass coverage. The strip-sodding process can be accomplished in a matter of days, and the golf course is then open for play. Hence, establishment costs are minimized, and there is little interruption in golf course revenue flow.

After strip sodding is completed, the area is managed to favor zoysiagrass cultural requirements. Complete zoysiagrass coverage can usually be expected over a period of two to three years. Past successes with strip sodding zoysiagrass on golf courses, and the release of cold-tolerant seeded warm-season turfgrass cultivars, led us to consider the use of strip seeding to convert a stand of perennial ryegrass to warm-season turf.

In this study, our objective was to evaluate how effectively a perennial ryegrass turf could be converted to 'Riviera' bermudagrass in small plots, and then develop a strip seeder that would allow the conversion to be accomplished on a larger scale.

Evaluating Strip Seeding as an Establishment Method

Plots measuring six by six feet were set up in an existing ryegrass stand to evaluate strip seeding. Treatments imposed on the perennial ryegrass sward were: broadcast bermudagrass seed; glyphosate broadcast + broadcast bermudagrass seed; and planting bermudagrass in rows to mimic those that would be created by a strip seeder, with and without a glyphosate over spray on each row. For the glyphosate broadcast treatment, the herbicide was applied one week before planting by using a backpack sprayer.

Before seeding, all plots except those to be established by strip seeding were core aerified and verticut. On July 2, 2002, bermudagrass seed was mixed with Milorganite and spread by using a shaker bottle to provide 1.5 lbs PLS /1,000 sq. ft. and 1 lb.N /1,000 sq. ft.

Planting rows to mimic those that would be made by a strip seeder were created by modi-

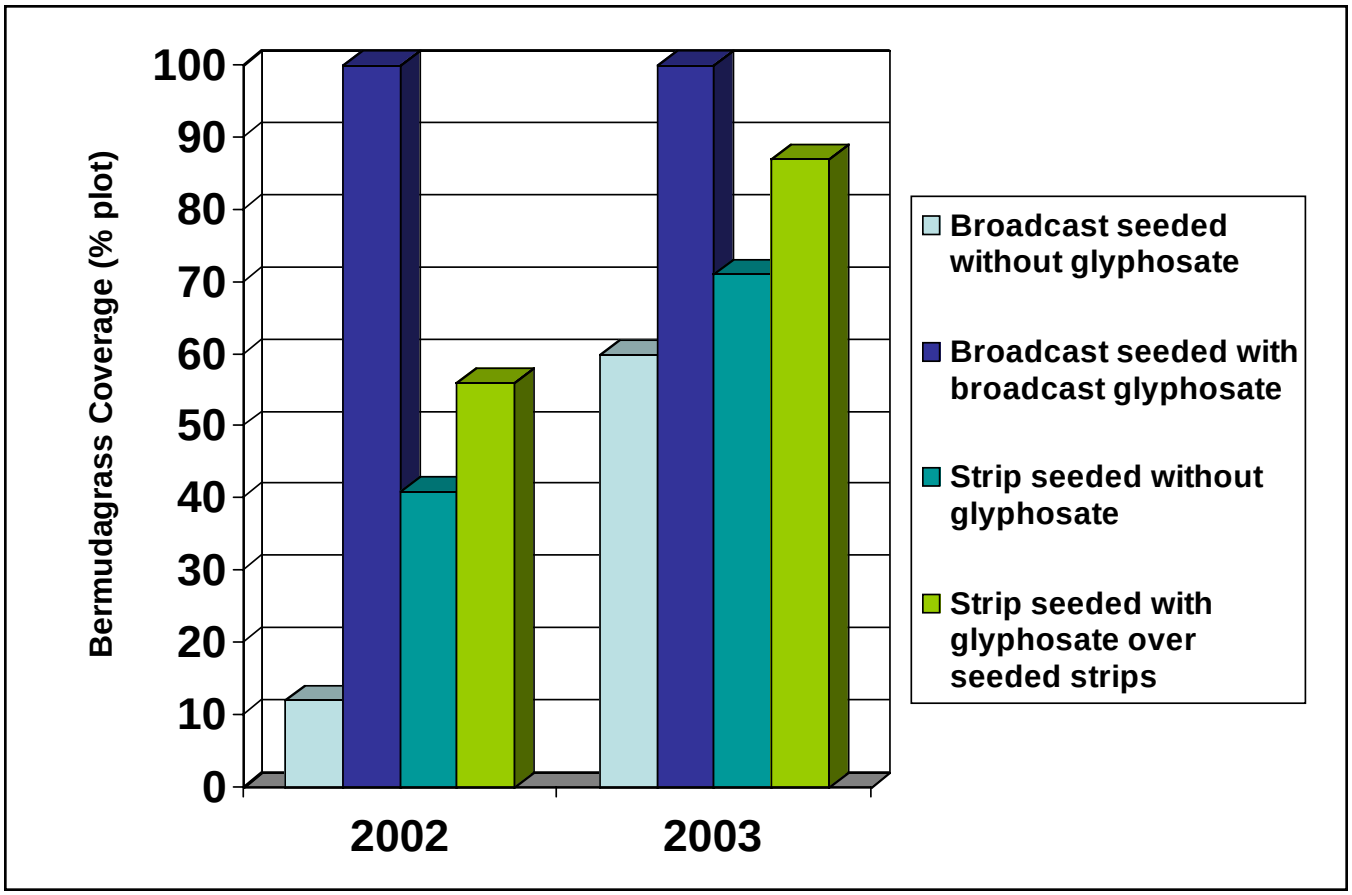

Figure 2. 'Riviera' bermudagrass coverage in an existing perennial ryegrass turf at the end of 2002 and 2003 after seeding in June, 2002 using various establishment methods.

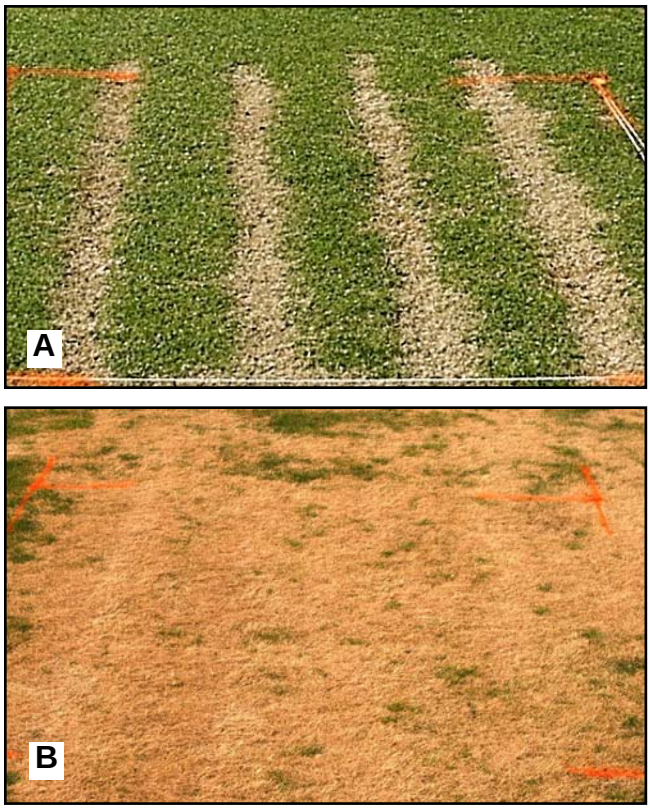

Figure 3. 'Riviera' bermudagrass coverage resulting from strip seeding into perennial ryegrass and then applying a 2.8-inch-wide band of glyphosate over each row. Dormant, straw-brown bermudagrass is shown above the end of 2002 (A), and in the same plot at the end of 2003 (B).

fying a slit seeder (Figure 1). Existing vertically operating knives were removed and replaced with four knives attached to a horizontal shaft. Knives had teeth extending obliquely from their perimeter. The unit was operated by using the power take off on a tractor and, when set on the soil surface, the knives created four, two-inch-wide tilled rows, one inch deep, 15 inches apart, the entire length of each plot. This resulted in disturbance of approximately 4 ft^2 in each plot (11% of the entire plot area).

'Riviera' bermudagrass seed was mixed with Milorganite to apply 2.4 lbs PLS/1,000 sq. ft.. A shaker bottle was modified to include a 0.2-inch-diameter tube in its lid to deliver the seed/Milorganite mixture in a narrow row. A hand-held press wheel the same width as the seeded rows was used to firm the surface after seeding. Immediately after seeding, a 2.8-inch-wide band of glyphosate was applied over the rows in one of the strip seeding treatments to eliminate perennial ryegrass up to 0.5 inches on either side of the row using the same sprayer and application rate described previously.

Irrigation was applied frequently after seeding, and then every two to three days once seedlings had emerged and begun to mature. A reel mower was used to cut the study area three days weekly at 0.5 inches. Nitrogen from urea was applied every two to three weeks to provide a total of 3 lbs./1,000 sq. ft. between the seeding date and mid-August. In 2003, nitrogen was applied at 1 to 1.5 lbs. N/1,000 sq. ft. every three weeks between early June and mid-August. Data were collected on bermudagrass coverage and turfgrass quality. The vertical-point quadrant method (3) was used to determine bermudagrass coverage within each treatment plot after growth had ceased in October.

To determine the impact of establishment treatments on turfgrass quality the first two months after seeding, visual ratings were taken weekly in July and August 2002, and monthly averages were determined. Quality was rated on a 0 to 9 scale, where 7 = acceptable quality for a golf course fairway.

Results

Perennial ryegrass plots that were broadcast seeded with 'Riviera' had 12% bermudagrass coverage at the end of the first year and 60% coverage at the end of the second (Figure 2) Complete bermudagrass coverage the first season was attained by using a broadcast glyphosate application followed by broadcasting bermudagrass seed. Visual observations indicated that complete coverage had occurred within four to five weeks after seeding.

The strip-seeding method, although disturbing only 11% of the plot area at planting, resulted in 41% bermudagrass coverage by Oct. 2002 and 71% coverage by Oct. 2003 (Figure 2). Applying glyphosate over rows resulted in an additional loss of 11% of the perennial ryegrass, and about 15% greater coverage in 2002 and 2003, compared with coverage in strip-seeded

Figure 4. The strip seeder and its components that were used to convert a perennial ryegrass turf to seeded 'Riviera' bermudagrass.

rows without a glyphosate over spray (Figures 2 and 3). Once bermudagrass coverage exceeds 80%, the turfgrass manager could remove remaining perennial ryegrass with a broadcast application of glyphosate over dormant bermudagrass.

Bermudagrass establishment using the strip seeding method was successful, in part, because it created space, or a gap, which allows the seedling to emerge and develop without the competition of surrounding perennial ryegrass plants. Converting sod-forming cool-season grasses, such as Kentucky bluegrass or creeping bentgrass using the strip seeding method has not been evaluated. The ability of these grasses to spread laterally would likely create more competition for seeded bermudagrass and affect establishment rate.

At the seeding rates evaluated herein, a seed savings of 79% would have been realized by using the strip seeder compared to the broadcast method. At the time the study was done, 'Riviera' bermudagrass seed cost was $ 27.90/lb PLS. At these seeding rates, using the strip seeder instead of a broadcast method would result in a savings of nearly $1,600/acre. Savings also would have been realized in glyphosate and labor involved in aerification and verticutting prior to seeding. In a golf course setting, strip-seeded turf could be played on shortly after seeding. Restricting carts from these areas would be necessary because traffic can greatly reduce establishment success of seeded warm-season grasses (4). Local rules would have to be implemented for occasions when a ball comes to rest on a seeded row.

Figure 5. Dormant 'Riviera' bermudagrass (straw brown) in December, 2006 that was strip seeded the previous June into cool-season turf at the River Oaks Golf Course in Grandview, Missouri.

Strip seeding 'Zenith' zoysiagrass at 1.7 lbs/1,000 sq. ft. into three-inch-wide glyphosate-treated strips spaced one foot apart resulted in 73% coverage by the end of the third season of establishment in Kansas (4). Bermudagrass is more aggressive than zoysiagrass, and we observed >80% coverage was achieved in two seasons by using two-inch wide rows 15 inches apart. Successful establishment of zoysiagrass using strip seeding in small plots suggest that this species may also be a candidate for conversion of perennial ryegrass turfs using the strip seeder.

Differences in turf quality were observed among all treatments during July 2002. Poorest quality was observed in plots where glyphosate was used over entire plots (quality = 1.1) or over rows created by the strip seeder (quality = 3.5). By August 2002, bermudagrass had completely covered glyphosate-treated perennial ryegrass plots and acceptable quality was observed. Similarly, strip-seeded plots over which glyphosate had been applied also exhibited acceptable quality by August. Use of the strip seeder without glyphosate also resulted in unacceptable quality in July, 2002 (quality = 5.9), but recovery occurred by Aug. (quality = 7.1). In general, treatments that resulted in the greatest reduction in perennial ryegrass quality provided the best bermudagrass establishment by the end of the season.

Although initial quality was better in strip-seeded turf than in glyphosate broadcast treated turf, one would expect a less uniform appearance to persist for a longer period of time in strip-seeded turf. In autumn and early spring, strip-seeded turf has a nonuniform striped appearance when bermudagrass is dormant and surrounding perennial ryegrass remains green. Some may consider this striping objectionable.

Strip Seeder Development and Evaluation

In 2003, a strip-seeder was assembled in the Department of Biological and Agricultural Engineering at Kansas State University (Figure 4). The strip seeder is capable of creating six rows, approximately two inches wide, using similar tilling devices employed in the initial evaluation. A seed/fertilizer mixture is retained in seed hoppers and is deposited on the surface of the tilled row. A press wheel firms the row and then a glyphosate spray solution, originating from a tank mounted on the unit, is applied over the surface. In June, 2006, the River Oaks Golf Course in Grandview, Missouri was strip seeded with 'Riviera' bermudagrass using the same seeder described herein. The course remained open for play after seeding, and by October, 2006, most fairways exhibited >60% bermudagrass coverage (Figure 5).

In summary, two primary advantages of strip seeding bermudagrass are: 1) there is little interruption in use of the turf, and on a golf course this would allow for revenue flow to continue during the conversion process; and 2) as much as to 80% less seed (on a weight basis) is required, compared with converting the perennial ryegrass turf by broadcasting bermudagrass seed. Savings are also realized on other practices associated with seedbed preparation prior to a broadcast application of seed. A U.S. patent is pending on the strip seeding method and equipment (2). Golf course superintendents or contractors who have interest in this establishment technique can contact: Topeka Sod Farm, 6506 Cherokee Lane, Ozawkie, KS, 66070, ATTN: Mike Mallory, 785-979-4078; e-mail: lpcc@gobluestreak.com.

Acknowledgement

Thanks are extended to Johnston Seed Company, Enid, Oklahoma, for providing ‘Riviera’ bermudagrass seed, and to the Kansas Turfgrass Foundation and USGA’s Turfgrass and Environmental Research Program for partial support of this project.

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