Ideas In Pest Management

Establishing Creeping Bentgrass in Annual Bluegrass Fairways

Glyphosate and interseeding appears to be an effective approach in boosting creeping bentgrass in annual bluegrass fairways.

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Golf course fairways that are established with creeping bentgrass (*Agrostis stolonifera* L.) are often invaded by annual bluegrass (*Poa annua* L.), which may easily become the dominant species over time. Undesirable traits associated with annual bluegrass are a light green color, prodigious seed head production, poor environmental stress tolerance, and high disease susceptibility.

Interseeding and nonselective herbicides, like glyphosate, have often been used to increase creeping bentgrass on golf course fairways. The objective of this research was to determine the most effective glyphosate rate and application timing necessary to quickly increase creeping bentgrass populations through interseeding into predominantly annual bluegrass fairways, while keeping the golf course open for play.

Research locations and management

Research was conducted from July to October 2010 at the University of Minnesota Les Bolstad Golf Course in St. Paul, Minn., and Michigan State University Hancock Turfgrass Research Facility in East Lansing, Mich. The Minnesota location was established in 1929 and has since transitioned to annual bluegrass. The plots in Michigan were established in 2006 from seedheads collected during mowing of an annual bluegrass stand.

Soil type in Minnesota was a Cathro Muck (organic material over loamy sediment); in Michigan soil type was a Colwood-Brookston loam.

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Initial turfgrass species composition was evaluated before initiation of the study using a grid intersect method (6). Species compositions as averaged over the study areas at each location were: Minnesota, 99% annual bluegrass and 1% perennial ryegrass (*Lolium perenne* L.); and Michigan, 96% annual bluegrass and 4% creeping bentgrass. Kentucky bluegrass (*Poa pratensis* L.) abundance was less than 1% at both locations.

The Minnesota site was subjected to normal golf traffic and received routine fairway maintenance (0.5-inch [12.5-millimeter] height of cut, mowing three times per week) throughout the duration of the study. The Michigan site was not subjected to golf traffic, but received the same routine fairway maintenance.

Timing of bentgrass interseeding

To avoid high temperature and drought pressures of the summer months, creeping bentgrass seed is typically sown in late summer or early fall; however, this timing might not be best when seeding into an existing stand of annual bluegrass because of competition from germination of this winter annual (10). Annual bluegrass seed germination increases in the late summer when soil temperatures fall below 70 F (21 C) (4), putting tremendous pressure on newly seeded creeping bentgrass fairways. Creeping bentgrass seed is able to germinate at higher temperatures than annual bluegrass (10), and annual bluegrass becomes physiologically stressed at these high temperatures after producing seedheads in late spring (12).

Seeding dates were July 15 for Minnesota, and July 20, 2010 in Michigan. Seeding was conducted using a Turfco TriWave slit-seeder calibrated to deliver a total of 65.1 pounds/acre (73 kilograms/hectare) T-1 creeping bentgrass seed to the study area by seeding in two directions on 45-degree angles from a fixed line. Seeder depth was set to penetrate the surface to the thatch-soil interface, not exceeding 0.5 inch (12.5 millimeters).

Glyphosate application timing and rate

Treatment factors included glyphosate rate and application timing relative to date of seeding. The glyphosate product used was Razor Pro (Nufarm Americas), containing 41% glyphosate in the form of isopropylamine salt. Glyphosate applications were applied with a CO_2-pressurized sprayer calibrated to deliver 1.8 gallons/1,000 square feet (7.5 liters/100 square meters). Application rates were 0, 0.25, 0.37, 0.75, 1.5, or 5.0 pounds ai/acre (0, 0.28, 0.42, 0.84, 1.68 and 5.62 kilograms ai/hectare) applied either 14, seven, or zero days before seeding.

A starter fertilizer was applied at a rate of 21.9 pounds nitrogen/acre (24.5 kilograms/

IMAGE 1: RATING = 3. This image is from a plot containing mostly annual bluegrass. No glyphosate applied The annual bluegrass is suffering from summer stress and dollar spot. Photo taken at 6 WAS and represents the decline in TQ during this time. Demonstrates the superior TQ of plots that were converted to bentgrass. (University of Minnesota Les Bolstad Golf Course, St. Paul, MN. Photo: Sam Bauer)

hectare), 43.7 pounds phosphorus (P_2O_5)/acre (49 kilograms hectare), and 21.9 pounds potassium (K_2O)/acre on the day of seeding and three weeks after seeding. Subsequent fertilizer applications of 21.9 pounds nitrogen/acre and 21.9 pounds potassium/acre were applied at six weeks and nine weeks after seeding; additional phosphorus was not required based on a soil test.

Irrigation during establishment was applied daily at 6 a.m., noon and 6 p.m. and delivered in uniform applications of no more than 0.5 inch (12.5 millimeters) water per day. Following establishment, irrigation schedules were adjusted to apply water at 80% to 100% of evapotranspiration as dictated by onsite or local weather station data.

Subdue GR (1% mefanoxam, Syngenta Crop Protection) was applied and watered in with 0.16 inch (4 millimeters) of water on the day of seeding and two weeks after seeding to prevent *Pythium*. An infection of *Pythium* occurred in Minnesota on Aug. 12, 2010, and was controlled with Banol (propamocarb hydrochloride, Bayer Environmental Science); this was beyond the 14-day Subdue reapplication interval and was attributed to excessively wet, hot and humid weather.

Dollar spot (*Sclerotinia homoecarpa*)

occurred at both locations throughout the study and was controlled with (Daconil Weather Stik, (clorothalonil, Syngenta Crop Protection). Additional fungicide applications were not required for the remainder of the study.

Data collection and experimental design

Increase in bentgrass abundance was evaluated using the previously described grid-intersect method at three weeks after seeding and again when all plots received 100% cover ratings. Visual turfgrass quality was evaluated weekly following the initial glyphosate application and continued until all plots attained 100% cover. Following guidelines from the National Turfgrass Evaluation Program (NTEP), visual turfgrass quality was assessed based on color, density, uniformity, texture, and biotic or abiotic stresses and rated on a 1 to 9 scale, where 9 is best turf quality and 6 or above is considered acceptable) (9).

The experimental design was a 5 × 3 factorial with a control (no glyphosate) in a randomized complete block with four replicates. Plot size was 4 feet × 6 feet (1.2 × 1.8 meters) with a 1-foot (0.3-meter) border around each plot.

Bentgrass increase with glyphosate applications

In Michigan, creeping bentgrass

IMAGE 2: RATING = 5, also taken at 6 WAS. Glyphosate applied at 0.28 kg a.i ha-1 at 7 DBS (University of Minnesota Les Bolstad Golf Course, St. Paul, MN. Photo: Sam Bauer)

IMAGE 3: RATING = 8 glyphosate applied at 0.42 kg a.i. ha-1 at 0 WAS. (University of Minnesota Les Bolstad Golf Course, St. Paul, MN. Photo: Sam Bauer)

abundance was significantly affected by both glyphosate rate and timing of application. Creeping bentgrass abundance was always greatest with increasing glyphosate rates. The rate of 5.0 pounds ai/acre (5.62 kilograms ai/hectare) provided the greatest creeping bentgrass abundance (83% creeping bentgrass at three weeks after seeding and 53% at eight weeks after seeding), but the abundance was not statistically different from that produced with the 1.5 pounds ai/acre (1.68 kilograms ai/hectare) rate (Figure 1). **[FIGURE1]** Glyphosate treatments at seven days before seeding provided the greatest creeping bentgrass abundance (41%) at eight weeks after seeding, versus 14 days before seeding (26%) and zero days before seeding (34%).

Glyphosate rates also resulted in significant differences in creeping bentgrass abundance in Minnesota. Again, higher rates provided for the greatest bentgrass abundance at three weeks after seeding as well as 12 weeks after seeding, when all plots reached 100% cover. Maximum creeping bentgrass abundance was 30% at three weeks after seeding and 24% on the final rating date. This is approximately half of the increase as reported in Michigan, which is likely a result of additional golf traffic and a large annual bluegrass seed bank at the Minnesota site. The glyphosate rate of 0.25 lb a.i ac^{-1} achieved a bentgrass increase of 13% on the final rating date.

Timing of application was not statistically significant in Minnesota on either rating date.

Overall, greatest bentgrass abundance was associated with increasing glyphosate rates, with the assumption that higher glyphosate rates suppressed the existing turf enough to allow adequate germination of new bentgrass seedlings. Annual bluegrass regrowth and competition was likely the main factor inhibiting bentgrass germination and spread in the lower rate glyphosate treated plots. Because of this competition, both locations showed a reduction in creeping bentgrass populations from three weeks after seeding to the final rating date.

Although not consistently significant, glyphosate application timing at seven days before seeding produced greater creeping bentgrass abundance on the final rating date at both locations. This was expected, as the 14 days before seeding application allowed for annual bluegrass regrowth before seeding was conducted. Additionally, when glyphosate was applied zero days before seeding, approximately five to seven days were required to suppress the existing annual bluegrass, but creeping bentgrass germination occurred as soon as three days after seeding and was therefore competing with the annual bluegrass.

Turfgrass quality reflects glyphosate application and bentgrass abundance

Effect of application rate

Lower glyphosate rates were more closely correlated with better turfgrass quality in Michigan (Figure 2) than in Minnesota (Figure 3). **[FIGURES 2,3]** Minnesota applications were made earlier in the morning to avoid golf traffic and it is hypothesized that more glyphosate was taken up by the plant during this time period. Foliar uptake of glyphosate is enhanced in more humid environments (5) and weather data for St. Paul, Minn., demonstrates that the relative humidity is historically 27% higher in the morning than in the afternoon during the month of July (11). At the beginning of the study, all glyphosate-treated plots showed a reduction in turfgrass quality compared to the control plots. At approximately three weeks after seeding in both locations, the control plots, comprised primarily of annual bluegrass, showed a significant reduction in turfgrass quality.

In terms of resistance to heat stress, annual bluegrass is inferior to creeping bentgrass (1). In Minnesota, the annual bluegrass quality reduction continued beyond five weeks after seeding, at which time the control plots received lower turfgrass quality ratings than all of the glyphosate-treated plots. In Michigan, control plots received lower turfgrass quality ratings beyond four weeks after seeding. Dollar spot disease played a role in the decline of the annual bluegrass control plots at both locations.

IMAGE 4: Plot overview photo at 3 WAS (University of Minnesota Les Bolstad Golf Course, St. Paul, MN. Photo: Sam Bauer)

Trends in turfgrass quality ratings beyond five weeks after seeding reflected the amount of creeping bentgrass present; plots that had more creeping bentgrass received higher turfgrass quality ratings. This turfgrass quality difference based on glyphosate rate was statistically significant in Michigan, but not in Minnesota.

Effect of application time

Turfgrass quality as affected by glyphosate application time showed similar trends for both locations, with the 14 days before seeding application having the longest duration of unacceptable turfgrass quality. In Michigan, turfgrass quality levels based on the timing of glyphosate application were not significantly different by five weeks after seeding. Although, on the final rating date, applications at zero and seven days before seeding had significantly higher turfgrass quality values than the application 14 days before seeding, which is reflected in the higher level of creeping bentgrass in these plots. In Minnesota, the timing of glyphosate application did not have a significant effect on turfgrass quality beyond four weeks after seeding.

Conclusions and recommendations

Results from this study demonstrate

that summer glyphosate application and slit-seeding has the potential to increase creeping bentgrass populations in annual bluegrass fairways, while keeping the golf course open for play. The control plots that were not treated with glyphosate showed a bentgrass increase of less than 5%, which indicates that interseeding without suppressing the existing turf is an ineffective technique. Other researchers have shown that creeping bentgrass has the potential to increase over time after the initial seeding (7,10), although our results showed a reduction over time, which may be due to competition with annual bluegrass.

Aggressive creeping bentgrass varieties, such as T-1, have been shown to outcompete annual bluegrass (2). However, this result probably depends on altering management practices to favor creeping bentgrass over annual bluegrass, including collecting clippings, reducing irrigation frequency (6), alleviating soil compaction, improving drainage, using lightweight equipment, decreasing shade and minimizing soil disturbance (3).

Annual bluegrass reduction programs have proved successful for selective control of annual bluegrass in creeping bentgrass fairways (6,8), but implementing a reduction program requires a moderate population of creeping bentgrass in order to maintain turfgrass quality and encourage creeping bentgrass growth and development.

The glyphosate and interseeding approach appears to be a good strategy to quickly increase creeping bentgrass populations when initial populations are low. A specific recommendation based on this study would be to apply glyphosate at 1.5 pounds ai/acre (1.68 kilograms ai/hectare) or greater zero to seven days before seeding, while interseeding creeping bentgrass at a rate of 65.1 pounds/acre (73 kilograms/hectare) during mid-summer high-stress periods. Lower rates of glyphosate will benefit turfgrass quality, but these rates will also reduce creeping bentgrass establishment. Since annual bluegrass fairways typically decline in summer in the Midwest, summer is an optimal time to increase creeping bentgrass populations. Timing glyphosate application from zero to seven days before seeding will maximize the duration of acceptable turfgrass quality and provide a greater increase in creeping bentgrass populations.

The research says

- Summer glyphosate application and slit-seeding has the potential to increase creeping bentgrass populations in annual bluegrass fairways, while keeping the golf course open for play.
- Apply glyphosate at 1.5 pounds ai/acre or greater at zero to seven days before seeding; interseed creeping

IMAGE 5: Plot overview photo at 4 WAS. (Michigan State University Hancock Turfgrass Research Facility, East Lansing, MI. Photo: Aaron Hathaway)

bentgrass at 65.1 pounds/acre during mid-summer high-stress periods.

- Lower rates of glyphosate will benefit turfgrass quality, but will reduce creeping bentgrass establishment.
- Timing glyphosate application from zero to seven days before seeding will maximize the duration of acceptable turfgrass quality and provide a greater increase in creeping bentgrass populations.

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