Date of Seeding Affects Establishment of Cool-season Turfgrasses

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Abstract. Little documentation exists on the success of seeding cool-season turfgrasses in the late fall, winter and spring. The objectives of these two studies were to document the success of seeding Kentucky bluegrass (*Poa pratensis* L.), perennial ryegrass (*Lolium perenne* L.), and tall fescue (*Festuca arundinacea* Schreb.) at less-than-optimum times of the year, and to determine if N and P fertilizer requirements vary with seeding date of Kentucky bluegrass. 'Ram I' Kentucky bluegrass, 'Fiesta' perennial ryegrass, and 'Mustang' tall fescue were seeded on 1 Sept., 1 Oct., 1 Nov., 1 Dec., 1 Mar., 1 Apr., and 1 May $\pm$ 2 days beginning in 1989 and 1990. As expected, the September seeding date produced the best establishment, regardless of species. Dormant-seeding Kentucky bluegrass and tall fescue in November, December, or March reduced the establishment time compared with seeding in April or May. Seeding perennial ryegrass in November, December, or March may not be justified because of winterkill potential. To determine the effect of starter fertilizer on seedings made at different times of the year, 'Ram I' Kentucky bluegrass was seeded 1 Sept., 1 Nov., 1 Mar., and 1 May $\pm$ 2 days in 1989 and 1990, and the seedbed was fertilized with all combinations of rates of N (0, 24, and 48 kg·ha⁻¹) and P (0, 21, and 42 kg·ha⁻¹). Fertilizer rate had no effect on establishment regardless of seeding date, possibly because of the fertile soil on the experimental site.

The optimum time for seeding cool-season turfgrasses is mid-August through early September (Beard, 1975). Turfgrass seeded at this time will develop a dense stand and will usually withstand the stress of winter in the Midwest. However, construction schedules often require seeding in late fall, winter, or spring. Although dormant seeding of turfgrass was mentioned in textbooks as early as 1962 (Musser, 1962), few scientific reports exist documenting the efficacy of seeding at less-than-optimum times of the year. Diesburg (1986) reported that dormant-seeding Kentucky bluegrass in November was preferable to seeding in December, February, or March in Iowa, but not as effective as seeding in September. The December, February, and March seedings in this study were done over snow, and thus seed-soil contact was poor. Hull (1948) reported that survival of seedlings of several cool-season grasses was low when planted later in fall, but survival of fall or late fall seedings was still superior to that following spring seeding. Dormant-seeding of the warm-season bahia-

grass (*Paspalum notatum* Flugge.), either alone or in combination with cool-season grasses, was successful, producing >90% cover by the end of the first growing season (Dudeck and Peacock, 1982).

Fertilization of turfgrass seedbeds is commonly practiced. Application of P increases seedling root and top growth (Juska et al., 1965), especially in soils low in P (Christians et al., 1981; McVey, 1967; Turner and Waddington, 1983; Westfall and Simmons, 1971). Application of N to seedbeds will also improve seedling establishment as long as P is adequate (Hathcock et al., 1984; McVey, 1967). However, nutritional requirements for seeding at less-than-optimum times of the year have not been reported. The two objectives of this study were: 1) to document the success of seeding Kentucky bluegrass, perennial ryegrass, and tall fescue at less-than-optimum times of the year; and 2) to determine if N and P fertilizer requirements for Kentucky bluegrass differ with seeding date.

Materials and Methods

Seeding began Sept. 1989 and 1990 at the Purdue University Agronomy Research Center in West Lafayette, Ind. The soil was a Chalmers silt loam (fine silty mixed mesic Typic Haplaquoll) with a pH of 7.1, CEC of 21.5, 4.7% organic matter, P at 90 kg·ha⁻¹, and K at 398 kg·ha⁻¹. The entire experimental area was sprayed with glyphosate [N-(phosphonomethyl)glycine] to control existing vegetation in August of each year and each plot was sprayed as needed to control weeds

prior to seeding the later-seeded plots. Immediately prior to seeding, individual plots were power-raked in two directions to a 1-cm depth and debris was removed. There was no significant thatch layer on the site. Following seeding, plots were lightly raked with a leaf rake to insure good seed-soil contact. Plots seeded in September, October, April, and May were irrigated as needed to encourage germination immediately after seeding, whereas plots seeded in November, December, and March were irrigated beginning in April after seeding. After initial establishment, areas were irrigated to prevent moisture stress, but received no pesticide or additional fertilizer applications. Once the plants from each seeding reached 5 cm in height, plots were mowed at 5 cm three times per week with clippings returned. Data were collected beginning 1 month after the seeding date of each treatment. Percentage of cover was rated visually throughout the study. Crabgrass (*Digitaria* sp. L.) cover was rated visually in August of each year. Analysis of variance (ANOVA) was conducted on all data at the termination of the study using Statistical Analytical System's PROC ANOVA. There were significant differences among species, and thus, the data from each species were analyzed independently. Seeding date $\times$ year interactions were also significant and thus the data are presented for each year.

Species study. 'Ram I' Kentucky bluegrass at 96 kg·ha⁻¹, 'Fiesta' perennial ryegrass at 240 kg·ha⁻¹, and 'Mustang' tall fescue at 336 kg·ha⁻¹ were seeded on 1 Sept., 1 Oct., 1 Nov., 1 Dec., 1 Mar., 1 Apr., and 1 May $\pm$ 2 d. Immediately prior to seeding, N at 24 kg·ha⁻¹ and P at 21 kg·ha⁻¹ were applied using hand-held shaker bottles to each plot. Experimental design was a randomized complete-block with three replications and plot size was 2 $\times$ 2 m.

Fertilizer study. 'Ram I' Kentucky bluegrass was seeded at 96 kg·ha⁻¹ with a drop seeder on 1 Sept., 1 Nov., 1 Mar., and 1 May $\pm$ 2 d. Each plot received a starter fertilizer with all combinations of N and P rates. Fertilizer sources used were 46N-0P-0K (urea) and 0N-20P-0K. Rates of N were 0, 24, and 48 kg·ha⁻¹ and P rates were 0, 21, and 42 kg·ha⁻¹. Fertilizer was applied using hand-held shaker bottles to individual plots immediately prior to seeding. Experimental design was a split-block with seeding dates as main plots and fertilizer rates as subplots. The experiment contained three replications of main plots and subplot size was 1.5 $\times$ 1.5 m.

Results and Discussion

Species study. Seeding Kentucky bluegrass on 1 Sept. produced up to 68% cover by 1 Dec., whereas waiting until 1 Oct. produced only a maximum of 7% cover by 1 Dec. (Fig. 1). Therefore, seeding a slower-germinating species like Kentucky bluegrass as early in the fall as possible is essential in order to achieve an acceptable stand by

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Fig. 1. Effects of date of seeding of 'Ram 1' Kentucky bluegrass in (A) 1989-90 and (B) 1990-91 on percentage of cover in subsequent months. Vertical bars indicate $LSD_{0.05}$ for each rating date.

winter. This would be especially important on slopes where soil erosion could occur during the winter on sparsely-turfed areas. The advantage to seeding in September was especially obvious in the second year of our study, when high air temperatures from mid-May through Aug. 1991 inhibited establishment of seedlings made in October through May. Optimum shoot growth and tillering of cool-season turfgrasses occurs from 15 to 24 °C (Beard, 1975). In 1990, soil and air temperatures occasionally exceeded 24 °C after mid-June (Fig. 2). In 1991, soil and air temperatures consistently exceeded 24 °C from the first week in May through September. Additionally, these temperatures favored crabgrass over bluegrass, as seeding on all dates from Oct. 1990 through May 1991 resulted in a minimum of 25% crabgrass cover by 1 Aug. 1991, while the Sept. 1990 seeding resulted in <15% crabgrass cover (Fig. 3). The Dec. 1990 seeding produced better cover of Kentucky bluegrass throughout the following year than either the Oct. or Nov. 1990 seeding. The Dec. 1990 seeding also outperformed the Mar., Apr., and May 1991 seedings, demonstrating that dormant winter seeding in early December is effective in establishing Kentucky bluegrass.

Perennial ryegrass seeded on 1 Sept. produced commercially acceptable cover (>90%) by 1 Dec. (Fig. 4). Seeding perennial ryegrass on 1 Oct. did not produce commercially acceptable stands by 1 Dec., but plots filled in

quickly the following spring in both years of the study. Seeding a quick-germinating species like perennial ryegrass on 1 Nov. would be a questionable practice in Indiana. Ideally, air and surface soil temperatures will remain cool so no germination of perennial ryegrass seeded in early November will occur until spring. This occurred in 1989 when soil and air temperatures remained low throughout November and December and the November seeding performed well throughout 1990. However, winter damage is a risk if soil temperatures remain favorable long enough to allow germination but not maturation of the plants (Arakeri and Schmid, 1949; Beard 1959). Air temperatures following the Nov. 1990 seeding exceeded 20 °C and soil temperatures exceeded 10 °C, which allowed for some germination of the perennial ryegrass, but the seedlings died during the winter. The Nov. 1990 seeding produced poorer turf cover throughout Summer 1991 than did other seedings of perennial ryegrass in Fall 1990 and Spring 1991. Although cold injury did not occur in our study, such damage could occur on dormant-seeded perennial ryegrass when warm temperatures in early spring stimulate germination, but ensuing cold, windy conditions kill young seedlings. Therefore, the winterkill risk of seeding perennial ryegrass in November, December, or March may not be justified, given cover in July was similar whether seeding occurred in April or May or in November, December or March.

Tall fescue must be seeded in early September to achieve commercially acceptable cover before winter and the best turf cover the following year (Fig. 5). Like perennial ryegrass, tall fescue is also susceptible to winterkill, especially in the seedling stage (Beard, 1966). However, the soil and air temperatures following the Nov. 1991 seeding affected tall fescue much less than they did perennial ryegrass. Like Kentucky bluegrass, tall fescue seeded in December performed well during both years of the study. Cover was less affected by seeding date in tall fescue than in Kentucky bluegrass and perennial ryegrass, as seeding date had no effect on cover of tall fescue in July.

Crabgrass population rated in August were lowest following seeding in September, and highest following seeding in April and May (Fig. 3). Turfgrass seeded in April and May was germinating at the same time as crabgrass, giving an advantage to crabgrass. As expected, crabgrass population was highest in the plots where the desirable species did not establish well, including the Nov. 1990 seeding of perennial ryegrass and all of the Kentucky bluegrass seedings from Oct. 1990 through May 1991. Weed pressure is increased when seeding occurs at less-than-optimum times, but few herbicides are available to control annual grasses or broad-leaf weeds in seedling turf. Therefore, optimizing establishment to minimize weed pressure is important.

Fertilizer study. There were no significant interactions between seeding date and N or P treatments (data not shown). Data throughout 1990 and 1991 revealed large effects of seeding date on establishment, but no agronomically important effects from the fertilizer treatments. The fertility of the silt loam soils of the research site may have been high enough to mask the response to added nutrients. Turner and Waddington (1983) reported that P applications to seedbeds are most beneficial when soils are inherently low in P, and P soil test levels as low as 60 kg-ha⁻¹ will allow seedlings to develop normally when rapid establishment is not needed. Phosphorus levels of soils on our experimental site were 90 kg-ha⁻¹.

In summary, August or September is the optimum time to establish cool-season grasses. Dormant-seeding Kentucky bluegrass and tall fescue in November, December, or March will hasten establishment compared with spring seeding. Late fall or dormant-seeding perennial ryegrass might not be justified because of winterkill potential. Varying the rate of N and P applied to the seedbed on fertile soils did not affect establishment regardless of seeding date.

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Fig. 2. Air and soil temperatures (°C) in 1989–1990 and 1990–1991. Soil temps were recorded at 5 cm under bare soil.

Fig. 3. Effects of date of seeding on percentage of cover of crabgrass measured in the August following seeding of Kentucky bluegrass, perennial ryegrass, and tall fescue in (A) 1989–90 and (B) 1990–91. Vertical bars indicate $LSD_{0.05}$ for each rating date.

Fig. 4. Effects of date of seeding of 'Fiesta' perennial ryegrass in (A) 1989–90 and (B) 1990–91 on percentage of cover in subsequent months. Vertical bars indicate $LSD_{0.05}$ for each rating date.

Fig. 5. Effects of date of seeding of 'Mustang' tall fescue in (A) 1989–90 and (B) 1990–91 on percentage of cover in subsequent months. Vertical bars indicate $LSD_{0.05}$ for each rating date.

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