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The Rutgers Turfgrass Proceedings is published yearly by the Rutgers Center for Turfgrass Science, Rutgers Cooperative Extension, and the New Jersey Agricultural Experiment Station, Cook College, Rutgers University in cooperation with the New Jersey Turfgrass Association. The purpose of this document is to provide a forum for the dissemination of information and the exchange of ideas and knowledge. The proceedings provide turfgrass managers, research scientists, extension specialists, and industry personnel with opportunities to communicate with co-workers. Through this forum, these professionals also reach a more general audience, which includes the public. Articles appearing in these proceedings are divided into two sections.

The first section includes lecture notes of papers presented at the 1999 New Jersey Turfgrass Expo. Publication of the New Jersey Turfgrass Expo Notes provides a readily available source of information covering a wide range of topics. The Expo Notes include technical and popular presentations of importance to the turfgrass industry.

The second section includes research papers containing original research findings and reviews covering selected subjects in turfgrass science. The primary objective of this section is to facilitate the timely dissemination of original turfgrass research for use by the turfgrass industry.

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Dr. Ann B. Gould, Editor
Dr. Bruce B. Clarke, Coordinator

CAN BENTGRASS COMPETE WITH *POA ANNUA*?

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A number of creeping and velvet bentgrass cultivars have been recently released that exhibit greater phenotypic variation (e.g., density, disease resistance, and aggressiveness) than was previously available. This affords researchers the opportunity to assess the potential for genetic differences in the competitive ability of these bentgrasses against invasion by annual bluegrass. The goals of this research are to identify bentgrass cultivars that exhibit improved genetic competitive ability against annual bluegrass invasion under traffic, and to determine if establishment date affects the ability of bentgrass to compete against invading annual bluegrass.

SEEDING DATE TRIALS

Objectives

The objective of this trial was to identify the time of year that bentgrass should be seeded to optimize establishment and minimize the invasion of annual bluegrass, and to assess the competitive ability of bentgrass cultivars against the invasion of annual bluegrass.

Methods

- The study site consisted of an existing mixed stand of Penncross creeping bentgrass and annual bluegrass with an established seed bank population of annual bluegrass. One trial was conducted in 1998 and a second was initiated in 1999.
- The study was arranged in a randomized complete block design with four replications using a split-plot factorial treatment combination (five bentgrass cultivars by five seeding dates) (see below). An unseeded check was included to evaluate the rate of annual bluegrass establishment for each seeding date.

Bentgrass cultivar/species	Seeding date
1. L-93/creeping	1. 16 May 1998
2. Penn A4/creeping	2. 19 June 1998
3. Providence/creeping	3. 20 Aug. 1998
4. Penncross/creeping	4. 19 Sept. 1998
5. SR-7200/velvet	5. 16 Oct. 1998

- Seeding date main plot areas were sprayed with glyphosate approximately 1 and 2 weeks prior to each seeding date. Main-plot areas were verticut and core cultivated to prepare a seedbed containing annual bluegrass seed. Bentgrass varieties were seeded at a rate of 0.75 lb/1000 ft^2 (5 g/0.25 m^2 sub-plots).
- The percent invasion of annual bluegrass was determined using a line-intersecting grid method. Counts were made on 28 October 1998 for the May, June, and August seeding dates, and on 12 May and 20 August 1999 for all seeding date treatments.

Results

- The impact of seeding date and bentgrass cultivar on percent creeping bentgrass per plot in

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1998 is presented in Table 1; data collected for the 1999 trial is still under evaluation.

- Bentgrass populations (%) were highest for the June seeding date, followed by the August seeding date, and were lowest in the plots seeded in September and October.
- There was a significant seeding date by cultivar interaction that affected bentgrass populations on all observation dates. The interactions indicated that initial establishment of the cultivar SR 7200 was less than the other cultivars except for the June seeding date.
- The most distinct separation between cultivars occurred for the June seeding on 12 May 1999 and the October seeding on 20 August 1999.
- Observations on 20 August 1999 indicated that annual bluegrass populations were greatest in the cultivar Penncross plots for all seeding dates; however, annual bluegrass populations in the Penncross and Providence plots in the May seeding were similar.

Discussion

- As a winter annual, annual bluegrass would be expected to emerge with the lowest frequency during late spring to early summer months and the highest frequency in late summer and early fall. Thus, it seems logical that a June seeding would result in higher bentgrass populations compared to annual bluegrass.
- Based on this first year of data, it appears that the September and October seedings were at greatest risk of annual bluegrass invasion during the late summer and early fall period.
- Velvet bentgrass is considered to have a slower shoot growth rate than creeping bentgrass, and this may explain the lower establishment rate for the cultivar SR 7200 on most observations less than one year after seeding. However, the greater establishment of velvet bentgrass, relative to annual bluegrass, in the June seeding, and the ability of SR 7200 to produce high bentgrass populations in the May and August seeding after 1 year of growth, suggest that growth rate is not the only factor affecting population dynamics.

Plan of work for 2000

- Continue to monitor the annual bluegrass populations via the line-intersect counting method in the seeding trial initiated in 1998 to assess long term population dynamics.
- Monitor annual bluegrass invasion during the spring, summer, and fall of 2000 for the trial initiated in 1999.

FAIRWAY TRIAL ON SOIL-BASED ROOT ZONE

Objectives

The objective of this study was to assess bentgrass population dynamics in a mixed stand with annual bluegrass which received treatments to simulate wear, compaction, and wear plus compaction on a fairway turf grown on sandy loam.

Methods

- The field site consisted of an existing mixed stand of colonial bentgrass and annual bluegrass with a low seed bank population of annual bluegrass.
- The study was arranged in a randomized complete block design with three replications using a split-plot factorial treatment combination of 15 bentgrass entries and four levels of traffic (no traffic, wear, compaction, and wear plus compaction). The traffic factor was arranged as the main plot and entries were established as sub-plots.
- The trial plot area was sprayed with glyphosate to kill the existing stand and was verticut and mower scalped to remove debris. The area was topdressed with soil cores from putting greens of Plainfield Country Club (Plainfield, New Jersey) that contained seed of annual bluegrass. Bentgrass varieties were seeded at 0.75 lb/1000 ft^2 (5 g of seed into 4.6 m^2 plots) on 17 October 1998.
- Plots were fertilized with nitrogen at 5.3 lb/1000 ft^2 in 1999 and were mowed three times per week at 13/32 inch with clippings removed.

Pests, except for annual bluegrass, were controlled with appropriate pesticides.
- Traffic treatments were initiated on 5 August 1999. Wear was applied weekly with a modified walk-behind Sweepster, and compaction was applied weekly with smooth water-filled roller and once with vibratory plate compactor and a Wacker vibratory roller.

Results

- Bentgrass populations assessed on 3 July 1999 (before traffic treatment) indicated subtle differences between cultivars for annual bluegrass encroachment during establishment (Table 2). The greatest amount of annual bluegrass present in a cultivar was 19% and the least was 11%.
- Similarly, quality differences were evident between cultivars before traffic treatments were initiated.
- As expected, traffic reduced turf quality. The combination of wear and compaction resulted in the greatest reduction of turf quality, and the wear treatment reduced turf quality more than the compaction treatment.
- No interactions between bentgrass cultivar and traffic treatments were observed.
- After the traffic treatment was initiated, larger differences in turf quality were observed between bentgrass cultivars. Most notable were the performance of Penn G-1, Penn G-2, Penn A-4, and 7001 (a selection of velvet bentgrass), which all maintained quality ratings above 7. A quality rating average below 5.5 indicates less than acceptable performance.

Plan of Work for 2000

- Continue managing plots as a fairway turf using the procedures outlined above.
- Maintain traffic treatments throughout the 2000 growing season.
- Monitor turf quality and annual bluegrass populations as affected by bentgrass cultivar and traffic in the spring, summer, and fall of 2000.
- Measure the effect of traffic on soil physical properties.

PUTTING GREEN TRIAL ON SOIL-BASED ROOT ZONE

The objective of this study was to assess bentgrass population dynamics in a mixed stand with annual bluegrass which received treatments to simulate wear, compaction, and wear plus compaction on a putting green turf grown on sandy loam.

Methods

- The field site consisted of an existing mixed stand of creeping bentgrass cultivars and annual bluegrass, with a low seed band population of annual bluegrass.
- The study was arranged in a randomized complete block design with four replications using a split-plot factorial treatment combination of 15 bentgrass entries and four levels of traffic (no traffic, wear, compaction, and wear plus compaction). The traffic factor was arranged as the main plot and entries established as sub-plots.
- The trial plot area was sprayed with glyphosate to kill the existing stand. The plot area was topdressed with soil cores from putting greens of Plainfield Country Club that contained seed of annual bluegrass. The plot area was also core cultivated and verticut to prepare a seedbed. Bentgrass varieties were seeded at 5 g of seed into 4.6 m^2 plots on 30 September 1998.
- The plots were fertilized sufficiently to produce a putting green quality turf (5 lb N/1000 ft^2 in 1999).
- A mowing height of 0.15 inch was achieved in May 1999 and mowed at least 6 times per week.
- Traffic treatments were initiated 21 July 1999.

Results

- Populations of bentgrass assessed on 3 July 1999 (before traffic treatment) indicated subtle differences between cultivars for annual bluegrass encroachment during establishment (Table 3). The greatest amount of annual blue-

grass present in a cultivar was 16% and the least was 5%.
- Initially, the traffic treatment that included compaction increased quality (29 July). This effect resulted from reduced mower scalping associated with the firming of the turf canopy with compaction. As expected, continued traffic reduced turf quality for the 22 August and 3 October ratings. Wear lowered turf quality more than the compaction treatment. The combination of wear and compaction did not affected quality ratings more than wear alone.
- No interactions between bentgrass cultivar and traffic treatment were observed.
- After the traffic treatment was initiated, larger differences in turf quality were observed between bentgrass cultivars. Most notable were the performance of Penn G2, Penn A4, and SR 7200 and MVB (both selections of velvet bentgrass) which maintained quality ratings significantly above 7. A quality rating average below 5.5 indicates less than acceptable performance.

Plan of work for 2000

- Lower mowing height from 0.140 to 0.125 inch (1/8-inch) or less during spring 2000.
- Continue traffic treatments through the 2000 growing season.
- Monitor turf performance and annual bluegrass invasion.
- Measure the effect of traffic on soil physical properties.

PUTTING GREEN TRIAL ON SAND-BASED ROOT ZONE

The objective of this study was to assess the ability of bentgrass cultivars to resist invasion by annual bluegrass under conditions of wear, compaction, and wear plus compaction on a USGA sand root zone.

Methods

- The field side consisted of an 85:15 (by volume) sand:sphagnum peat root zone mixture, meeting USGA recommendations for putting green construction, constructed during 1998 (completed 28 October 1998).
- The study was a randomized completed block design with three replications using split-plot factorial treatment combination of 15 bentgrass entries and four levels of traffic (no traffic, wear, compaction, and wear plus compaction). The traffic factor was arranged as the main plot and entries established as sub-plots.
- The plots were hand-seeded on 28 May 1999 at 0.75 lb/1000 ft^2 (5 g/15 ft^2).
- A mowing height of 1/8 inch was achieved on 9 September 1999.
- Overseeding with Petersen's creeping bluegrass (*Poa annua*) at 0.07 lb seed/1000 ft^2 was performed in September and November 1999.
- Traffic treatments were initiated on 2 October 1999.

The following bentgrass species and entries were used to study the genetic ability to resist invasion of annual bluegrass under putting green mowing height on a sand-based root zone.

Cultivar	Species
A-4	Creeping
Cato	Creeping
Century	Creeping
G-2	Creeping
L-93	Creeping
Penncross	Creeping
Penneagle	Creeping
Pennlinks	Creeping
Providence	Creeping
Putter	Creeping
Southshore	Creeping
SR 1020	Creeping
SR 1119	Creeping
MVB	Velvet
SR 7200	Velvet

Plan of work for 2000

- Overseed monthly with Petersen's creeping bluegrass (perennial *Poa annua*) at no more than 0.1 lb seed/1000 ft^2 to simulate introduc-

tion of weed seed into a green via foot and vehicular traffic, wind, etc.

- Perform mowing, fertilization, irrigation, topdressing, and pest management practices that produce putting green quality meeting industry standards.
- Assess annual bluegrass encroachment into plots via line-intersect counting in spring, summer, and fall of 2000.
- Evaluate treatments for differences in traffic tolerance and annual bluegrass invasion.
- Measure the effect of traffic on soil physical properties.

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Table 1. Populations of creeping bentgrass as affected by cultivar and seeding date in 1998.

Source of Variation		Evaluation Date 19 Oct. 1998	Evaluation Date 12 May 1999	Evaluation Date 20 Aug. 1999
ANOVA				
Seeding Date (SD)		**[1]	***	***
Bentgrass Cultivar (BC)		***	***	***
SD x BC		**	*	***
Treatment				
Seeding Date	Bentgrass Cultivar	Bentgrass Population (%)		
16 May	Penncross	75	37	52
16 May	Providence	60	37	57
16 May	Penn A-4	78	46	77
16 May	L-93	71	40	72
16 May	SR 7200	46	42	73
19 June	Penncross	90	62	67
19 June	Providence	85	69	84
19 June	Penn A-4	87	79	95
19 June	L-93	86	76	88
19 June	SR 7200	89	87	94
20 Aug.	Penncross	76	53	50
20 Aug.	Providence	69	59	72
20 Aug.	Penn A-4	66	62	81
20 Aug.	L-93	79	59	78
20 Aug.	SR 7200	47	59	81
19 Sept.	Penncross		15	40
19 Sept.	Providence		14	56
19 Sept.	Penn A-4		17	67
19 Sept.	L-93		21	66
19 Sept.	SR 7200		8	37
16 Oct.	Penncross		22	27
16 Oct.	Providence		16	40
16 Oct.	Penn A-4		32	67
16 Oct.	L-93		24	59
16 Oct.	SR 7200		25	55

(Continued)

Table 1 (continued).

Source of Variation	Evaluation Date 19 Oct. 1998	12 May 1999	20 Aug. 1999
LSD at 5% =	14	16	11

[1] * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$

Table 2. Initial creeping bentgrass populations within bentgrass entry and quality of entry after establishment as a fairway turf in 1999.

Source of Variation		Creeping Bentgrass Population 3 July[1]	Turf Quality[3] 29 July[1]	22 Aug.[2]	3 Oct.[2]
ANOVA					
Traffic		NS[4]	NS	*	***
Bentgrass Cultivar (BC)		***	***	***	***
Traffic x BC		NS	NS	NS	NS
Traffic		% Bentgrass/Plot	Rating		
None		86	7.5	7.0	7.4
Wear		82	7.4	6.0	5.8
Compaction		83	7.4	6.8	6.2
Wear and Compaction		88	7.6	6.2	5.3
LSD at 5% =		NS	NS	0.3	0.3
Bentgrass Entry					
Cultivar	Species				
G-2	Creeping	89	8.3	8.1	7.9
G-1	Creeping	89	8.3	7.7	7.4
A-4	Creeping	88	8.3	8.3	7.8
Southshore	Creeping	88	7.3	6.4	5.8
SR 7200	Velvet	86	7.6	6.6	6.3
Penncross	Creeping	85	7.0	5.0	4.8
SR 1119	Creeping	84	7.8	6.8	6.5
Putter	Creeping	84	7.3	5.8	5.3
Pennlinks	Creeping	84	7.2	5.8	5.0
L-93	Creeping	83	7.7	6.5	6.2
Providence	Creeping	83	6.9	5.7	5.4
7001	Velvet	83	8.2	7.7	7.7
Century	Creeping	82	6.8	5.8	6.0
Penneagle	Creeping	82	6.8	5.8	5.4
SR 1020	Creeping	81	6.8	5.5	5.3

(Continued)

Table 2 (continued).

Source of Variation	Creeping Bentgrass Population 3 July[1]	Turf Quality[3] 29 July[1]	22 Aug.[2]	3 Oct.[2]
LSD at 5% =	4	0.5	0.5	0.7

[1]Denotes data collected before traffic treatments were initiated
[2]Denotes data collected after traffic treatments were initiated
[3]9 = best turf quality
[4]NS = not significant; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$

Table 3. Initial creeping bentgrass populations within bentgrass entry and quality of entry after establishment as a putting green turf grown on sandy loam in 1999.

Source of Variation		Creeping Bentgrass Population 3 July[1]	Turf Quality[3] 29 July[1]	22 Aug.[2]	3 Oct.[2]
ANOVA					
Traffic		NS[4]	*	***	***
Bentgrass Cultivar (BC)		***	***	***	***
Traffic x BC		NS	NS	NS	NS
Traffic		% Bentgrass/Plot	Rating		
None		92	6.0	6.4	7.2
Wear		90	6.1	5.4	5.9
Compaction		92	6.5	6.7	7.3
Wear and Compaction		91	6.6	5.7	5.6
LSD at 5% =		NS	0.2	0.3	0.3
Bentgrass Entry					
Cultivar	Species				
A-4	Creeping	95	7.5	8.1	8.5
G-2	Creeping	95	7.5	7.9	8.6
L-93	Creeping	93	6.3	6.5	6.9
Century	Creeping	93	6.3	6.3	7.3
Providence	Creeping	93	5.6	5.4	5.7
Southshore	Creeping	92	5.9	5.7	5.7
SR 1020	Creeping	92	5.6	5.4	5.8
Putter	Creeping	92	5.9	5.3	5.7
Penncross	Creeping	92	5.6	4.3	4.3
SR 1119	Creeping	91	6.0	5.8	6.6
Pennlinks	Creeping	91	5.9	4.9	5.1
Penneagle	Creeping	90	5.2	5.3	5.5
SR 7200	Velvet	89	7.3	6.7	7.8
MVB	Velvet	86	7.3	7.1	7.9
7001	Velvet	84	6.6	6.1	6.4

(Continued)

Table 3 (continued).

Source of Variation	Creeping Bentgrass Population 3 July[1]	Turf Quality[3] 29 July[1]	22 Aug.[2]	3 Oct.[2]
LSD at 5% =	2	0.4	0.5	0.6

[1]Denotes data collected before traffic treatments were initiated
[2]Denotes data collected after traffic treatments were initiated
[3]9 = best turf quality
[4]NS = not significant; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$