CULTIVAR AND TRAFFIC EFFECTS ON POPULATION DYNAMICS OF *AGROSTIS* SPP. AND *POA ANNUA* MIXTURES

Progress Report to the United States Golf Association

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Executive Summary

Project Title: Cultivar and Traffic Effects on Population Dynamics of *Agrostis* spp. and *Poa annua* Mixtures

A number of cultivars of creeping and velvet bentgrasses have been released that exhibit greater phenotypic variation than was previously available. This affords the opportunity to assess the potential for genetic differences in the competitive ability of these bentgrasses against annual bluegrass. The goals of this research project are to identify bentgrass cultivars that exhibit an improved genetic competitive ability against annual bluegrass invasion under the influence of traffic, and to determine if the time of year for establishment affects the competitive posture of bentgrasses against annual bluegrass invasion.

A trial was conducted in 1998 and 1999 on sandy loam to evaluate the influence of seeding date and bentgrass (creeping and velvet bentgrass) cultivar on the amount of bentgrass that will establish in competition with emerging annual bluegrass plants. First-year results are available for the 1998 trial. The least invasion of *Poa annua* during establishment was observed for the June seeding date compared to all other dates. The second best establishment of bentgrass occurred with an August seeding, whereas seeding in September and October resulted in the lowest bentgrass populations. A seeding date by cultivar interaction was found on all observations dates. 'Penncross' had consistently lower bentgrass population than other cultivars. 'Providence' had similar bentgrass population compared to 'Penn A4', 'L-93' and 'SR 7200' for the June, August and September seeding dates, but was less than these cultivars for the May and October seeding bentgrass. Penn A4 and L-93 had consistently high bentgrass population for all seeding dates. SR 7200 (velvet bentgrass) had similar bentgrass populations to Penn A4 and L-93 in the May, June and August seedings; however, SR 7200 had lower bentgrass population than these cultivars in the September and October seedings. It is apparent that cultivar selection impacts the success of renovating *Poa annua* infested turf. Further evaluation is needed to understand the importance of the interaction between seeding date and cultivar.

Field trials have been initiated to evaluate *Poa annua* encroachment into creeping bentgrass and velvet bentgrass cultivars maintained as putting green and fairway turf. These studies are assessing the bentgrass cultivars under the traffic stresses: wear, compacted soil, and wear plus compacted soil. Fairway and putting green trials were established on sandy loam with *Poa annua* population ranging from 10 to 19% in the fairway trial and 5 to 16% in the putting green trial. Traffic treatments were initiated in August 1999 and have affected turf quality. The combination of wear and compaction has produce the lowest quality turf in the fairway trial. Ratings in August and October 1999 indicate that wear treatment has been more detrimental to turf quality than compaction treatment. There has not been a significant interaction between cultivar and traffic treatment, indicating that cultivar ranking under the non-trafficked conditions was statistically similar to the cultivars rankings under traffic. *Poa annua* and bentgrass populations will be assessed in November 1999 and in spring, summer and fall of 2000.

A putting green trial was seeded 28 May 1999 on a sand-based (85:15 sand:peat by volume) root zone conforming to USGA guidelines. A mowing height of 3.2-mm ($^1/_8$–inch) was achieved on 9 September 1999. The entire experimental was overseeded in September and November 1999 with Petersen's creeping bluegrass (perennial *Poa annua*) at $\leq$ 0.5 g m^{-2} (0.1 lb / 1000 ft^2) and will be overseeded periodically throughout the study to simulate the gradual introduction of weed seed commonly experienced on golf turf. Traffic treatments were initiated in October 1999. Evaluation of turf performance in response to traffic has been initiated and will continue through the duration of the project.

These projects will be demonstrated at formal and informal field days during 2000. Data from these projects will be presented at the 2000 American Society of Agronomy meeting, and state and regional turf conferences.

Seeding Date Trials

Objectives: Identify the time of year for bentgrass seeding that optimizes the establishment of bentgrass against annual bluegrass, and assess the potential differences between bentgrass cultivars for the ability to establish against annual bluegrass.

Methods:

- Field site - 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.
- Randomized complete block design with 4 replications using a split-plot factorial treatment combination (5 bentgrass cultivars x 5 seeding dates). An unseeded check was included to evaluate the rate of annual bluegrass establishment for each seeding date.

Factors:	Bentgrass cultivar/species	Seeding Dates
	1. L-93/creeping	1. 16 May 1998
	2. Penn A4/creeping	2. 19 June 1998
	3. Providence/creeping	3. 20 August 1998
	4. Penncross/creeping	4. 19 September 1998
	5. SR-7200/velvet	5. 16 October 1998

- Establishment – Seeding date main-plot areas sprayed with glyphosate approximately two weeks and 1 week prior to each seeding date. Main-plot areas were verticut and core cultivated to prepare a seedbed containing annual bluegrass seed. Bentgrass varieties seeded at 0.75 pound / 1000 ft^2 (5 g / 1.4-m^2 sub-plots).
- Line-intersecting grid counts to determine percent annual bluegrass invasion were made on 28 October 1998 for the May, June, and August seeding dates, and 12 May and 20 August 1999 for all seeding date treatments.

Results:

- Results are presented for the trial conducted in 1998. Data collected for the 1999 trial is still in progress.
- Table 1 presents the affect of seeding date and bentgrass cultivar on percent annual bluegrass invasion. Bentgrass populations were highest for the June seeding date compared to all other dates. The second best establishment of bentgrass occurred with an August seeding. Seeding in September and October resulted in the lowest bentgrass populations.
- The ANOVA, however, indicated that there was a significant seeding date by cultivar interaction affecting bentgrass populations on all observations dates. The interactions indicated that the cultivar, SR 7200, had an initial establishment of bentgrass, relative to annual bluegrass, that was less than the other cultivars, except for the June seeding date where it was the same or better than the other bentgrasses.
- The interaction indicated the most distinct separation between cultivars occurred for the June seeding on 12 May 1999 and the October seeding on 20 August 1999.

- Observations of populations on 20 August 1999 indicated that annual bluegrass population was greatest in the cultivar, Penncross, for all seeding dates. Annual bluegrass populations were similar between Penncross and Providence in the May seeding plots. Providence, however, had greater bentgrass than Penncross for all other seeding dates on 20 August.

Discussion

- As a winter annual, annual bluegrass seed emergence would be expected to be lowest during the late-spring to early-summer and highest 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 populations of bentgrass 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 one-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 line-intersect counting in the seeding trial initiated in 1998 for evaluation of longer-term population dynamics.
- Monitor annual bluegrass invasion during spring, summer and fall of 2000 for trial initiated in 1999.
- Summarize establishment data for both trials and submit to a scientific journal for peer-review.
- Submit trade journal article for USGA Green Section Record.

Table 1. Annual bluegrass populations as affected by seeding date in 1998 and bentgrass cultivar, measured October 1998, and May and August 1999.

ANOVA Source	Oct 19	May 12	Aug 20
Seeding Date (SD)	**	***	***
Bentgrass Cultivar (BC)	***	***	***
SD x BC	**	*	***

Treatment		Bentgrass Population		
Seeding Date	Bentgrass Cultivar	19 Oct 1998	12 May 1999	20 Aug 1999
		----------% ----------		
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 Jun	Penncross	90	62	67
19 Jun	Providence	85	69	84
19 Jun	Penn A-4	87	79	95
19 Jun	L-93	86	76	88
19 Jun	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 Sep	Penncross		15	40
19 Sep	Providence		14	56
19 Sep	Penn A-4		17	67
19 Sep	L-93		21	66
19 Sep	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
	$LSD_{0.05}$	14	16	11

Fairway Trial on Soil

Objectives: To assess bentgrass species and cultivar population dynamics in a mixed stand with annual bluegrass receiving treatment to simulate wear, compaction, and wear + compaction on a fairway turf grown on sandy loam.

Methods:

- Field site - An existing mixed stand of colonial bentgrass and annual bluegrass, with a low seed bank population of annual bluegrass.
- Study - Randomized complete block design with 3 replications using a split-plot factorial treatment combination of 15 bentgrass entries and 4 levels of traffic (no traffic, wear, compaction, and wear + compaction)]. Traffic factor was arranged as main plot and entries established as sub-plots.
- Establishment - Trial plot area sprayed with glyphosate to kill existing stand. Plot area verticut and mower scalped to remove debris. Plot area was topdressed with soil cores from putting greens of Plainfield C.C. (Plainfield, NJ) that contained seed of annual bluegrass. Bentgrass varieties seeded at ¾ pound / 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 pounds / 1000 ft^2 in 1999; mowed three times per week at $^{13}/_{32}$-inch with clippings removed. Pests, except annual bluegrass, controlled with appropriate pesticides.
- Traffic treatments were initiated on 5 August 1999.
  i) Wear was applied weekly with a modified walk-behind Sweepster
  ii) Compaction was applied weekly with smooth water-filled roller and once with vibratory plate compactor and a Wacker vibratory roller.

Results (Table 2):

- Bentgrass populations assessed on 3 July 1999 (before traffic treatment) indicated subtle differences between cultivars for annual bluegrass encroachment during establishment. The greatest amount of annual bluegrass present in a cultivar was 19% and the least was 11% (Table 2).
- Similarly, quality differences were evident between cultivars before traffic treatments were initiated (Table 2).
- As expected, traffic has reduced turf quality. The combination of wear and compaction resulted in greatest reduction of turf quality. Wear treatment has reduced turf quality more than compaction treatment.
- No interactions between bentgrass cultivar and traffic treatment were observed (Table 2).
- After traffic treatment was initiated, larger differences in turf quality were observed between bentgrass cultivars. Most notable, were the performance of Penn G1, Penn G2, Penn A4 and 7001 (selection of velvet bentgrass) which maintained quality ratings above 7. A quality rating average below 5.5 indicates less than acceptable performance (Table 2).

Plan of Work for 2000:

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

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

ANOVA		Annual Bluegrass Population	Turf Quality Rating		
		July	July	August	Oct
Source		3†	29†	22‡	3‡
Traffic		NS	NS	*	***
Bentgrass Cultivar (BC)		***	***	***	***
Traffic x BC		NS	NS	NS	NS
Traffic					
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 & Compaction		88	7.6	6.2	5.3
$LSD_{0.05}$	4	NS	NS	0.3	0.3
Bentgrass Entry					
Cultivar	Species				
		%	--- Rating, 9=best ---		
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
SR1020	Creeping	81	6.8	5.5	5.3
	$LSD_{0.05}$	4	0.5	0.5	0.7

†, denotes data collected before traffic treatments initiated.
‡, denotes data collected after traffic treatments initiated.

Soil Green Trial

Objectives: To assess bentgrass species and cultivar population dynamics in a mixed stand with annual bluegrass receiving treatment to simulate wear, compaction, and wear + compaction on a putting green turf grown on sandy loam.

Methods:

- Field site - An existing mixed stand of creeping bentgrass cultivars and annual bluegrass, with a low seed band population of annual bluegrass.
- Study – Randomized complete block design with 4 replications using a split-plot factorial treatment combination of 15 bentgrass entries and 4 levels of traffic (no traffic, wear, compaction, and wear + compaction). Traffic factor was arranged as main plot and entries established as sub-plots.
- Establishment - Trial plot area sprayed with glyphosate to kill existing stand. Plot area was topdressed with soil cores from putting greens of Plainfield C.C. (Plainfield, NJ) that contained seed of annual bluegrass. 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.
- Plots were fertilized sufficiently to produce a putting green quality turf (5 pounds of N per 1000 ft^2 in 1999).
- A mowing height of 0.150-inch was achieved in May 1999 and mowed at least 6 times per week.
- Traffic treatments were implemented 5 August 1999.

Results (Table 3):

- Bentgrass populations assessed on 3 July 1999 (before traffic treatment) indicated subtle differences between cultivars for annual bluegrass encroachment during establishment. The greatest amount of annual bluegrass present in a cultivar was 16% and the least was 5% (Table 3).
- Similarly, quality differences were evident between cultivars before traffic treatments were initiated on 29 July (Table 3).
- As expected, traffic has reduced turf quality for the 22 August and 3 October ratings. Wear has lowered turf quality more than compaction treatment. The combination of wear and compaction has not affected quality ratings more than wear alone.
- No interactions between bentgrass cultivar and traffic treatment have been observed.
- After traffic treatment was initiated, larger differences in turf quality were observed between bentgrass cultivars. Most notable, were the performance of Penn G2, Penn A4, SR 7200 and MVB (selection of velvet bentgrass) which maintained quality ratings significantly above 7. A quality rating average below 5.5 indicates less than acceptable performance.

Table 3. Initial annual bluegrass population of bentgrass plots and quality of entry after establishment as putting green turf grown on sandy loam in 1999.

ANOVA		Annual Bluegrass Population	Turf Quality Rating		
Source		July 3†	July 29†	August 22‡	Oct 3‡
Traffic		NS	*	***	***
Bentgrass Cultivar (BC)		***	***	***	***
Traffic x BC		NS	NS	NS	NS
Traffic					
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 & Compaction		91	6.6	5.7	5.6
$LSD_{0.05}$	4	NS	0.2	0.3	0.3
Bentgrass Entry					
Cultivar	Species				
		%	---------- Rating, 9=best ----------		
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
	$LSD_{0.05}$	2	0.4	0.5	0.6

†, denotes data collected before traffic treatments initiated.
‡, denotes data collected after traffic treatments initiated.

Plan of work for 2000:

- Lower mowing height from 0.140- to 0.125-inch ($^1/_8$-inch) or less during spring 2000.
- Traffic treatments will continue throughout 2000 growing season.
- Monitor plot turf performance and annual bluegrass invasion.
- Present data at 2000 Annual Agronomy meetings and state turf conferences.

Putting Green Trial on Sand-based Root Zone

Objectives: To assess the ability of bentgrass cultivars to resist invasion by annual bluegrass under conditions of wear, compaction and wear + compaction on a USGA sand root zone.

Methods:

- Field site - 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)
- Study – Randomized completed block design with 3 replications using split-plot factorial treatment combination of 15 bentgrass entries and 4 levels of traffic (no traffic, wear, compaction, and wear + compaction). Traffic factor was arranged as the main plot and entries established as sub-plots.
- Plots were hand-seeded on 28 May 1999 at ¾-pound / 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 pound of seed per 1000 ft^2 was performed in September and November 1999.
- Traffic treatments were initiated on 2 October 1999.

Table . Bentgrass species and entries used to study the genetic ability to resist annual bluegrass invasion under putting green mowing height on a sand root zone.

Cultivar	Species	Cultivar	Species
A-4	Creeping	SR1020	Creeping
L-93	Creeping	Penneagle	Creeping
G-2	Creeping	Putter	Creeping
Cato	Creeping	Pennlinks	Creeping
Century	Creeping	Penncross	Creeping
SR1119	Creeping	SR72000	Velvet
Southshore	Creeping	MVB	Velvet
Providence	Creeping		

Plan of work for 2000:

- Overseed monthly with Petersen's creeping bluegrass (perennial *Poa annua*) at no more than 0.1 pound of seed per 1000 ft^2 to simulate introduction 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.