

# Variation in *Poa annua* on Golf Course Greens in the Pacific Northwest

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## Introduction

Annual bluegrass (*Poa annua* L.) has had an impact on the golf course industry world-wide. Currently, the growth and development of perennial-type *Poa annua* are being studied to attain a better understanding of its life cycle, reproductive biology, and dominance over creeping bentgrass (*Agrostis palustris* Huds.) on golf course fairways and greens (Huff, 1999). Because there has been limited effort to collect annual bluegrass in the Pacific Northwest (Gibeault, 1971), the overall goal of this project is to characterize *Poa annua* in this region.

## Research Objectives

1. Conduct an extensive collection of *Poa annua* var. *reptans* biotypes from golf course greens in Washington, Oregon, and Idaho.
2. Evaluate the collection based on several agronomic characteristics.
3. Relate agronomic characterization to the geographic origin of the biotypes.
4. Develop a core collection subset to represent the diversity of the entire collection.

## Materials and Methods

*Poa annua* var. *reptans* biotypes (200 accessions) were collected from putting greens at 78 golf courses throughout Washington, Oregon, and Idaho, during 1999. Golf courses were typically more than 30-years-old. *Poa annua* (patches on an individual green) with the same leaf color, density, and texture were designated as an accession (Fig. 1). For each accession sampled, three 7.5 by 1.9-cm-diam. cores were taken. Collection sites were designated into ecological regions according to the Level III Ecoregion map compiled by the Environmental Protection Agency (EPA) and the Office of Information Resources Management (OIRM) using aspects of geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology (Fig. 2). At the WSU Turfgrass Research Area, Pullman, WA, cores (experimental units) were planted on 0.6 m spacing in a randomized complete-block experimental design with three replications (Fig. 3). During 1999-2000 the accessions were evaluated at each golf course (Table 1) and in field plots for several parameters (Table 2).

Table 1. Golf course collection site parameters evaluated in 1999.

Parameter	Mean	Std. dev.	Range
Color (1-3; 3=dark green)	2.3	0.9	1-3
Texture (1-4; 4=coarse)	2.9	1.0	0.5-4
Patch size (cm diam.)	49.7	146.0	10-254
Putting green age (yrs)	64.0	23.0	10-108
<i>Poa annua</i> composition (% of green)	83.0	22.0	5-100
Golf course maintenance (1-10; 10=high)	8.1	1.4	2-10

Table 2. Annual bluegrass parameters evaluated in field plots during 1999-2000 at Pullman, WA.

Parameter	Mean	Std. dev.	Range
Fall seed head production (0-10; 10=prolific)	1.7	1.20	0.0-9.2
Fall dormancy (1-10; 10=dormant)	2.4	1.37	0.6-4.9
Genetic leaf color (1-5; 5=dark green)	2.8	0.96	1.0-5.0
Winter injury (1-5; 5=dead)	0.9	1.29	0.0-3.3
Spring green-up (1-9; 9=green)	6.1	0.93	1.1-8.5
Spring seed head production (1-9; 9=prolific)	4.9	1.15	0.8-8.4
Summer seed head color (0-5; 0=white, 5=purple)	2.2	1.43	0.3-5.0
Early spring leaf color (0-3; 0=green, 3=purple)	0.2	0.70	0.0-2.6
Texture (1-9; 9=fine)	6.0	1.76	2.0-9.0
Density (1-9; 9=dense)	6.7	1.20	2.6-9.0
Growth habit index (1-5; 1=erect, 5=prostrate)	2.7	0.78	1.3-4.3
Seed head orientation (1-5; 1=erect, 5=prostrate)	1.8	0.99	0.3-4.6
Seed head height (cm)	9.3	3.88	2.0-19.8
Seed head height above canopy (cm)	2.8	1.81	0.2-7.4
Mean canopy height (cm)	6.5	2.45	1.1-12.9
Mean core diameter (cm)	16.2	5.51	4.0-30.0
Summer dormancy (0-9; 0=dormant, 9=green)	7.0	1.64	2.6-9.0
Munsell color rating (1-4; 1=green, 4=brown)	2.4	0.83	1.0-4.0



Fig. 1. Accession sampled on golf course green.



Fig. 4. Variation in leaf morphology of selected *P. annua* samples.

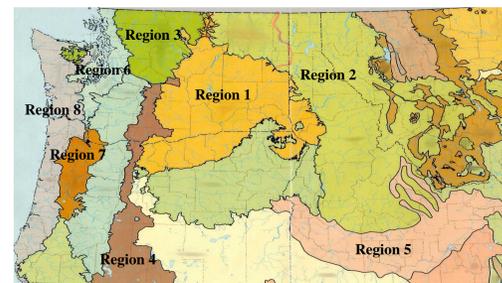


Fig. 2. Level III ecoregions of the Northwestern United States.

Cluster	n <sup>a</sup>	Origin
1	3	Coffax Golf Club, Coffax, WA.
2	5	Wandermere, Spokane, WA.
3	2	Downriver Golf Course, Spokane, WA.
4	1	Meadow Springs, Yakima, WA.
5	16	Mantle Country Club, Spokane, WA.
6	44	Avondale Golf Club, Hayden Lake, ID.
7	4	Overlake Country Club, Seattle, WA.
8	7	Columbia Edgewater, Vancouver, WA.
9	2	Salem Golf and Country Club, Salem, OR.
10	69	Riverside Country Club, Vancouver, WA.
11	5	Downriver Golf Course, Spokane, WA.
12	20	Gearhart Country Club, Astoria, WA.
13	3	Astoria Country Club, Astoria, WA.
14	3	Astoria Country Club, Astoria, WA.
15	1	Shadow Hills Country Club, Springfield, OR.
16	8	Tacoma Country Club, Tacoma, WA.
17	2	Lower Valley Golf Course, Sunnyside, WA.
18	1	Mount Adams Golf and CC, Toppenish, WA.
19	1	Moses Lake Country Club, Moses Lake, WA.
20	2	Esmeralda, Spokane, WA.

<sup>a</sup>n = number in cluster



Fig. 3. WSU Turfgrass Research Area field plot planting site, Pullman, WA.



Fig. 5. Prostrate tillering and nodal rooting characteristic of *Poa annua* var. *reptans*.

## Results and Discussion

### Collection site (golf course) parameters.

Color and texture means of 2.3 and 2.9, respectively, indicated a selection of darker, coarser textured annual bluegrass (Table 1). Patch size and *Poa annua* green composition were 49.7 cm and 83%, respectively, indicating aggressiveness in accessions and high *P. annua* populations on greens sampled (Table 1). The golf course maintenance rating and mean putting green age were 8.1 and 64 years, respectively, indicating a vast majority of the collection came from older and well maintained golf courses. These environments are conducive to the development of *P. annua* var. *reptans* (Huff, 1999).

### Agronomic descriptor data at Pullman, WA.

ANOVA indicated differences among ecoregions for all parameters (except for seed head orientation) evaluated in the field at Pullman, WA. (Table 2); however, accessions were not always different within ecoregion. Selected data presented (Fig. 6-9) represents the most important differences for turfgrass quality and seed production.

High variability of seed head production is common with *Poa annua* var. *reptans* (Huff, 1999). Most of the accessions produced seed heads primarily in the spring. Spring seed head emergence began in mid-April and peaked for the collection around 25 May 2000. In the fall, accessions from ecoregions 1 and 2 produced more seed heads than those from ecoregions 4, 5, 7, and 8 (Fig. 6).

Extreme variation (1.1 to 12.9 cm) in canopy ht. occurred (Table 2). Most dwarf accessions were from ecoregion 8; it was different from all other ecoregions (Fig. 7). Seed head ht. was correlated with canopy height (Coeff. = 0.93). Although dwarf growth character is a desirable turfgrass trait (Huff, 1999), seed from dwarf plants would be difficult to commercially harvest due to limited seed head elongation.

Mean plant density for the collection was 6.7, indicating a selection of dense annual bluegrass (Table 2). Accessions from ecoregions 6, 7, and 8 were among the most highly dense samples in the collection (Fig. 8). Density and leaf texture were correlated (Coeff. = 0.68).

Accessions from ecoregion 1 had greater winter injury than those from ecoregions 4 and 5 (Fig. 9). Fifty percent of the accessions in ecoregion 8 were uninjured, which was the lowest proportionate amount of winter injury of the ecoregions (Data not presented). Perhaps accessions from regions 4, 5, and 8 contain plants with superior winter tolerance.

### Core collection

Utilizing UPGMA cluster analysis on the basis of 15 agronomic descriptors, a core collection was developed to represent the diversity of the entire Pacific Northwest annual bluegrass collection (Table 3). This core represents accessions from 18 golf courses and 10% of the collection. Casler (1995) suggests this level is adequate for representing diversity of a collection.

## Conclusions

The Pacific Northwest annual bluegrass collection exhibited considerable variability for all parameters evaluated. Seventeen agronomic descriptors were different among the Level III ecoregions of the Northwestern USA, which will aid in future germplasm acquisition. A core collection subset was developed to represent the diversity of the whole collection. This subset will aid in detailed studies in the future. The variability identified in this study can be used in breeding programs to develop greens-type annual bluegrass with superior turfgrass quality and seed production for use on Pacific Northwest golf courses.

## References

- Casler, M.D. 1995. Patterns of variation in a collection of perennial ryegrass accessions. *Crop Sci.* 35:1169-1177.
- Gibeault, V. 1971. Perenniality in *Poa annua* L.; Ph.D. diss. Oregon State University, Corvallis.
- Huff, D. R. 1999. For richer, for Poa. *USGA Green Section Record* 37(1):11-14.

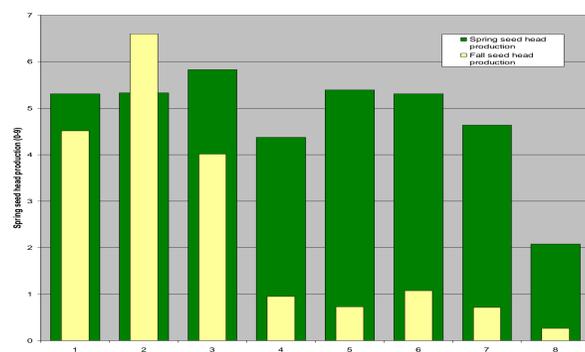


FIGURE 6. Fall and spring seed head production of annual bluegrass evaluated during 1999 and 2000 at Pullman, WA.

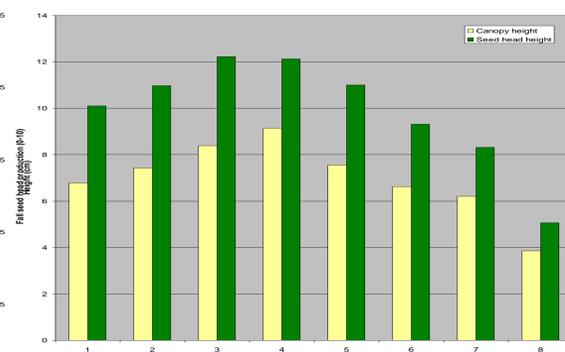


FIG. 7. Canopy and seed head height of annual bluegrass evaluated during 1999-2000 at Pullman, WA.

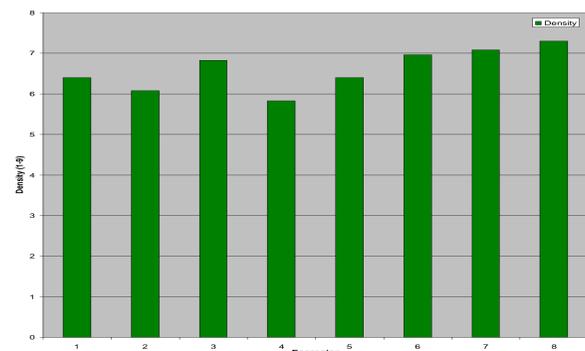


FIGURE 8. Density of annual bluegrass evaluated during Aug. 2000 at Pullman, WA.

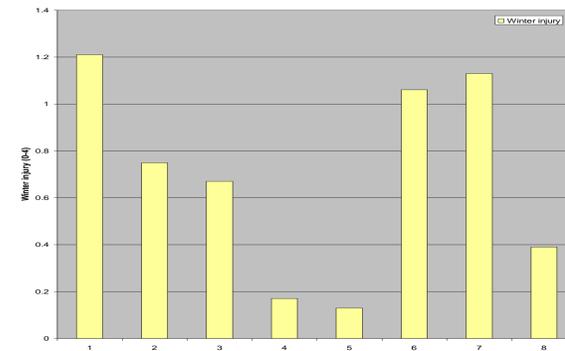


FIGURE 9. Winter injury evaluated during Mar. 2000 at Pullman, WA.