GSCSSA Final Progress Report 2006

Title: **Development of High Yielding Kentucky Bluegrass for Non-thermal Seed Production**

Objectives:

1. Assess the within and among variation in agronomic and molecular attributes of selected accessions and select different individual plant genotypes for high seed weight, high seeds per panicle, high panicles per unit area, and high overall seed yield using accessions with potential value in non-thermal seed production.
2. Determine the selection response for seed yield and yield components by testing the resulting selections in Objective 1 for seed production in on-farm testing under a residue removed (baled; burn plots will be included at N. Idaho site only) management system in diverse environments and over years. In addition, test the selections for turf quality factors in different environments and years. (*New GSCSSA proposal submitted for FY07*)

Principal Investigator: Dr. William J. Johnston, Professor/Agronomist, Department of Crop and Soil Sciences, Washington State University, Pullman, WA (0.1 FTE allocated)

Cooperators:
Dr. Richard C. Johnson, Research Agronomist, Western Regional Plant Introduction Station, Pullman, WA. Will provided laboratory facilities and personnel for molecular analyses and assist in field evaluations for plant growth and seed yield.
John Burns, WSU Cooperative Extension, Pullman, WA. Will assist in decimation of results to grass seed growers.
John Holman, Univ. of Idaho, Moscow, ID. Will assist in decimation of results to grass seed growers.

Abstract of 2006 Progress: One hundred plants of each Accession/selection x parameter (head per unit area, seeds per head, 1000 seed weight, yield per plant, and the original population) were established in a seed increase nursery (50 plots of 100 plants = 5000 plants) at the USDA research farm at Central Ferry, WA in late fall 2004. In the summer 2006 the nursery was evaluated for several agronomic traits. June 2006 the plots were harvested and clean seed weight was obtained. Bluegrass seed yield is ample for on-farm field trials for seed production to begin in 2007. To evaluate turf quality, a National Turfgrass Evaluation Program (NTEP) type trial was planted in August with the 50 entries in a RCB experimental design with 3 replications at the Turfgrass and Agronomy Research Center at Pullman, WA.

Justification: A ban on burning has been implemented in Washington State, and restrictions are in place in Idaho and Oregon. Our previous research showed that without post-harvest burning bluegrass seed yield decreased over time (Johnson et al., 2003). This has forced growers to use shorter rotations to maintain economically viable seed yields. What are needed are bluegrasses that will maintain high seed yield over several years without burning. In a multi-year study we previously identified germplasm that had improved seed production without burning (Johnston, 2004). This germplasm needs seed increase for on-farm seed yield trials and university turfgrass evaluations. Ultimately, high yielding, turf-type bluegrasses that can be successfully grown without burning will be released to growers.

Progress: During 2006, the 3rd year of the project, the seed increase nursery (50 plots of 100 plants = 5000 plants) at the USDA research farm at Central Ferry, WA was evaluated for several agronomic traits. In June 2006, the plots were harvested, air dried, threshed, and cleaned. Clean seed weight was obtained. Bluegrass seed yield was ample for on-farm field trials for seed production in 2007. To evaluate turf quality, a National Turfgrass Evaluation Program (NTEP) type trial was planted with the 50 entries in a RCB experimental design with 3 replications at the Turfgrass and Agronomy Research Center at Pullman, WA. Individual plot size was 5 ft x 5 ft and was seeded at 2.2 lb per 1000 ft^2.

During prior research in 2004, seed yield components and seed yield data was obtained on 840 space plants at Pullman, WA. The 1680 samples (two harvest years) were stored in paper bags at low temperature and RH following harvest. For each sample the number of panicles per plant was recorded. Panicles were then hand threshed (belt thresher), cleaned with a seed blower, and total seed weight was recorded. A subsample was taken and 100 seed were counted. This was used to obtain 1000 seed weight. The data were analyzed for 1000 seed weight, seed per panicle, panicles per cm^2, and yield (g per cm^2). There was considerable variation between and within accessions and we were able to identify the highest contributing single plant within each accession for each parameter (Johnston, 2004). Seed of each selected plant (from a composite of equal amount of seed from each replication) and remnant seed of the original population for each accession were germinated in vermiculite and 100 individual plants of each selection were then established in flats in the greenhouse. In October 2004, the 100 greenhouse plants of each selection x parameter and remnant seed of the original population for each accession were transplanted into a seed increase nursery the USDA research farm at Central Ferry, WA. The nursery consisted of 5000 plants.

Project cooperator Richard Johnson's research group took leaf tissue from each space plant and the extracted DNA was used in AFLP analysis. The gels will be scored until new software is purchased. Thus, the agronomic and molecular variation within and among entries will be assessed.

The bluegrass nursery at Central Ferry was evaluated for plant vigor during 2005 (Table 1). Seed production was very poor in 2005 due to the late fall planting in 2004. In June 2006 plots were evaluated for seed head height, blade texture, color, uniformity of heads, turf potential, and date of harvest (data not presented). Seed was harvested in June 2006. Ample clean seed is currently available for on-farm field trials for seed production and turfgrass quality (Objective 2).

Ultimately, high yielding, turf-type bluegrasses that can be successfully grown for several years without burning will be released to growers.

Table 1. Seed production selection parameters evaluated on accessions at Central Ferry, WA during 2005.

	Selection parameter				
	Seed wt.	Seed per panicle	Panicles per area	Yield	Base population
Accession 1	6[1]	5	7	6	6
Accession 2	3	6	6	6	6
Accession 3	4	5	5	4	4
Accession 4	3	2	3	2	3
Accession 5	3	6	6	7	5
Accession 6	4	4	4	4	4
Accession 7	2	1	2	1	2
Accession 8	7	7	6	5	3
Kenblue check	4	6	6	5	5
Midnight check	6	4	5	4	4

[1]Rated 1 to 9; 1 = very poor vigor, dormant or potentially dead.

Table 2. Seed yield for selection parameters evaluated on accessions at Central Ferry, WA during June 2006.

	Selection parameter				
	Seed wt.	Seed per panicle	Panicles per area	Yield	Base population
			Clean seed wt. (g per plot)		
Accession 1	1862	1904	2003	1859	1990
Accession 2	1822	2233	2571	2196	2162
Accession 3	1282	1746	2035	2336	2239
Accession 4	1255	1092	669	380	340
Accession 5	1294	309	2322	1278	2190
Accession 6	1549	1058	729	338	476
Accession 7	160	189	325	319	267
Accession 8	318	354	329	132	352
Kenblue check	811	2132	1720	1496	1708
Midnight check	484	430	746	623	726

Interaction: During the project the PI interacted with the listed cooperators on this project, or related grass seed production issues. There was interaction with GSCSSA scientists and international seed scientists at the International Herbage Seed conference at Winchester, England. Several presentations were made to regional seed production groups and the Washington Department of Ecology. During the 3-year project, Danish, French, and English scientists, government officials, farmers, and seed council members visited and toured research plots.

Timeline:

Year 2004-2005 (FY04, year 1 funding):

Clean seed obtained for 1680 samples collected from space plants during 2002 and 2003 (completed). Select plants for genotype by environment (location) studies of selection response (completed). Establish seed increase plots in early fall 2004 at the USDA research farm at Central Ferry, WA (completed). Analysis of molecular (in progress) and agronomic data (completed).

Year 2005-2006 (FY05, year 2 funding):

Spring and summer 2005. Collect data on seed increase plots (5000 plants) at Central Ferry, WA (completed).

Year 2006-2007 (FY06, year 3 funding):

Summer 2006. Harvest seed increase plots (5000 plants) at the USDA research farm at Central Ferry, WA. Clean seed. Establish turfgrass trial at Pullman, WA (completed).

Year 2007-2008 (FY07, year 1 funding, new GSCSSA proposal):

Winter 2007. Contact growers for on-farm sites for seed yield trials.
Spring. Establish on-farm seed production plots with local growers.
Summer. 2nd seed harvest at Central Ferry, WA.
Fall. Establish turfgrass trial at off-campus sites.
Publish results from Objective 1.

Continue seed production and turfgrass trials as funding permits. Publish results and release a high yielding turf-type Kentucky bluegrass that does not require post-harvest burning to maintain seed production at a later date.

Publications, Reports, and Presentations for Current Year and Pertinent References:

Johnston, W. J. 2006. Development of high yielding Kentucky bluegrass for non-thermal seed production. Washington DOE Ag Burn Task Force, Walla Walla, WA. June 27.

Johnston, W. J. 2006. Development of high yielding Kentucky bluegrass for non-thermal seed production. GSCSSA, Moscow, ID, Oral presentation to be made Dec. 19.

Johnston, W. J. 2006. Development of high yielding Kentucky bluegrass for non-thermal seed production. GSCSSA, Moscow, ID, Poster presentation to be made Dec. 18.

Johnston, W. J. 2004. Development of high yielding Kentucky bluegrass for non-thermal seed production. GSCSSA FY 2005 Progress Reports. p. 13-16.

Johnson, R. C., W. J. Johnston, and C. T. Golob. 2003. Residue management, seed production, crop development, and turf quality in diverse Kentucky bluegrass germplasm. Crop Sci. 43:1091-1099.