

Wheat Research Progress Report - Final

Project #: 3019-3227

Title: Development of Perennial Wheat for Washington State

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Progress Report Year: 2008

Goals and Objectives: This research is designed to focus on two broad goals:

1. **Breeding:** The continued development of *Thinopyrum-Triticum* amphiploids and partial amphiploids utilizing parents adapted to the PNW to produce long-lived and vigorous perennial wheat germplasm.
2. **Field Testing:** To develop varieties that will allow for fewer inputs while maintaining profitable yields.

Our specific goals are to breed perennial wheat varieties that:

1. Optimize yield in low-input systems through enhanced nitrogen-use efficiency.
2. Thrive in soil microbial communities found in low-input wheat based farming rotations.
3. Contain durable disease resistance to common bunt and dwarf bunt, stripe rust, foot rot, etc.
4. Have competitive characteristics and exude allelopathic chemicals important for weed suppression.
5. Contain beneficial quality and nutritional characteristics.

Accomplishments:

Perennial wheat development and field testing:

Currently planted	Location	Comments
4,000 perennial head rows	Spillman Farm	Confirmed field regrowth
13 F6 advanced lines, replicated yield trial	Mt Vernon	Regrown 4 years in field, resistant to stripe rust
30 F6 advanced lines, replicated yield trial	Spillman Farm	Same nursery as above; insufficient seed of some lines to plant all at Mt Vernon.
400 perennial x annual F2 plots	Spillman Farm	Will advance selected perennial and annuals
200 plots and numerous head rows	Spillman Farm	Plants regrowing from Fall 2007 planting
~ 1/2 acre of 3 rd and 4 th year perennial head rows	Spillman Farm	Plants regrowing from Fall 2005 and 2006 planting

Ongoing collaboration trials and data analysis:

We are analyzing data now from our three-state perennial yield trials with 20 advanced lines tested in Michigan, Texas, and Washington. And we are analyzing data from our five-state perennial yield trial with 10 populations (5 from us, 5 from the Land Institute) in Michigan, Oklahoma, Kansas, Texas and Washington.

Collaborators included: Charlie Rush, Wheat Pathologist, Texas A & M; Brett Carver, Wheat Breeder, Oklahoma State University; Sieg Snapp, Agronomist, Michigan State University; Lee DeHaan, The Land Institute, Salinas KS; Dhruba Thapa, Wheat Breeder, Nepal; Len Wade, Wheat Physiologist, Australia, Martin Entz, Agronomist, University of Manitoba, Canada; Dr. Sun, Plant Breeder, China.

We will be sending seed of our advanced lines to collaborators in Nepal and Canada as soon as we get the phytosanitary certificates.

Progress:

Perennial cereal crops are emerging as a potential economically and environmentally sustainable response to global agroecological problems resulting from soil erosion and nutrient and chemical run-off. For the past decade, the perennial wheat breeding program at Washington State University has been developing agronomically viable perennial wheat lines from crosses between wheatgrass species and annual hexaploid cultivars. In 2005/06, we conducted field scale agronomic trials of the most promising perennial breeding lines, resulting from *Thinopyrum elongatum* x *Triticum aestivum* crosses. We report results on regrowth after harvest, nutritional value, baking and milling quality, first-year grain yield, and grain threshability in perennial wheat. Regrowth after harvest ranged from 20 to 90% in the perennial hybrids, with no regrowth apparent in the annual control cultivars. Compared to annual wheat cultivars, the perennial wheat lines produced grain of smaller size, lower test weight and flour yield, and greater protein content. Mineral nutrient concentrations in the perennial wheat lines were 46, 45, 31, 27, 38, 33 and 37% higher than annual wheat cultivars for calcium, copper, iron, magnesium, manganese, phosphorus and zinc, respectively. The mean of the perennial wheat yield was approximately 44% of annual wheat with a range among perennial lines of 20 to 93% at individual locations. No relationship existed between grain yield, regrowth and nutritional content among the perennial lines, indicating the potential for simultaneous selection of these traits. We anticipate these results will serve as a benchmark with which future advances in perennial cereal breeding can compare and build upon.

Publications and Presentations:

2008

Agronomic and nutritional potential of perennial wheat as an emerging specialty crop for ecologically sensitive landscapes (submitted 2008).

See project #6194 for complete list.