

Funded Research Projects for FY 03

Title: Enhanced Field Selection for Wheat Stem Sawfly Resistance.

Institution: MSU

Department: MSU/Plant Sciences

Principal Investigator: Phil Bruckner

Amount Funded: \$7,000.00

Objectives:

- 1) Subject early-generation segregating winter wheat bulk populations and derived lines to heavy selection pressure for wheat stem sawfly (WSS) resistance and select plant phenotypes resistant to WSS infestation and cutting damage.
- 2) Evaluate spring and winter wheat cultivars and advanced lines for resistance to infestation and cutting damage by WSS and for yield performance under heavy infestation by WSS.
- 3) Systematically evaluate selected germplasm for enhanced stem solidness and alternative sources of WSS resistance.
- 4) Provide field sites, representative of sawfly-infested production regions, for research and demonstration to producers of effective sawfly management strategies including use of resistant cultivars.

Project Update February 28, 2003

Summary:

A five-acre selection and testing nursery for WSS research was established in Chouteau County near Loma in the fall of 2001 and spring of 2002. This was the fifth sawfly selection nursery at Loma. A smaller off-station sawfly nursery was planted near Molt. Conditions were harsh at all sites except Bozeman. Winter wheat sawfly nurseries at Loma, Conrad, and Molt in 2002 were lost due to extreme dry planting conditions and poor stands. Useful data on solid-stem lines was collected only at Bozeman, Havre, and Williston. Although progress was limited in 2002, the ability to select for our primary breeding objective in environments where reasonable selection pressure for sawfly normally occurs has strengthened the Montana winter wheat cultivar development programs. A solid-stem line with improved yield potential relative to Rampart is being increased for potential release.

Future Plans:

The priority breeding objective will remain WSS resistance until adequate cultivars are developed. This field selection site for screening of WSS resistance, which is a key component of the winter wheat cultivar development program, was reestablished on the McKeever farm near Loma in the fall of 2002. This site is considered a low risk site in terms of weed pressure and observation over the last several years indicates sawfly pressure is adequate at this site. Evaluation of early-generation segregating populations and selected lines under heavy WSS selection pressure will continue in 2002-03, both at Loma and supplemental sites. Spring and winter wheat cultivars and advanced lines will be evaluated at multiple sites to quantify levels of WSS resistance and to determine relative yield performance under WSS pressure.

Title: Winter Wheat Breeding/ Genetics.

Institution: MSU

Department: MSU/ Plant Sciences

Principal Investigator: Phil Bruckner

Amount Funded: \$57,500.00

Objectives:

- 1) Develop improved cultivars of winter wheat adapted to Montana climatic conditions and cropping systems, which possess superior on-farm production characteristics (grain yield, winter hardiness, adequate and durable pest resistance, stress tolerance, agronomic characteristics) and superior end-use quality characteristics.
- 2) Isolate, as much as possible, our foreign wheat customers from variations in wheat quality performance by development and release of suitable cultivars and production research to develop strategies to maximize quality consistency for wheat produced in Montana.
- 3) Investigate environmental, genetic, and management factors which influence wheat productivity and end-use in Montana including 2002 project: effects of selection for low polyphenol oxidase (PPO) on disease resistance, agronomic performance, and end-use quality; and molecular markers for wheat stem sawfly tolerance and cold tolerance.
- 4) Coordinate Montana statewide winter wheat variety testing program and provide long-term performance data necessary for cultivar release decisions, variety recommendations, and producer management decisions.

Project Update February 28, 2003**Summary:**

2002 was a difficult year for winter wheat breeding and selection purposes. Several field sites were lost to drought conditions and little useable performance data was generated. Selection programs were carried out with limited data but release decisions were delayed in some cases due to inadequate data. Progress has been made in winter wheat cultivar development. Foundation seed of Paul hard red winter wheat will be distributed fall of 2003. Testing and accelerated selection of solid-stemmed lines remains top priority, with one promising line being purified and increased for potential release. Makeup of the 2003 Advanced Winter Wheat Nursery demonstrates the progress we have made toward meeting our diverse objectives. The 2003 nursery contains five checks, eight solid-stem, 1 WSMV-resistant, two RWA-resistant, six hard white, and fourteen 'normal HRW' lines. Development of competitive cultivars with resistance to IMI-herbicide, RWA, and WSMV continues. We continue to transition toward more hard whites in our program, although there are no obvious outlets for more hard white varieties. This decision to modify the direction of the program has long-term implications.

Future Plans:

Priority breeding objectives will remain resistance to wheat stem sawfly, Russian wheat aphid, wheat streak mosaic virus, and stem rust, winter hardiness, and end-use quality. Development of yield-competitive, winter hardy, sawfly-resistant HRWW and HWWW cultivars is priority. The sawfly selection nursery southwest of Big Sandy will be used as a selection site for screening of sawfly resistance. Selection for winter hardiness and sawfly resistance will also be conducted at Research Center sites including Williston, Havre, and Moccasin. Efforts will continue toward development of cultivars with tolerance to WSM virus using molecular markers and direct viral screening. End-use quality protocols will be expanded to evaluate noodle-making characteristics. Proprietary research such as herbicide-resistant varieties will be conducted for benefit of Montana wheat producers.

Title: Early Generation Durum Selection and Germplasm Improvement.

Institution: MSU

Department: MSU/ Eastern Agricultural Research Center

Principal Investigator: Joyce Eckhoff

Amount Funded: \$10,000.00

Objectives:

To produce improved durum germplasm for development of varieties for Montana Producers

Project Update February 28, 2003

Summary:

Durum will continue to be an important crop in eastern Montana because of disease problems in eastern North Dakota and a good durum market. Current varieties are mostly day length sensitive and late-maturing in Montana conditions. The durum breeder in North Dakota is devoting most of his program to scab tolerance and resistance. Durum producers in Montana need varieties that are tailored to Montana conditions, which are warmer and drier than Canadian and North Dakota durum production areas. This project is developing germplasm appropriate to Montana conditions using both conventional breeding methods and double-haploid technology.

Future Plans:

Double haploids developed by this project will be tested in preliminary trials at EARC in 2003. More double haploids may be developed in the future. We would like to develop the double haploid technology at Sidney. The traditional portion of this project should continue indefinitely. The entire project is dependent on grant funding for its continuation.

Title: Developing and Releasing Improved Barley Varieties for Montana.

Institution: MSU

Department: MSU/Plant Sciences

Principal investigator: Suzanne Mickelson

Amount Funded: \$57,500.00

Objectives:

The main objective of this project is to develop barley varieties that improve the economic value of barley for Montana farmers. This will be achieved through the use of improved germplasm for initial crosses, selection and advancement of the lines exhibiting the greatest potential, a thorough line evaluation system throughout the state of Montana, and finally release of improved lines. Specifically, our focus will be on improving yield and agronomic performance of lines with improved malting quality as well as feed barleys. Additionally, we will begin studies to improve the yield of hulless waxy barley and determine if it has potential for production in Montana

Project Update February 28, 2003

Summary:

The MSU barley breeding and genetics program has operated the majority of our breeding program for improved feed, malt, and hay barleys with the financial support of the MW&BC. Utilizing a traditional single-seed descent breeding approach, our program is developing a number of barley lines with great potential for improving producer yields and grain quality. Two barleys were approved for release on January 29, 2003. Evaluation of a large number of lines, careful selection, and advancement of developmental materials are the keys to successfully producing improved barley lines and constitute the foundation of our breeding program.

Future Plans:

We will continue to produce and select barley lines with the goal of economic benefit to Montana barley producers. We are currently harvesting F₃ generation materials derived from the 2002 breeding nursery in the greenhouse and will plant the F₄ generation shortly with F₅ seed ready for the 2002 summery nursery.

There are several lines in our program which have promise in the near future. Further information on both MT960099, a feed barley, and MT970116, a potential malt barley, is being gathered. Three Montana experimental lines (MT 960099, MT970229 and MT970155) will be entered in the 2003 Western Regional Spring Barley Trials. While the emphasis of our breeding program will remain focused on breeding for increased performance malt and feed barley, several additional projects are being developed by this research program. With the drought Montana farmers have been facing a greater need for hay barley has been seen. Because few hay barleys are available in Montana, additional evaluation of increased performance hay barleys will be conducted. In anticipation of FDA acknowledgement of the cholesterol reducing effect of barley, crosses for hulless, waxy barleys are being made in our breeding program. Molecular markers are also being used to facilitate the transfer of a chromosome region associated with low grain protein into malting backgrounds.

Title: Improved Quality of Montana Hard Red and Hard White Wheats.

Institution: MSU

Department: MSU/ Plant Sciences and Plant Pathology

Principal Investigator: Luther Talbert/ Debra Habernicht

Amount Funded: \$25,000.00

Objectives:

- 1) To determine end-use quality parameters of Montana breeding lines of hard red and hard white wheat for the spring and winter wheat breeding programs.
- 2) To evaluate and develop the most efficient methods to evaluate early generation material for end-use quality.
- 3) To determine end-use quality parameters of genetically altered wheat to contribute to the understanding of wheat genetics and help geneticists determine the best genes for superior milling and baking quality.
- 4) To cooperate with Research Centers, researchers, producers, general public, and industry to educate and explore areas to improve cereal quality.

Project Update February 28, 2003

Summary:

The CQL is accomplishing end-use quality analyses for the wheat breeding programs to use in making decisions regarding variety development, release, and recommendation. We are completing studies aimed toward improving bread quality and development of alternative end-uses of Montana-grown grain.

Future Plans:

In collaboration with the Wheat Breeding Programs and Small Grain Quality Lab, the CQL is gaining great momentum and is well on the way to realizing its full potential as a major contributor to MAES and the agricultural industry in the state. We are dedicated to consistent improvement. Our goal is to continue to serve the breeding programs by providing useful and reliable data to be used in the breeding procedure. We are also committed to provide information and services to farmers and the small grain industry in the state of Montana. Also, we want to continue to expand our expertise in the area of alternative uses for Montana grains.

Title: Spring Wheat Breeding and Genetics.

Institution: MSU

Department: MSU/ Plant Sciences and Plant Pathology

Principal Investigator: Luther Talbert

Amount Funded: \$57,500.00

Objectives:

- 1) To develop spring wheat varieties that provide an economic advantage to Montana farmers.
- 2) To manage the varietal testing program for Montana.
- 3) To increase understanding of wheat genetics in order to improve breeding efficiency and output.

Project Update February 28, 2003**Summary:**

Progress was made in all areas of the spring wheat breeding program. New releases have the potential to occupy significant acreage in Montana, and we hope that our research program is laying the foundation for future improved variety releases.

Future Plans:

Our main goal is to maintain excellence throughout all stages of the program. Ten generations of crossing, selection, and testing are required for the development of a new variety. The new variety is only as good as the weakest year, thus it is critical that rigor be maintained throughout the process. We hope to continue to provide new and better varieties, along with information that farmers in Montana find useful.

Title: Wheat Stem Sawfly Parasitism and its Effect on Wheat Physiology and Stress.

Institution: MSU

Department: MSU/ Entomology

Principal Investigator: David Weaver

Amount Funded: \$5,000.00

Objectives:

Characterize and compare physiological responses of wheat to parasitized and unparasitized sawfly larvae.

Project Update February 28, 2003

Summary:

Results to date reveal that WSS injury significantly reduces wheat photosynthetic rates throughout the larval infestation period. The physiological mechanisms underlying the reductions in photosynthesis are unclear at this time, but results suggest that the reductions are not due to disruption of water transport, closure of stomata, reduced efficiency of the photosynthetic enzyme, rubisco, or reduced efficiency of light harvesting and electron transport. Current and future studies dealing with wheat primary metabolism will enable us to identify crop physiological mechanisms which potentially could be exploited to enhance resistant to WSS. Characterizing physiological responses of wheat to sawfly injury will provide new insights into wheat resistance breeding approaches, and also will provide critical information needed to enhance parasitoid success. Further, this knowledge will help us develop comprehensive and sustainable pest management strategies for Montana wheat.

Future Plans:

Future work will be integrated even more closely into ongoing WSS research. The work will allow us to systematically and comprehensively examine the impact of WSS and their parasitoids on wheat physiology and yield. This project is novel in that it provides a unique mechanism (plant physiological responses) to assess the impact of parasitoids on the wheat stem sawfly-wheat system in Montana. Further, this research may provide insights into physiological-mechanism based breeding wheat for resistance to sawfly. Both outcomes of this research may lead to significant extramural funding, which will be aggressively pursued.

Title: Evaluation of various materials and practices contributing toward economic crop production under flexible, continuous and other cropping systems in Montana.

Institution: MSU

Department: MSU/ Research Centers

Principal Investigator: MASE Research Center faculty

Amount Funded: \$48,000.00

Objectives:

- 1) To evaluate the effects of differing systems on crop and cultivar performance under diverse environments represented across the Montana Agricultural Experiment Station-Research Center network
- 2) To evaluate the potential fit of other materials, concepts and techniques with various cropping systems employed.

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