

**RESEARCH SUMMARIES FOR
MONTANA WHEAT AND BARLEY COMMITTEE
FUNDED PROJECTS FOR FISCAL YEAR 2009**

- Title:** Evaluation of various materials and practices contributing toward economic crop production under flexible, continuous and other cropping systems in Montana
- Personnel:** Research faculty members at the following Research Centers:
- 1) Central Agriculture Research Center (CARC)
 - 2) Eastern Agricultural Research Center (EARC)
 - 3) Northern Agricultural Research Center (NARC)
 - 4) Northwestern Agricultural Research Center (NWARC)
 - 5) Southern Agricultural Research Center (SARC)
 - 6) Western Triangle Research Center (WTARC)
- Amt. Funded:** \$108,000
- Objective:**
- 1) To evaluate the effects of differing systems on crop and variety 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.
- Summary:** For summary of individual projects out of the MSU Research Stations, please refer to <http://plantsciences.montana.edu/mtproducerinfo.html>
- Title:** Critical Infrastructure at Wheat and Barley Research Facilities
- Personnel:** Jeff Jacobson, Dean, College of Agriculture, Director, Montana Agricultural Experiment Station; Mal Westcott, Department Head, Department of Research Centers; Jim Squires, farmer, former MWBC and EARC Advisory Committee member
- Amt. Funded:** \$100,000
- Objectives:** To improve and create quality research facilities

Summary: The financial support has shown in Montana, and beyond, how strong we are as an agricultural community and how we value the impact of our MAES system. A strong and successful non-state match campaign demonstrates to the Legislative Assembly how strongly the industry feels about agricultural research and outreach, our land-grant system and the future of Montana's agricultural families and businesses. Improved facilities means there will be more time and energy spent by faculty and staff on research and outreach programs and projects.

Title: **Host Plant Resistance, Tritrophic Pest Interactions, and Cropping Systems for IPM of Wheat Stem Sawfly**

Personnel: David Weaver (PI) Department of Land Resources and Environmental Sciences, Montana State University
<http://landresources.montana.edu/Department/Weaver/html>

Kevin Delaney, Postdoctoral Associate, Department of Land Resources and Environmental Sciences

Megan Hofland, Research Associate, Department of Land Resources and Environmental Sciences

Norma Irish, Research Associate, Department of Land Resources and Environmental Sciences

Jenny Marquez, Research Associate, Department of Land Resources and Environmental Sciences

Amt. Funded: \$100,000

Objectives: Overall, to meet ongoing commitments on projects with the cooperators listed above by providing funds to match 50% of the overall costs to this program. Specifically, to provide:

- 1) Technical expertise and undergraduate labor to support cropping systems research. The project investigates agronomic practices to ascertain best management practices for planting hollow and solid stem wheat varieties under heavy sawfly pressure.
- 2) Technical field and laboratory expertise and undergraduate labor to support trap crop development using hollow and solid

stem spring wheat. The project includes detailed laboratory exploration of factors that influence attractiveness of the crops.

- 3) Technical support and undergraduate labor to support a project aimed at developing consistent producer recommendations for wheat crops that are challenged by fungal pathogens, grassy weed species, and by the wheat stem sawfly.
- 4) Research capacity to continue to develop new host plant resistance. Specific areas of focus will be compensatory of tolerance mechanisms for wheat stem sawfly feedings in currently grown hollow and solid stem cultivars. Host plant resistance compounds, including phenolics and terpenoids, will be assayed and screened. Plant physiological responses, such as light and dark photosynthesis reactions and stomatal closure will be explored. Ideally, the target will be to have a variety that killed most sawfly immatures, and did not suffer yield loss due to feeding (tolerance)

Summary:

This study showed that the primary factor involved in sawfly impact on yield was whether it was a winter or spring crop, other factors such as fallow versus re-cropping, seeding rate or row spacing had no effect on the impact of wheat stem sawfly on yield. Sawfly cutting was much greater in hollow stem winter wheat and the overall yields of hollow and solid stem were comparable. Under this scenario, it would be optimal to plant Genou solid stem to reduce sawfly numbers, given the comparable yield. It is not recommended to plant spring wheat later to avoid infestation, due to an obvious yield recommended to plant spring wheat later to avoid infestation, due to an obvious yield penalty. This study also confirms the greater yields associated with planting of winter wheat.

Title:

Winter Wheat Breeding/Genetics

Personnel:

Phil Bruckner, Winter Wheat Breeder, PSPP Dep., Bozeman
Jim Berg, Research Associate, PSPP Dep., Bozeman
Ron Ramsfield, Agr. Res. Spec III, PSPP Dep., Bozeman
Petrea Hofer, Research Associate, PSPP Dep., Bozeman

Amt. Funded:

\$70,000

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 2008 project: field verification of molecular markers for backcross transfer of stem solidness into elite lines.
- 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.

Summary:

Progress has been made in winter wheat cultivar development. Yellowstone and three improved Clearfield winter wheat cultivars were released in 2005. Yellowstone represents the highest yielding winter wheat line ever developed at MSU and no cultivars have been released from 2006 to 2008 because none show better performance than Yellowstone. Advanced line MT0552 is being considered for potential release. Several promising experimental lines are emerging from the testing program and are being increased and considered for variety release.

Our program has explored marker-assisted selection technology to enhance efficiency of solid stem, disease resistance, and imidazolinone-tolerant cultivar development efforts. We have identified 2 gene-imidazolinone-tolerant lines for further testing. Marker-assisted selection is a useful and exciting tool for variety development. Unfortunately, our breeding program does not have the financial resources to maintain our laboratory effort in marker-assisted selection.

Pending unforeseen budget changes, the winter wheat breeding program will be down-sized by terminating the laboratory

research professional involved in DNA extraction and PCR marker selection efforts.

Title: **Spring Wheat Breeding and Genetics**

Personnel: Luther Talbert (Plant Sciences and Plant Pathology), Susan Lanning, Nancy Blake

Amt. Funded: \$70,000

Objectives:

- 1) Develop spring wheat varieties for Montana farmers
- 2) Coordinate the variety testing program for spring wheat
- 3) Conduct applied research related to genetic improvement for spring wheat

Summary: Varieties developed by the spring wheat program occupied over 900,000 acres in 2008. Vida should be grown on substantial acreage in 2009 from seed produced in 2008. Major research efforts included the development of solid-stemmed lines with increased height relative to Choteau. We have begun the increase and purification process for eventual variety release. In addition, major research thrusts were to better understand the genetics of preference of certain wheat varieties for the female sawfly, and to assess genetic approaches to developing heat tolerant spring wheat varieties.

Title: **Development and Deployment of Improved Barley Varieties for Montana Small Grain Producers**

Personnel: Dr. Tom Blake, Plant Sciences and Pathology

Amt. Funded: \$50,000

Objectives:

- 1) Complete the process of commercializing the new malting barley varieties, Hockett and Geraldine
- 2) Initiate plant scale testing of MT010158 with Miller Brewing Company
- 3) Expand statewide evaluation of the best performing barley lines from the USDA Barley CAP program

- 4) Expand evaluation of high-yield barley lines carrying the high grain starch allele at *qGPC6H*
- 5) Continue exploration of barley germplasm and straw degradation technology to expedite development of barley varieties with straw-to-ethanol potential
- 6) Initiate expanded winter barley evaluation

Summary:

The MAES barley improvement group achieved its objectives for 2008-2009. We enjoy a full pipeline of varieties in development and look forward to continuing our efforts on behalf of Montana barley production and Montana barley producers. Hockett, Geraldine and MT010158 are moving toward commercialization as rapidly as the malting and brewing industries can manage. The best way to improve the efficiency of plant breeding programs is to increase germplasm exchange and evaluation. We can all benefit from the efforts of our colleagues. The barley CAP provided an initial mechanism that funded expanded germplasm evaluation. We demonstrated that unusual genotypes of barley have the potential to act as feedstocks for straw-based ethanol production, and look forward to attempting to prove this concept.

Title:

Marker Assisted Breeding in Spring and Winter Wheat

Personnel:

Jamie D. Sherman, Assistant Research Professor
Department of Plant Sciences

Amt. Funded:

\$40,000

Objectives:

- 1) Develop white-seeded wheat through the conversion of high performing red lines using newly identified markers for white genes.
- 2) Use markers in forward breeding to address emerging problems.
- 3) Identify new markers for heat tolerance and sawfly attraction.

Summary:

Development of a Marker for White Seed Color

We have developed a means of increasing the effective size of the hard white breeding programs without negatively impacting the hard red programs. We have –

- Identified markers for all three white gene
- Confirmed them in segregating populations
- Completed the crossing program for conversion of red to white
- Published these results (Sherman et al., 2008, Crop Science in press)
- White, solid, low PPO lines have been advanced to breeders for evaluation

Development of Protocols for Marker Screening

Markers may be used at many stages of the breeding program. A primary function of this project has been to optimize procedures such that the breeding programs can take full advantage of the technology. Both programs have been able to integrate marker analysis into breeding protocols. The total number of MAS selections completed this year was well over 15,000.

Identify and Verify New Markers of Heat Tolerance and Sawfly Attraction

We have identified new QTL's for heat tolerance and sawfly attraction. We have submitted a paper for the sawfly attraction trait. We need another year of data for heat tolerance. We are in the process of confirming the utility of these loci and markers. We also identified QTL's and markers for midge attraction. We are in the process of confirming those as well. We have also identified additional QTL's for solid stem. These QTL's may be used to explain variability in the expression of the solid stem trait in different backgrounds.

Title: **Extension Redistribution Supported by Long-Term Monitoring of Wheat Stem Sawfly Parasitoids**

Personnel: David Weaver (PI) Department of Land Resources and Environmental Sciences, Montana State University, <http://landresources.montana.edu/Department/Weaver.html>

Amt. Funded: \$33,000

- Objectives:**
- 1) To continue a pilot program that is monitoring the population growth of inoculatively established sawfly parasitoids on farms where historically there was sawfly damage in the presence of negligible parasitism. The project is conducted in direct collaboration with selected wheat producers and wheat grower organizations and aims to evaluate the continuing success of these parasitoids at fifteen farms.
 - 2) This year we wish to establish twenty new sites throughout Montana to continue the process of translating parasitoid redistribution and conservation to Montana wheat growers. Therefore, these twenty new sites will be established with input from both County Agents and Grower Organizations. These sites will not be monitored for long-term population dynamics, due to the fact that we are at maximum capacity for long term monitoring.

Summary: It remains apparent that parasitoid populations, sawfly populations, and crop cultivar grown interact in a dynamic manner over time. It is beneficial to collect the long term monitoring data to determine the nature of the cycling of parasitoid populations, and to assess long term impacts of planting rotations that include solid stem cultivars on wheat stem sawfly populations.

Working with County Extension personnel is straightforward and efficient. Although busy, the participants all expressed interest in the project and in disseminating the overall intent of the program. Local growers, weary of losses due to sawfly, are eager to participate in this project. All would like more parasitoids, if possible.

Title: **Improved Quality of Hard Red and Hard White Wheat**

Personnel: Deanna Nash

Amt. Funded: \$33,000

Objectives:

- 1) Evaluate end-use quality of hard red and hard white lines developed by MSU spring and winter wheat breeding programs.

- 2) Showcase Montana's newest varietal releases for visiting Trade Teams as they tour the Cereal Quality Lab (CQL) testing facilities.
- 3) Participate in the milling and baking contests for the Central Montana Fair and the Choteau County Fair.
- 4) Promote Montana wheat quality by conducting tours and hands-on demonstrations.
- 5) Participate in research projects designed to determine ways to improve end-use quality parameters of new wheat varieties by cooperating with Montana Agricultural Experiment Station (MAES) researchers, the general public and industry.

Summary: Beyond our work with the MSU breeding programs, the CQL continues to cooperate with MAES researchers and the general public for addressing end-use quality attributes of experimental material.

We actively participate in collaborations across the Pacific Northwest (PNW) in order to promote Montana wheat and to be contributing members in the society of wheat researchers.

Title: **Orange Wheat Blossom Midge Management**

Personnel: Bob Stougaard: agronomist, Northwestern Ag Research Center
 Qingwu Xue: agronomist, Northwestern Ag Research Center
 David Weaver; entomologist, LRES, Bozeman
 Luther Talbert: spring wheat breeder, PSPP Bozeman

Amt. Funded: **\$21,913**

- Objectives:**
- 1) Validate a degree-day model for the Montana population
 - 2) Screen spring wheat varieties for midge resistance
 - 3) Introduce biological control agents from North Dakota
 - 4) Monitor potential midge populations in Triangle counties

Summary: The developmental rate of the Flathead midge biotype appears to be abnormally early. The major developmental stages occur about 10 days earlier than predicted by the Canadian model.

This situation is problematic and may reduce the effectiveness of using either early planting dates or early maturing varieties as methods for avoiding insect damage. More importantly, the potential exists for the insect to cause damage to winter wheat.

Early recognition of OWBM adults is best achieved with emergence traps. However, the small sampling area reduces their effectiveness. Sticky traps were very similar to EM traps in describing the pattern of emergence, but they have the disadvantage of collecting other non-target insects. The PH traps only attract OWBM, but appear to be late in predicting the major emergence events. However, this was largely due to the fact that PH traps continued to attract large numbers of adults latter in the season than the other two methods.

Detection of the insect can be accomplished with emergence, sticky, or pheromone traps, provided that the adult population is high enough. The question remains as to which detection method is best when populations are low and border on the action threshold. It's recommended that fields should be monitored using either emergence traps or pheromone traps in combination with field scouting.

- Title:** **Susceptibility of Great Plains Wheat Varieties and Weeds to *Wheat Streak Mosaic Virus***
- Personnel:** Dr. Mary Burrows, Assistant Professor and PI, Dai Ito, graduate student, and Ken Baker, research assistant, PSPP, Montana State University.
- Objectives:**
- 1) Evaluate widely planted winter and spring wheat varieties in Montana for susceptibility of *wheat streak mosaic virus*.
 - 2) Evaluate wheat varieties and weed biotypes from the Great Plains region for susceptibility to *wheat streak mosaic virus*.
 - 3) Disseminate the results of this study to growers in Montana and throughout the Great Plains region.
- Summary:** We have successfully compared winter and spring wheat varieties widely grown in Montana for susceptibility to *Wheat streak mosaic virus* (WSMV). Despite hail damage in our field plots which made accurate yield estimates difficult, the yield and quality of the majority of wheat varieties was reduced. Some varieties did show tolerance to WSMV, being symptomatic but

not losing significant yield. This field experiment will need to be repeated in 2009. The outcomes of this experiment will provide management options to growers faced with WSMV-epidemic conditions and assist our breeders in developing or maintaining pathogen tolerance.

We have begun experiments to compare wheat varieties and weed biotypes from throughout the Great Plains region for their susceptibility to WSMV. We have already found that wild oat is the most susceptible grassy weed in Montana. The virus replicates in wild oat at similar levels as in wheat. We are currently investigating whether wild oat can support wheat curl mite replication and whether mites will feed on wild oat and transmit WSMV to wheat. We have identified variation in weed species susceptibility to WSMV according to geographic source of the weed seed. This could partially explain why different states observe different levels of virus epidemics.

The results of this project have been distributed via presentations, online workshops, and will be included in a Montguide to be published in the spring of 2009.

- Title:** **Dryland Cropping Systems: 1) diversified high and low input strategies; 2) residual soil herbicide effects on 12 crops; and 3) agronomic factors for sawfly management.**
- Personnel:** Perry Miller (P.I.), Jeff Holmes (field operations), Clain Jones (soil nutrient dynamics), Rick Engel (nitrous oxide emissions), Dave Buschena (economic assessment); Fabian Menalled (herbicides); and David Weaver (sawfly).
- Amt. Funded:** \$19,741
- Objectives:**
- 1) Crop Diversity Rotation Study (CDRS):** Compare diversified no-till and organic cropping systems, including low and high input strategies, for crop productivity and quality, resource use efficiency, and weed population characteristics. [and soil nutrient status measured independently by Clain Jones]
 - 2) Greenhouse Gas Rotation Study (GGRS):** Compare low and high N fertilizer levels within and among a series of tilled, no-till, and organic wheat only and wheat – pea cropping systems for crop productivity and quality, resource use efficiency, and cropping system energy

budgets. [and greenhouse gas effects, funded independently by Rick Engel]

- 3) Quality crop yield loss due to residual soil herbicides in a favorable environment.
- 4) Quantify the effects of wheat management (field environment, wheat type, variety, row spacing, and seeding rate) on wheat productivity and quality. [and relate wheat agronomy to sawfly-induced yield losses and parasitoid interactions, funded independently by David Weaver

Summary:

These crop rotation studies have contributed importantly to the understanding of diversified cropping strategies within no-till and organic cropping systems in Montana.

- 1) Organic systems can be economically competitive during the transition phase, especially during drought, but may carry greater risk in the long term from difficult to manage weeds and from declining soil fertility status. [Miller, P.R., D.E. Buschena, C.A. Jones, and J.A. Holmes. 2008. Transition from intense tillage to no-till and organic diversified annual grain cropping systems: Agronomic, economic and soil nutrient analyses. *Agronomy Journal* 100:591-599] Results from this research were critical to obtaining a large grant at MSU from a nationally competitive source to conduct research on major sources of long-term risk in organic systems, related to these and other issues. [Miller, P., D. Buschena, C. Jones, F. Menalled, B. Jacobsen, R. Engel, and B. Maxwell. Organic production in the challenging environment of the northern Great Plains; from Transition to Sustainability. USDA-CSREES Integrated Organic Program. 2006-08. \$471,111.] Results from these studies have been shared with the Montana Organic Association, and this research will result in at least two Montguides and at least one scientific paper in 2009. Further research of organic systems at MSU-Bozeman is uncertain at this time.
- 2) No-till systems are more efficient at storing soil water than tilled organic systems.
- 3) The yield potential of winter wheat is greater than spring wheat under normal rainfall conditions. However, during drought years spring wheat yielded similar to winter wheat, likely because winter wheat failed to attain its yield potential. Within a continuous spring wheat – winter wheat system,

spring wheat has consistently yielded greater (avg = 3.5 bu/ac) at ½ recommended rate of N fertilizer.

- 4) Due to sensitivity of pea to post-emergent broadleaf herbicides, rotational strategies must be sought that omit PE broadleaf herbicides in pea.
- 5) Rotational benefits of pea are superior to canola due to soil N contribution and water conservation.
- 6) Sunflower and safflower yield remarkably well despite summer drought, where deep stored soil water is available. However, deep rooted crops like sunflower reduce subsequent yields for two or more years.
- 7) Continuous wheat is more costly to manage than wheat in a diversified rotation but is capable of sustaining high levels of production in the short to medium term.
- 8) High N fertility regimes produce greater cereal crop yields and protein content in normal rainfall years, but not during drought. The nitrogen use efficiency of moderate N regimes is much greater than high N regimes. Nitrogen fertilizer rates will be examined relative to crop energy budgets to optimize net energy gain.

Further, these rotation studies have served as valuable field laboratories for undergraduate and graduate instruction and numerous outreach activities, and have also facilitated collaborative research in soil nutrient status (Clain Jones) and greenhouse gas emissions (Rick Engel). [Dusenbury, M.P., R.E. Engel, P.R. Miller, R.L. Lemke, and R. Wallander. 2008. Nitrous oxide emissions from a northern Great Plains soil as influenced by N management and cropping systems. *Journal of Environmental Quality* 37:542-550]

- 9) Dicot crop yields continue to be severely affected by two sulfonyl urea herbicides (*Finesse* and *Maverick*) applied at recommended usage rates 42 months prior to planting. Yield damage was even greater at 2X rates representing unavoidable overlap application in the field.
- 10) Under moderate to severe sawfly infestation, wheat yields were affected primarily by type (winter>spring). Field phase (i.e. fallow vs. recrop) stem solidness (i.e. hollow vs. solid) has caused inconsistent yield effects. Other parameters such

Title: **Distribution and Severity of Root Disease in Montana's Wheat**

Personnel: Alan T. Dyer, Jeffery Johnston

Amt. Funded: \$15,000

Objectives:

- 1) Apply real-time PCR to determine the distribution and severity of Fusarium crown rot and common root rot within Montana.
- 2) Evaluate tolerance and performance of top wheat cultivars to Fusarium crown rot, common root rot and Cephalosporium stripe.

Summary: In summary, a survey of Central and North Central Montana showed that common root rot of wheat is widespread and fairly uniform throughout a ten county area. In contrast, Fusarium crown rot is highly variable in its distribution. Fusarium crown rot damage was insignificant in over half of the fields examined and likely caused significant losses in about 17% of the fields examined. This variability in distribution is a potential opportunity as it suggests Fusarium crown rot is heavily affected by either environmental conditions or agricultural practices. In contrast to the success of the field survey, the trials at the Arthur H. Post Farm were heavily impacted by hail damage. Despite this confounding factor, differences in performance were identified among winter wheat cultivars challenged with the dual stresses of hail and Cephalosporium stripe. In particular, Ledge, Norris, Genou and MTS04120 performed well. Other pathogens did not have a strong impact on winter wheat. For spring wheat, Fusarium crown rot had a significant impact on yield but there was no differential reaction among the spring wheat cultivars challenged. Common root rot did not significantly affect yield. Among the spring wheat, some cultivars stood up well to hail damage and outperformed other cultivars. Most notable among these were the cultivars, Hank and Choteau.

Title: **Enhanced Field Selection for Wheat Stem Sawfly Resistance**

- Personnel:** Phil Bruckner, PSPP Dep., Bozeman
Gregg Carlson, Northern Ag. Res. Ctr., Havre
Luther Talbert, PSPP Dep., Bozeman
Jim Berg, PSPP Dep., Bozeman
Peggy Lamb, Northern Ag. Res. Ctr., Havre
- Amt. Funded:** \$15,000
- Objectives:**
- 1) Subject early-generation segregation winter wheat bulk populations and derived lines to heavy selection pressure for wheat stem sawfly (WSS) resistance and selected 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 germ plasm 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 and including use of resistant cultivars.
- Summary:** Progress has been made in winter wheat cultivar development. Genou hard red winter wheat was released in 2004 and has increased in acreage to the point where Genou is the leading winter wheat cultivar planted in Montana. Genou represents significant genetic improvement in yield potential and cold tolerance relative to Rampart. Two promising solid stem experimental lines have been identified that appear to offer additional yield potential in a sawfly-tolerant background. A 3 acre selection and testing nurseries for WSS research was established in Hill County in the fall of 2007 and spring of 2008. Smaller sawfly nurseries which produced useful data were planted at Bozeman, Conrad, and Havre. At north Havre we had high levels of sawfly infestation and cutting which made phenotypic selection for tolerance to sawfly quite effective in that tolerant genotypes were visually distinguishable from susceptible genotypes. Lines also were cut by wheat stem sawfly at Havre and usable resistance ratings were obtained. 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.

- Title:** **Molecular Genetics of Wheat Stem Sawfly Odor Receptors to Enhance IPM Based on Chemical Ecology**
- Personnel:**
- 1) PI, Kevin W. Wanner, Assistant Professor of Entomology & Extension, Department of Plant Sciences and Plant Pathology, Montana State University.
(<http://www.life.uiuc.edu/robertson/personnel/kevin.html>)
 - 2) Co-PI, David Weaver, Associate Professor of Entomology, Department of Land Resources and Environmental Sciences, Montana State University.
(<http://landresources.montana.edu/Department/Weaver.html>)
- Amt. Funded:** \$11,500
- Objectives:**
- 1) Study the molecular mechanisms of odor reception in the wheat and stem sawfly. Specifically, identify the receptor genes in sawfly antennae that detect host plant odors.
 - 2) Obtain preliminary data to support a USDA, CSREES, NRI grant application for 2008-2009. The proposal will target strategic exploitation of wheat stem sawfly odor receptors to develop new IPM tools.
- Summary:** No Report Submitted by the Deadline for This Project.

- Title:** **Response of Spring Wheat with and Without “Stay-Green” Trait to Nitrogen Fertilizer Under Irrigated and Dryland Conditions**
- Personnel:**
- Chengci Chen, Assistant Professor of Cropping Systems, Central Ag. Research Center
Mal Westcott, Professor of Soil Fertility, Western Triangle Ag. Research Center
Grant Jackman, Professor of Soil Fertility, Western Triangle Ag. Research Center
Jeff Whitmus, Research Assistant, Northern Ag. Research Center

Amt. Funded: \$11,261

Objectives: The objectives of this study are:

- 1) To investigate the different yield responses of spring wheat cultivars with an without “stay-green” trait to nitrogen fertilizer under irrigated and dryland conditions; and
- 2) To investigate retranslocation of soluble carbohydrates and proteins from leaves and stems of “stay –green” and non “stay-green” cultivars to grains under irrigated and dryland conditions.

Summary: Outlook, Reeder, and Vida spring wheat grain yield and protein content responded to N fertilizer similarly. There was no significant difference among the varieties in either yield or protein content at all three locations in both irrigated and dry land (figs. 1-6). However, Reeder and Vida had slightly higher straw protein (or N contents) than Outlook at higher N levels in both dryland (Fig. 9) and irrigated trial (Fig. 12). This indicates that Vida probably took up more N to keep the leaf “staying-green”, but the N was not effectively remobilized to the grain. Based on the results from this study, current nitrogen fertilizer application recommendation may be adjusted. Theses results agreed with previous year’s experiment.

Title: **Early Generation Durum Selection and Germplasm Improvement**

Personnel: Joyce Eckhoff
Debbie Kunda
MSU Eastern Ag. Research Center
1501 N Central Ave., Sidney, MT 59270
Phone: (406) 433-2208
e-mail: jeckhoff@sidney.ars.usda.gov

Amt. Funded: \$10,000

Objectives: To produce improved durum germplasm for development of varieties for Montana producers

To develop value-added characteristics in durum for manufacture of specialty producers

Summary: Durum production continues to increase in Montana and the Mondak region. This project is developing germplasm appropriate to Montana conditions using both conventional breeding methods and double-haploid technology. The germplasm is tested in each generation for agronomic and quality characters. A solid stem program was initiated in 2005 with 86 solid-stemmed lines identified and crossed onto male sterile lines to establish a solid-stemmed population. Selections from this population were made. Genetic material with low Cd accumulation has been used in crosses onto populations to develop composite cross populations with low accumulation of Cd.

Title: **Impact of Polyphenol Oxidase Genes on Agronomic and Quality Traits in Winter Wheat**

Personnel: Jack Martin, Professor, Dept. of Plant Sciences and Plant Pathology
Phil Bruckner, Professor, Dept. of Plant Sciences and Plant Pathology

Amt. Funded: \$10,000

Objectives:

- 1) Determine the effects of two major genes controlling Polyphenol oxidase activity on agronomic traits in a segregating winter wheat population.
- 2) Determine the effects of two major genes controlling Polyphenol oxidase activity on noodle and bread quality in a segregating winter wheat population.

Summary: The PPO genes affected plant height with low PPO genotypes being shorter than high PPO genotypes. The Ppo-A1 gene has a larger effect on PPO activity than the Ppo-D1 gene. Wheat breeders would be advised to develop new varieties with the low allele for each gene. This can be done by using marker assisted selection with functional markers for these genes.

Title: **Characterization and Transfer of New Rust Resistance Genes**

Personnel: Li Huang

Amt. Funded: \$10,000

- Objectives:**
- 1) Evaluate leaf and stem rust resistance genes in several breeding lines.
 - 2) Develop mapping populations to genetically map the rust resistance genes.
 - 3) Transfer different rust resistance genes in Montana elite spring wheat varieties.
 - 4) Evaluate leaf and stem rust resistance for wheat breeding programs in the department of PSPP

Summary: The project proposed in this proposal is the first step of our three-part plan to prepare Montana for the possibility of a Ug99 infection. Our plan is 1) to obtain and identify resistance sources; 2) to tag the resistance genes with molecular markers; 3) to incorporate resistance genes into Montana elite cultivars. We have completed all proposed objectives in this proposal. We have obtained resistance sources, developed populations for future gene tagging and confirmed resistance status for the breeding lines developed at Montana State university wheat breeding program. The research supported by the committee has provided essential mapping populations for tagging the resistance genes with molecular markers which will assist the final goal for breeding stem rust resistance cultivars for Montana wheat farmers without bringing the dangerous pathogen to the lab.

Title: **Continuing as an Underwriter for MONTANA AG LIVE!**

Personnel: Jack Riesselman

Amt. Funded: \$3,500

- Objectives:**
- 1) The committee will receive significant public exposure at modest cost. Underwriters are listed monthly in the KUSM program guide, which is received by the 5,500 members of Montana Public Television. In addition, underwriters receive on-air credits during each of the 67 weekly programs.
 - 2) The committee will help to provide grain producers and agricultural businesses with timely and relevant answers to their questions in a cost-effective manner.

- 3) The committee will help interpret the day-to-day issues facing ag producers to nonag audiences. Given the growing tensions in some sectors of Montana between producers and nonproducers, a forum such as MONTANA AG LIVE!, where the needs of farmers are clarified and addressed, offers a rational atmosphere for increased public awareness.

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