

**Agriculture MREDI Grant**  
**Quarter 1 Report**  
**September 29, 2015**

**Research Center/MAES subproject of the Agriculture MREDI Grant**

**Principal Investigator:** Barry Jacobsen; Email: [bjacobsen@montana.edu](mailto:bjacobsen@montana.edu)

Hiring

Roger Hybner was hired as a Research Associate at the NARC to assist with the planning, design and implementation of field crop research projects and coordination of livestock related research pertaining to this project. Shana Wold was also hired as the Ag MREDI Project Coordinator.

**Pulse Crop Research subproject of the Agriculture MREDI Grant**

**Principal Investigator:** Chengci Chen; Email: [cchen@montana.edu](mailto:cchen@montana.edu)

- 1) Samples of 8 varieties were collected from 10 locations across Montana to analyze protein contents (320 total samples).
- 2) 320 Soil samples corresponding to pea test sites above were also collected and sent to John Peters' lab to analyze microbial community.
- 3) Protein contents of pea samples will be analyzed this winter.
- 4) One postdoc research associate is yet to be hired to study pea nitrogen fixation.

**Soil Microbiology and Pea Protein subproject of the Agriculture MREDI Grant**

**Principal Investigator:** John Peters; Email: [john.peters@chemistry.montana.edu](mailto:john.peters@chemistry.montana.edu)

Perry Miller, Email: [pmiller@montana.edu](mailto:pmiller@montana.edu)

Hiring

Julie Zickovich was hired in August of 2015. Julie has a Masters in Evolutionary Biology from San Diego State University and has been at Montana State University in the Department of Microbiology and Immunology since 2007. Julie was hired because of her experience in multivariate statistics which is a key component in the analysis and interpretation of this project. Perry Miller has hired a research associate starting January 1, 2016. Justin Vetch is a senior in the department of Chemistry and Biochemistry. Justin is receiving research credit for being involved with the project and plans on attending graduate school.

Procurement of Equipment

Soil Sampler for \$70.00

Progress 08/01/15- 09/25/15

- 1) Research sites identified and soil samples collected from all sites – Collaborator: Dr. Perry Miller
  - a) Post Agronomy Farm: Samples collected every two weeks. Three sets of samples from 8/13/15, 8/27/15, and 9/10/15 already collected.
  - b) Montana Agricultural Experimental Stations – Collaborator: Dr. Chengci Chen
    - Northern
    - Western
    - Southern
    - Western Triangle
    - Eastern
    - Central
    - Northwestern

- 2) Soil samples prepared for sequencing of 16s rRNA and soil chemistry
  - a) Able to extract high quality DNA from soils
  - b) Tested and begun screening 16s rRNA with 515F/806R primers
  - c) Michigan State identified for cost effective/ high quality Illumina MiSeq sequencing
  - d) University of Idaho identified for broad range soil chemistry
- 3) Perry Miller has collected 1000 farmer produced pea samples from throughout MT for protein content determination

#### Timeline

- 1) All samples processed and ready to be sent sequencing and chemistry by mid-November
- 2) Analyze data through winter and into spring

#### **Cover Crop/Grazing subproject of the Agriculture MREDI Grant**

##### **1) Principal Investigator:** Darrin Boss; Email: [dboss@montana.edu](mailto:dboss@montana.edu)

Cover crop research trials were planned with co-PIs Glunk and Hatfield and faculty at the 7 MAES Agricultural Research Centers. Specific trials planned are mixtures of fall seeded cover crops, these trials will be done in fall of 16 with initial research this year on survivability of single species at the 7 MAES Agricultural Research (it is likely there will be great difference between Research Centers) and 30 mixtures or single species of spring seeded cover crops. Protocols were developed for experimental design, forage harvest and quality measurements and for grazing by beef cattle at Havre and sheep at Bozeman.

##### **2) Principal Investigator:** Carl Yeoman; Email: [carl.yeoman@montana.edu](mailto:carl.yeoman@montana.edu)

Sarah Olivio has been assigned/funded to my portion of the project. We have not yet managed to purchase the bioreactor because the company has been slow in responding to the purchase request. In terms of progress we have begun organizing previously collected samples of Bison, Elk, Sheep, and Deer rumen and will soon collect fresh cow rumen to use for screening and isolation of nitrate and nitrite reducers. We also expect to have our AACUC submitted by the end of the week.

#### **On-Farm Precision Experiment subproject of the Agriculture MREDI Grant**

##### **1) Principal Investigator:** Bruce Maxwell; Email: [bmax@montana.edu](mailto:bmax@montana.edu)

Philip Davis was hired as technician to facilitate communication, data transfer and manage logistical aspects associated with collaborator farms. We purchased a CropScan protein analyzer for combines and have mounted it on Chuck Merja's combine for calibration and testing. Phil has been to the Merja farm repeated times to help conduct calibration tests. We are also working close with Triangle Ag consultants in Fort Benton to learn about protein analyzer combine installation and identify more collaborators. Phil has made site visits to 8 farms and we now have 5 farms that will act as full cooperators in the On-Farm Precision Experiment (OFPE) field research. We are negotiating with Next Systems (manufacturer of CropScan protein analyzer) to purchase 3 or 4 more protein analyzers.

#### Current OFPE farmers:

Gary Broyles, Rapelje, MT  
Jess Wood, Fort Benton, MT  
Chuck Merja, Sun River, MT  
Mark Van Dyke, Hyline Farms, LLC, Manhattan, MT  
Herb Oehlke, Conrad, MT

We will have 2 or 3 levels of cooperators in this project. The 5 or 6 farmers named above that will provide full participation in the study because they have stored previous spatial yield data from the fields that we will study and

implement the OFPE, they are technologically savvy and they have the ability to site specifically apply fertilizer. A second level of participation will be from farmers that have some aspect of the above criteria, but not all, and are interested in implementing the OFPE at some level. A possible third level are farmers without any of the technology but are interested in adding some aspects of the technology and possible implementation of the OFPE. We have created a database of all of these farmers and will invite them to meetings of the reconstituted Precision Agriculture Research Association (PARA) with the first held in Great Falls in February 2016.

**2) Principal Investigator:** Clem Izurieta; Email: [clem.izurieta@gmail.com](mailto:clem.izurieta@gmail.com)

#### Hiring

- Seth Kurt Mason (Lotic Hydrological). Hired for the duration of the grant at an amount not to exceed \$36K
- Mike Trenk (MSU student). Mike is hired as an MS student for Clem for the duration of the grant. He is currently on track to finish his undergraduate degree and will commence in the Spring of 2016 as an MS.
- Jenna Lipscomb (MSU student). Jenna is hired as a coder until the end of the Fall 2015. She is a senior in CS and she will be re-evaluated at the end of the semester
- Pol Lovet (Research Computing Group). Hired 0.05 time.
- Thomas Heetderks (Research Computing Group). Hired 0.2 time.

#### Equipment

- 20K encumbered for storage with the Research Computing Group

#### Responsibilities

- Thomas Heetderks and Jenna Lipscomb are working on the reverse engineering of the current VOEIS architecture
- Seth Mason is working on DB schema design
- Mike Trenk is working on DB schema design

#### Tasks

- We have created separate Forge projects for both the CORE and the DB schema design work
- We have already logged issues/action items with both
- We have established regularly scheduled meeting times.
- Started evaluating existing raw data files from two separate sources.

### **Durum Quality subproject of the Agriculture MREDI project**

**Principal Investigator:** Mike Giroux; Email: [mgiroux@montana.edu](mailto:mgiroux@montana.edu)

#### Hiring

Andrew Hogg, M.S., has been hired as a research associate to work on this project along with MSU senior Kendra Hertweck as an undergraduate lab assistant. Andrew has ~15 years of experience in wheat genetics and end product quality.

#### Equipment

Quotes were obtained and purchase orders were placed for the equipment required to complete this project. As originally described, this consists of a Perten Glutomatic, a Brabender Quadrumat Jr. mill, and a Perten Falling Number apparatus.

#### Samples Collected

Durum field trials were harvested and are being cleaned and prepared for further testing. The samples collected consists of current and future varieties grown at MT research stations as well as populations in development. For the

populations under development a total of more than 700 rows were harvested and seed from a selection of these individual rows will be planted in Arizona by Northern Seeds personnel to advance toward Montana field trials in 2016.

New durum populations

Advanced durum genotypes and varieties were selected and planted in the greenhouse for crossing. First crosses for these new breeding populations will be completed in October 2015.

**Wheat Stem Sawfly subproject of the Agriculture MREDI project**

**Principal Investigator:** David Weaver; Email: [weaver@montana.edu](mailto:weaver@montana.edu)

- 1) I have identified someone I will hire to start my project on October 1.
- 2) We have identified 10 potential contacts, over a broad area of the State, where we can make paired observations on the abundance and size of wheat stem sawfly parasitoids in wheat adjacent to fallow; compared with wheat adjacent to flowering crops.

We have cursorily collected one site thus far and did a quick comparison on the size of the pre-pupal parasitoids inside cocoons. At this point in development of the immature overwintering parasitoids the ones from fields next to peas were 17% larger than those next to fallow.

**Weed Imaging/Pulse Crop Herbicide subproject of the Agriculture MREDI project**

**1) Principal Investigator:** Prashant Jha; Email: [pjha@montana.edu](mailto:pjha@montana.edu)

Hiring

The funding obtained from this grant is currently being used for 12-months' salary of a post-doctoral research associate at SARC involved in this project.

Procurement of Equipment

Currently, we are in process of purchasing an environmentally-controlled growth chamber at SARC, Huntley, as indicated in the grant budget (awaiting shipment). The growth chamber will be used starting this October, 2015 to conduct environmentally-controlled (representing MT) bioassays for herbicide carry-over issues in cereal-pulse rotation across diverse soil types in Montana. A portion of the funding from this grant has been allocated for greenhouse and field research supplies, and as subcontracts for conducting the off-station (multi-location) field trials across the state during this quarter.

Herbicide carry-over studies for successful integration of pulse crops in cereal-based cropping systems

The field studies have been initiated across multiple locations: Huntley, Moccasin, Havre, and Sidney, MT, starting September 20, 2015. There are 3 major objectives of these field studies:

1. Effect of fall-applied soil residual herbicide programs on pea, lentil, and chickpea tolerance and weed control (emphasis on kochia and Russian thistle control) in the following year (*plots established*)
2. Effect of Group 2 Sulfonylurea herbicides applied in the fall PRE and spring POST in winter wheat (including Clearfield wheat varieties) and carry-over to pea, lentil, and chickpea (*plots established*).
3. Spring-applied PRE/POST herbicide tolerance (variety response) and weed control in pea, lentil, and chickpea. Protocol for Objective 1 (multi-location field study) is shown below (as an example):

Trt No.	Treatment Name	Form Conc	Form Type	Other Rate	Other Rate Unit	Appl Code	Appl Description	Rep 1	Rep 2	Rep 3
1	METRIBUZIN 75 DF	75	DF	4	oz/a	A	FALL-APPLIED	101	217	303
2	METRIBUZIN 75 DF	75	DF	8	oz/a	A	FALL-APPLIED	102	216	314
3	SPARTAN CHARGE	4	SL	6	oz/a	A	FALL-APPLIED	103	213	311

4	SPARTAN CHARGE	4 SL	12 oz/a	A	FALL-APPLIED	104	209	307
5	VALOR SX	51 WG	3 oz/a	A	FALL-APPLIED	105	210	317
6	VALOR SX	51 WG	6 oz/a	A	FALL-APPLIED	106	212	302
7	CORVUS	2.63 SC	4 oz/a	A	FALL-APPLIED	107	211	304
8	CORVUS	2.63 SC	8 oz/a	A	FALL-APPLIED	108	201	313
9	AUTHORITY MTZ	45 DF	8 oz/a	A	FALL-APPLIED	109	204	301
10	AUTHORITY MTZ	45 DF	16 oz/a	A	FALL-APPLIED	110	215	310
11	CORVUS	2.63 SC	3 oz/a	A	FALL-APPLIED	111	214	316
	METRIBUZIN 75 DF	75 DF	4 oz/a	A	FALL-APPLIED			
12	CORVUS	2.63 SC	6 oz/a	A	FALL-APPLIED	112	207	308
	METRIBUZIN 75 DF	75 DF	8 oz/a	A	FALL-APPLIED			
13	ANTHEM FLEX	4.3 SC	3.64 fl oz/a	A	FALL-APPLIED	113	205	309
14	ANTHEM FLEX	4.3 SC	7.28 fl oz/a	A	FALL-APPLIED	114	208	315
15	PROWL H2O	3.8 SC	16 fl oz/a	A	FALL-APPLIED	115	206	305
	OUTLOOK	6 EC	18 fl oz/a	A	FALL-APPLIED			
16	PROWL H2O	3.8 SC	32 fl oz/a	A	FALL-APPLIED	116	203	312
	OUTLOOK	6 EC	36 fl oz/a	A	FALL-APPLIED			
17	NONTREATED					117	202	306

### Precision Weed Control

Field studies on precision optical sensors and spot-spray system (WeedSeekers) will be continued in spring of 2016. During 2016, we will test the efficacy of WeedSeeker technology using a 30 ft, tractor-mounted precision sprayer (30 sensor units spaced 12 inches apart) in large-scale plots in fallow. Demonstration plots for growers will also be established across Montana during various MAES/ DRC field days. Additionally, collaborative work has been initiated with the MSU Department of Electrical Engineering/Optics on testing new, low-cost optical sensors, for weed mapping and for hyperspectral imaging to differentiate between herbicide-resistant vs. susceptible weed species, such as kochia, wild oat, and downy brome predominant in MT cropping systems. Hyperspectral images and algorithms will be developed to differentiate between a crop and a weed species. The aim of this research is to utilize this technology for selective control of resistant weeds in the field, and detecting and spraying specific problematic weeds in a crop field. Plants are currently being grown in the greenhouse at SARC for the hyperspectral imaging data collection and analysis during this fall.

**2) Principal Investigator:** Joseph Shaw; Email: [jshaw@montana.edu](mailto:jshaw@montana.edu)

### Hiring

- Dr. Joseph Shaw – subproject director (to receive partial summer salary only)
- Mr. Paul Nugent – Research Engineer and Ph.D. student (partial academic year salary)
- Mr. Andrew Donelick – Ph.D. student

### Equipment Procurement

We have submitted purchasing paperwork for a Resonon Pika IIg hyperspectral imaging system, scanning tripod, and narrow-field and wide-field lenses (Resonon is a local Bozeman optics company). Delivery is expected by early November 2015.

### Research Progress

The primary focus of this subproject is to develop optical remote sensing methods for enabling spot spraying to reduce herbicide costs and for detecting and identifying weeds growing amid crops. During this first quarter our accomplishments have been primarily identifying and appointing personnel, beginning procurement of specialized equipment, and making plans for experiments to be conducted in preparation for the 2016 growing season. For the latter, we visited with Dr. Prashant Jha at the Southern Agricultural Research Center to carefully examine the

commercial system that Prashant is experimenting with as a possible method for enabling spot herbicide spraying (so that we could assess what needs to be done to adapt our potentially lower-cost alternative for this task). We also made plans for Prashant to grow several herbicide-resistant and non-resistant weeds in the greenhouse so that we can collect hyperspectral images to begin the process of developing possibly unique spectral reflectance signatures and associated algorithms that can be used for weed species identification. Finally, we also began training a new PhD student to conduct hyperspectral imaging experiments and process hyperspectral imaging data.

#### **Economic analysis subproject of the Agriculture MREDI project**

**Principal Investigator:** Anton Bekkerman; Email: [anton.bekkerman@montana.edu](mailto:anton.bekkerman@montana.edu)

I'm on track so far with the timeline that I submitted. I've acquired one set of data (daily historical elevator prices for various commodities in Montana) and am sending out a completed contract today to acquire the fertilizer price data. The next step, which I have already started working on, is to collect information about the factors influencing Montana's Ag market and develop and parameterize a model of those factors using estimates from the acquired data and information from the literature.

#### **Participatory research network subproject of the Agriculture MREDI project**

**Principal Investigator:** George Haynes; Email: [haynes@montana.edu](mailto:haynes@montana.edu)  
Colter Ellis; Email: [colter.ellis@montana.edu](mailto:colter.ellis@montana.edu)

#### Hiring

Tom Woods, a graduate student in Political Science has committed to the project and is working through the hiring process.

#### Identification of research sites

The initial interviewing of producers will begin at the Montana Grain Growers Association (MGGA) Annual Conference in early December; and, any other information – the research team, Colter Ellis, Mary Burrows and George Haynes, has met and is developing a research protocol, qualitative questionnaire and other tools to implement at the MGGA Annual Conference. PI Colter Ellis has begun the human subjects IRB application and has met with Perry Miller and Bruce Maxwell about recruitment for site visits and interviews. They have a standing meeting every two weeks to discuss progress on these and other goals.