

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Food Safety -- Sustainable Agriculture

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			20%	
121	Management of Range Resources			10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			5%	
211	Insects, Mites, and Other Arthropods Affecting Plants			15%	
212	Pathogens and Nematodes Affecting Plants			15%	
213	Weeds Affecting Plants			10%	
215	Biological Control of Pests Affecting Plants			5%	
216	Integrated Pest Management Systems			11%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			2%	
721	Insects and Other Pests Affecting Humans			2%	
722	Zoonotic Diseases and Parasites Affecting Humans			3%	
903	Communication, Education, and Information Delivery			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	83.6	0.0
Actual Paid Professional	0.0	0.0	80.9	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	579168	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	3072624	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	3077838	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Communicate research results through field days, news releases, fact sheets, research summaries, and presentations at county and state meetings and conventions
- Distribute results of research via the internet
- Hold strategic planning discussions with state agricultural groups including ag associations and federal and state land management agencies
- Conduct research experiments
- Provide training
- Maintain healthy partnership with College of Education, Health, and Human Development for Sustainable Agriculture Degree

2. Brief description of the target audience

- Alternative energy groups and state agricultural advisory committees
- Crop and livestock producers in Montana
- Montana Wheat and Barley Committee, companies, fertilizer advisory committees, equipment companies
- State of Montana, Montana Department of Agriculture, Bureau of Land Management, USFS, and other government entities
- Participants in extension and commodity group meetings, conferences, and field days

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1627	0	900	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	3	13	16

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research citations

Year	Actual
2012	21

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of interactive meetings with state groups and agencies
2	Number of producers per year implementing new farm management and budgeting practices
3	Increased number of new crops adapted to Montana through percent acres increased
4	Number of field days, news releases and presentations at conventions
5	Number of new producers per year adopting measures to improve agricultural efficiency (e.g. better seed quality, higher numbers of fields with soil tested, optimization of fertilizer use)
6	Increase in acres of non-traditional crops planted in Montana.
7	Number of routine field crop and forage samples processed by the MSU Seed Laboratory per year

Outcome #1

1. Outcome Measures

Number of interactive meetings with state groups and agencies

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

It is important to meet regularly with crop and livestock producers, wheat and barley committee, crop protection companies, fertilizer advisory committee, equipment companies, alternative energy groups, and state agricultural advisory committees to identify research and outreach needs for MSU COA/MAES.

What has been done

Producers, commodity groups, advisory boards, and industry hold annual meetings to present research results and to plan future research and outreach activities. Organizers conduct surveys so they develop research program that reflect stakeholder needs. In addition, resolutions are passed in numerous associations and approved by voting members providing direction to MAES.

Results

MSU researchers provide new small grain varieties and alternative crops to meet Montana producers needs. Researching new crops and finding new markets for existing crops are potential ways to enhance growth in sustainable agriculture. As technology advances and producers rely more on computer-aided information, the role of MSU research and outreach continues to grow in value and impact. MAES leaders use stakeholder feedback and input to refine and redirect research programs while providing realistic time frames for outputs.

As testimony to the support the Montana agriculture community offers and the value they place on MAES research, the Montana Farm Bureau passed a resolution recommending the Montana Legislature make a long-term commitment to adequately fund the Montana Agricultural Experiment Station and Extension Service. This is but one example of how sharing information with state groups and agencies increases sustainability support of Montana agriculture through research and education.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
121	Management of Range Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
721	Insects and Other Pests Affecting Humans
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #2

1. Outcome Measures

Number of producers per year implementing new farm management and budgeting practices

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Dryland wheat production characterizes a key agro ecosystem of the northern Great Plains (NGP) that is dependent on nitrogen (N) fertilizer. Future farming in this region under energy-constrained scenarios must focus on increasing the net gain associated with N inputs. A new class of crops, the pulses (annual grain legumes), are poised to play a major role in diversifying cropping systems in the NGP, due to their inherent profit potential, and due to farmer perceptions of meaningful N contributions to their wheat crops.

What has been done

The dominant variable energy input to crop production in the northern Great Plains is N fertilizer. This has raised a new awareness of soil N dynamics among wheat growers and led to an increase in legume crop production. Pea and lentil acreage has risen to nearly 500,000 acres in Montana from 2010 to 2012. Conclusions from an on-farm energy audit showed the largest energy effects from N fixing pulse crops are in the form of a 40 percent increase in wheat yields and a 15 percent decrease in N fertilizer requirements or need.

Results

Area devoted to pea and lentil crops increased in the NGP over the past decade and may increase further. There are two key limitations to using pulse crops to offset N fertilizer: 1) N contributions from pulse crops are difficult to estimate accurately, especially in the short term. It will be important to investigate pulse crop effects over time to better understand their role in conditioning cropping system energy budgets and changes in soil, and 2) perhaps more important, some areas within the NGP do not receive enough rainfall to permit annual cropping, and are reliant on fallow wheat systems. There may be an unmet opportunity to green fallow in a more sustainable fashion, with the use of annual legume green manures.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #3

1. Outcome Measures

Increased number of new crops adapted to Montana through percent acres increased

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1349000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

MSU researchers continue to develop and register new crops for Montana producers. The best measurement of success is in the number of acres devoted to new crops. Another measure is the

number of producers selecting plant varieties developed through the MSU breeding programs. Our spring and winter wheat breeding programs are prime examples of how new crops are regularly introduced to area producers.

What has been done

Montana farmers planted 2.2 million acres of winter wheat in 2012, ranking fifth in the United States for the number of acres planted. Three of the top four varieties planted in Montana this year were developed by the MSU Winter Wheat Breeding Program. "Yellowstone," "Genou," and "Rampart" made up more than half of the total winter wheat planted bringing in about \$600 million in revenue each year to Montana and maintaining an adequate supply require a high quality, outcome-based breeding program.

Results

Montana farmers selected several Montana varieties of wheat and barley. Following are a few significant crops developed through COA/MAES reflecting an increase in seeded acres from 2011 to 2012.

- "Yellowstone" winter wheat increased from 380.9 (000)acres to 500.5 acres
- "Vida", a spring wheat, increased from 553.7 to 559.2 acres
- "Choteau", another MSU spring wheat, increased from 443.3 to 447.8
- "Hockett" barley increased from 235.1 acres to 240.4.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources

Outcome #4

1. Outcome Measures

Number of field days, news releases and presentations at conventions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	22

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Sharing information is a critical function of the College and Montana Agricultural Experiment Station and one of the most popular ways to interact with stakeholders is through the annual field days. Additionally researchers have established a professional relationship with local, national and international media outlets and their valuable research has contributed to professional conferences around the globe.

What has been done

Critical information is shared on a regular basis with stakeholders through key events such as the annual field days in each of the research centers as well as regular press releases regarding critical information that must be disseminated in a timely manner. Examples of this are the confirmation of glyphosate resistant Kochia and concerns over a potential bluetongue outbreak. Media around the state are quick to assist researchers in sharing critical information.

Results

Researchers share expertise in a variety of ways including National Public Radio, weekly participation in a local PBS program called Montana Ag Live (spring and fall seasons) reaching nearly 10,000 viewers weekly, more than 19 international presentations, 7 videos for range management courses, and weekly articles in newspapers throughout Montana. Research projects were also shared with global audiences through the New York Times and Fox News.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
121	Management of Range Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
721	Insects and Other Pests Affecting Humans
722	Zoonotic Diseases and Parasites Affecting Humans
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Number of new producers per year adopting measures to improve agricultural efficiency (e.g. better seed quality, higher numbers of fields with soil tested, optimization of fertilizer use)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Producers are faced with ever increasing costs including seed, land, and fertilizer and chemical inputs. Maximizing efficiency is paramount for producers to remain in business and address consumer preferences. According to leading researchers with the Agricultural Economics and Economics Department nitrogen fertilizer prices continued to be exceptionally high and producers used more than 700,000 tons in 2011 and the expense to Montana producers went from \$158 million to \$347 million.

What has been done

Several researchers are investigating optimal use of fertilizer, tillage and crop rotation effect on N, and the impact it has on weed control and the final crop. MSU agronomists made hundreds of off-campus presentations focusing on new crop varieties, nutrient management concepts and pest management methodologies. Information was shared via formal presentations to growers, seed companies, and industry representatives as well as through field days, local fair booths, farmers markets, classroom instruction, and a variety of media outlets including new websites and online tools.

Results

Montana Agricultural Research Centers are sharing research advancements through traditional field days, while also using the latest computer technologies. Researchers at the Southern Agricultural Research Center developed a new online tool for producers to use when selecting herbicides. The agronomy decision tool helps producers select fertilizer, herbicides, and develop an irrigation schedule. The interactive table allows farmers to enter current crop data and the next planned crop along with a time schedule. By selecting specific weeds present in the fields, the program compiles data and offers users appropriate herbicide options. The intent is not to rank or recommend any particular herbicide, but filter out chemicals that don't fit the crop, rotation interval, or the weed spectrum.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #6

1. Outcome Measures

Increase in acres of non-traditional crops planted in Montana.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Surveys at Montana farm conferences indicate a strong interest in diversified crop rotations for increasing on-farm receipts while reducing a monoculture of small grains. Winter and spring peas, canola, corn, lentils, mustard, sunflowers, triticale, and chickpeas are included in long-term rotation studies. MSU research has been instrumental in identifying potential oilseed crops suitable for production in Montana for use as culinary oils, biolubricants, omega-3 oils, feeds, and production of biodiesel and bioenergy products.

What has been done

Researchers at the Central Agricultural Research Center continued improving crop lines for both food and forage uses. The superintendent summarized progress in four areas: peas and lentils, hooded barley, spineless safflower, and winter triticale. Researchers successfully planted Austrian winter, green, and yellow peas during fall planting with several consecutive successful harvests. Researchers encourage growers in Central Montana to try these fall plantings.

Results

Investigators selected improved hooded hull-less barley lines for forage and grain production with higher levels of beta-glucan, a soluble fiber. Developing shorter season safflower offers another rotational crop producers can market as bird seed, cattle forage and upland game bird habitat. In spite of safflowers coarse appearance, cattle find it palatable and it is highly digestible minimizing calf scours. Progress was also made with the winter triticale study. Triticale, a cross between rye and wheat, offers producers an alternative forage crop that also has good potential for food as it is often found in seven grain breads and grows well in Central Montana.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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{No Data} null

Outcome #7

1. Outcome Measures

Number of routine field crop and forage samples processed by the MSU Seed Laboratory per year

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	3718

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The MSU Seed Laboratory processed 3,178 samples in 2012.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes
- Public Policy changes

Brief Explanation

Successful pulse crop options encouraged producers to continue increasing their crop diversity.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

MAES and COA investigators are participating in a myriad of studies aimed at finding optimal fertilizer and nutrient levels for soils and crops.

Researchers focused on pulse crops, mustard, safflower, sunflower, canola, turf grasses, and specialty grains. In 2011 and 2012, Montana was number one in the nation for pulse crop production with nearly 80 percent of the pulse crop acreage in Northeastern Montana where producers are planting on acreage that was previously left fallow for a growing season. An estimate from the Montana Department of Agriculture identifies the economic benefits attributable to the 2010 pulse crop at \$102 million including the money received from the pulse crop instead of fallow acres, and an estimate of the economic benefit the pulse crop had on the following wheat crop in terms of increasing yield and improving wheat protein levels.

Eighteen safflower varieties were released in the previous five years. Up to 100 high oleic oil safflower advanced lines and 100 high linoleic oil safflower advanced lines were grown annually in replicated dryland and irrigated tests. Approximately 1,000 safflower genetic lines were grown in summer nurseries at Sidney, Montana for evaluation of fatty acid composition, meal fiber content, meal protein content, disease resistance, biodiesel, bio-lubricant, cosmetic, high-end livestock nutritional supplement, and other value-added oil and plant characteristics.

Oilseed crops continue to represent new sources of income for farmers and provide opportunities for increasing crop diversity. Oilseed production was up again this year and researchers advanced projects looking toward using plant oils for industrial applications. Researchers identified genes responsible for directing polyunsaturated fatty acids into triacylglycerols in oilseeds.

Research information on water utilization and management in the Northern Rockies is limited, but investigators are evaluating riparian protection as a tool to protect and promote water quality.

Targeted grazing (TG) continues to increase the competitiveness of Montana lamb and wool in world markets. Montana ranks number eight in the nation for both wool and lamb production and produced nearly two million pounds of wool in 2012.

The Mother Nature Network selected the new MSU Bachelor of Science degree in sustainable food and bioenergy systems as one of the top ten best college environmental programs in the United States. Enrollment is currently at 174 and the program saw its first twelve graduates in 2012.

Key Items of Evaluation

Rapid changes in technology and globalization in the agricultural industry mean producers must have a greater understanding of technology, new farming practices, and a strong grasp of economics and budget practices. Researchers at MSU continue to support the needs of area producers through high quality research and constant interaction between investigators and growers.

Investigators are advancing knowledge in crop and livestock production through studies designed to measure inputs and outputs. Feed, fertilizers, crop selections and rotations, and integrated pest management; all enhancing sustainable agriculture which remains the number one industry in Montana.

Montana producers showed support of COA/MAES agronomists by selecting crop varieties developed through the MSU breeding program.

- Seeded acres (000) of "Yellowstone" winter wheat increased from 381 acres in 2011 to 500 acres in 2012.
 - Seeded acres of "Vida," a spring wheat, increased from 554 to 559 acres
 - "Choteau," another MSU spring wheat, increased from 443 to 448
 - "Hockett" barley increased from 235 acres to 240.
- Pulse crops hit a new high with nearly 500,000 acres making Montana the top pulse crop producer in the U.S.

Researchers shared their expertise with 925 elementary school kids in the Gallatin Valley alone and to nearly 400 students at two schools on Native American Reservations.

The B.S. degree in sustainable food and bioenergy was selected as one of the top ten best college environmental programs in the U.S. with 12 graduates this year and 174 current students.

MSU COA professors developed new teaching programs including a new online master's degree program in environmental sciences; a landscape design laboratory focusing on native plants and xeriscaping; expansion of hops and grape nurseries; flipped classrooms where students read the material and view an online lecture prior to attending class, so class time is devoted to student /faculty interaction; international and abroad studies focused on agricultural sustainability; and a new outreach program linking horticulture students to senior citizens interested in gardening and fresh produce.