

2017 Montana State University Combined Research and Extension OGFM Multi-State and Integrated Activity Supplemental Forms

Status: Submitted

Date Submitted: 04/02/2018

I. Brief Summaries

- Use the 2017 Plan of Work in place of submitting a separate brief summaries document.

{NO DATA ENTERED}

- Separate Brief Summaries document (brief description of the multi-state and integrated program activities).**

Research/Extension Integrated Activity:

- **Investigations on Emerging Arthropod-Vectored Diseases of Livestock and Wildlife:**

- The research in this proposal will describe the spatial and temporal distribution of mosquito species and other arthropods of med/vet importance in Montana. Through collaborative efforts, a MaxEnt model will be developed to estimate areas within the state that are of high risk. On- animal insecticide treatments will be evaluated for effectiveness in reducing arthropod attacks.

- **Cattle Grazing Strategies to Sustain and Enhance Sage-Grouse Habitat:**

- Western US beef cattle production relies heavily on sagebrush rangelands. The greater sage-grouse, a large ground-nesting bird, also requires sagebrush rangelands for its survival. The greater sage-grouse is a candidate for future protection by the Endangered Species Act, and formal listing as federally threatened or endangered could occur in September 2015. Listing this species will dramatically impact western ranching, and strategies are urgently needed to facilitate coexistence of cattle grazing and sage-grouse. Our Extension-led, Integrated Research-Extension-Education Project will evaluate and encourage adoption of cattle grazing strategies that sustain and enhance sage-grouse habitat and sage-grouse populations. Many sagebrush rangelands no longer provide optimal sage-grouse habitat because sagebrush canopy cover is too dense, limiting the understory forbs and arthropods that sage-grouse eat.

- **Elucidating the Molecular Mechanisms of Odor and Pheromone Signaling in Olfactory**

Neurons:

- The chemical ecology and behavioral responses associated with insect olfaction, particularly sex pheromone communication, have been thoroughly studied. More recently, significant progress has revealed the molecular mechanisms of odor detection at the periphery and the neurological basis for processing this information in the insect brain (reviews: Rützler and Zwiebel 2006; Fan et al. 2011; Leal 2012; Riffell 2012; Martin et al. 2011). Recent research has demonstrated that important insect pest behaviors, including feeding, host selection and mating, can be controlled by the activity of specific chemosensory neurons (Sakurai et al. 2011; Joseph and Heberlein 2012).

- **Management of diseases in Montana crops:**

- Providing diagnostics, education and practical management strategies to farmers is key for the mitigation of plant disease threats in our cropping systems. In this project we propose three separate objectives. First, we will determine the most effective fungicide seed treatments for seedborne plant pathogenic fungi in pulse crops, which will give growers unbiased data for their choices for disease management at planting. Second, we will develop a rapid method to identify resistance to fungicides in pathogens causing Ascochyta blight in pulse crops. This will give growers early warning about the loss of fungicides, and encourage them to use integrated pest management strategies for plant diseases. Thirdly, we will investigate the role that agronomic practices including planting date and variety have on pest and beneficial insect and disease species in wheat, with a particular emphasis on Wheat streak mosaic virus

management.

- **Marketing and Delivery of Quality Grains and BioProcess Coproducts:**

- Use of conventional synthetic insecticides to protect stored grains is a complicating factor that impacts negotiation of grain sales. In general, decreasing insecticide use without sacrificing quality is the best approach. We propose to reduce grower reliance on these chemicals by further demonstrating the value of using climate and weather to manage insect pests in farm-stored grain in Montana. A reduction in use of insecticides can be accomplished without any loss in quality. This is accomplished by using cool, dry air to aerate the stored grain mass, reducing pest survival and reproduction. This information will be incorporated into a stored products module for a senior level course in integrated management. In controlling insect pests of stored grain, inert dusts are often less used tools. We will test whether nanostructured alumina will be a more effective inert dust than those currently available.

- **Integrated Management of Rangeland Invasive Plants in Montana**

- The focus of this five-year MAES project will be on improving methods for revegetating invasive plant-infested rangeland and increasing our understanding of the ecology and integrated management of downy brome (*Bromus tectorum*) and tall buttercup (*Ranunculus acris*). Specific objectives for improving methods for revegetating invasive plant-infested rangeland are a) Quantify the impact of planting time on the establishment of native grasses and the invasive annual grass downy brome and b) Measure plant community response to invasive plant control and determine thresholds for natural recovery versus active revegetation.

- **Using Research to Facilitate Production of Antioxidant-rich Berries and Small Fruits in the Northern Rockies**

- There are growing Market opportunities for berry and small fruit production. According to a recent market analysis published in Fortune, fruits have risen to the second most popular food item in the U.S. and this rise is largely driven by increased sale of berries and berry products with annual sales topping \$3 billion dollars in 2013 (Zillman 2014). This growth is, in part, due to an increased interest in eating healthy and health benefits associated with consuming berry and other small fruits (ParedesLopez et al. 2010). While demand exists in Montana and the surrounding N. Rockies and N. Great Plains, the harsh climates and soil present challenges to fruit production. For small-scale producers to benefit from this growing market, there's a need to identify varieties adapted to climates, soils, and markets. Producer need to know that the type and variety of fruit will provide an economic return on that investment before they plant since the startup costs of berry orchards are high. Estimates for costs to establish a berry orchard range from \$2500 to 5500 per acre (Faye 2008, Byers et al. 2014). In the region, the primary climatic limitation is cold tolerance. Much of the state is classified in USDA plant hardiness zone 4 with smaller areas in either zones 3 or 5. Perennial plants that are not winter hardy will be injured or killed. Growing season temperatures can also be a limitation.

- **Adding Value to Beef Cattle:**

- The objective of this project is to evaluate the opportunities to increase the value of beef cattle within the state of Montana. Development of new crops within the state of Montana with the potential to produce co-products must not only be evaluated on an agronomic level but must be investigated to determine the value to Montana beef production as an alternative feed source. Objectives 1 and 2 encompass evaluating potential new feedstuffs and co-products of an industry being developed in Montana. Currently the emphasis is on camelina meal since it is the co-product that researchers and producers know the least about; however, as the project develops, other new crops or co-products can be evaluated. Camelina appears to grow adequately in Montana and appears to be effective as a low input crop (Lamb and Carlson, 2006).

Research Multistate activity:

COA/MAES Multistate Hatch projects reflect Montana and the Northern Great Plains most pressing agricultural challenges and needs, across each of our Planned Program areas. These Integrated and Multistate activities speak directly to current and emerging pests, climate changes affecting production agriculture, animal health systems, crop production, soil nutrient viability and exploratory research in animal and land resources.

1.) Animal Sciences:

MSU Research and Extension partnered with producers to address issues and needs of Montana's agricultural industry in a variety of animal health topics, largely the reproductive performance in animals, nutrition, genetic improvements for herds, and developing better animal management systems. The majority of the Animal Health program focused on pre-harvest research and investigation; namely neonatal health of livestock, disease resistance and best breeding practices. Food safety and security continued as important concerns for the beef industry at all production levels. COA/MAES and Extension helped to ensure that Montana producers raise safe beef while improving the quality of the beef and ensured consumers are aware of the quality and health of their products through advancements in educational programs on beef quality assurance (BQA) practices, voluntary beef cattle marketing options, and ranch management issues throughout the state via meetings, one-on-one discussions and interactive technologies. Food safety within Animal Health also involved mycotoxins in grains and feeds. Multistate projects included:

- **Integrated approach to enhance efficiency of feed utilization in beef production systems**
- **Enhancing the competitiveness and value of U.S. beef**
 - Major goals:
 - Measure and improve beef quality, safety and value by assessing impacts of animal health, animal care and processing management/production strategies.
 - Understand the biological sources of variation in efficiency of feed utilization.
 - Discover physiological biomarkers and genetic markers for feed efficiency
 - Develop producer educational programs to enhance technology adoption by the beef industry.
 - Develop informed molecular studies in building multi-trait selection indices and decision-support tools to facilitate selection for improved feed efficiency in beef cattle.

2.) Plant and Soil Sciences:

Plant Sciences 2017 research accomplishments in Plant Sciences spoke to the plant science, genomics and pathology that have a direct impact on increasing yield potential, improving winter hardiness, enhancing disease resistance, and improving dual-purpose end-use quality grains. MSU's intensive genomic research helped Montana producers stay competitive and provided improved cultivars adapted to Montana's climatic conditions and cropping systems. Continued productivity of breeding programs improved the understanding of the genetics from key traits and produced the development of new selection tools. The broader impacts of the work were a larger and higher quality food supply for the world, an improved ability of Montana farmers to compete in a global marketplace, and a strengthening of export markets for U.S. wheat. MSU faculty and researchers continued to garner national notoriety in their horticulture research in biology, chemistry, plant materials and physiology, plant pathology, plant reproduction and arboriculture. COA, MAES and Extension faculty conducted and led programs in cereal quality, genetics, cropping systems, molecular and conventional approaches to plant improvement, plant breeding, molecular genetics, biochemistry and agronomy. Much of the current research conducted in campus labs and in fields across the state was centered on disease resistance through genetics, bacterial diseases and the biochemistry and molecular genetics of plant diseases.

Multistate projects included:

- **Soil, water and environmental physics across scales**
- **Regulation of photosynthetic processes**
 - Major goals:
 - Emphasis will be placed on abiotic stresses (temperature, water and salinity) nitrogen use, and global atmospheric change relating to the manipulation of carbon partitioning and in terms of understanding of its regulation.
 - Deepen the understanding of the importance of both leaf and seed starch biosynthesis in terms of metabolic, transcriptomic, and developmental factors currently limiting plant productivity in order to improve plant production.
 - Improve the fundamental understanding of soil physical properties and processes, and how they interact with other environmental and biogeochemical processes across various spatial and temporal

scales.

- Extend knowledge of sale-appropriate methodologies to improve stakeholder-management of soil and water resources that benefit agricultural, natural resource and environmental sustainability.

3.) Farm, Ranch and Business Management:

COA/MAES and Extension faculty again supported Montanans in managing their farms, ranches and similar enterprises as businesses in 2017. Multistate projects in this planned program saw a significant increase of Hatch projects and faculty activity. Collectively, the faculty capacity ensured best practices, contracts and estate planning, marketing from an ag perspective, taxation, accounting, operational planning, budgeting, agricultural policy and commodity support programs, risk management and decision support software for Montana. MSU Extension faculty and specialists ensured Montana producers understood implications and changes within the 2016 Farm Bill and MSU agricultural economics faculty continued evaluating, engaging and researching federal agricultural policy that directly affects regional producers, in addition to monitoring and providing public analysis of commodity markets and trends. Multistate projects included:

- **Impact analyses and decision strategies for agricultural research**
- **Exploratory research in agricultural economics and economics**
- **Agricultural and rural finance markets in transition**
 - Major goals:
 - Develop efficient operating and management systems that maintain quality, capture value, and preserve food safety in the farm-to-user supply chain.
 - Measure trends, patterns and sources of agricultural productivity growth.
 - Estimate net benefits of public and private investments in agricultural research and characterize the nature of those benefits to consumers, producers, and the environment.
 - Analyze the adoption and diffusion of new agricultural technologies, assess agronomic, economic and institutional barriers to adoption, and evaluate policies to overcome such barriers.
 - Identify and measure responses to the positive and negative impacts of change and disruption on the family/household, the family business and the community.
 - Generate and disseminate objective, scientifically-based knowledge about agricultural economics, economics and ecosystem services.
 - Examine the impact of recent fluctuations in capital and commodity markets on the performance, management and regulation of agricultural financial institutions.
 - Evaluate the management strategies, capital needs and policy impacting the financial performance and long-term sustainability of firms in the food and agricultural sector.
 - Identify financial institutions and services that benefit agricultural producers and rural communities and expand agricultural markets, especially those producers that are beginning, young, from socially disadvantaged groups, and/or involved in producing specialty crops.

4.) Integrated Pest Management

In 2017, researchers again explored new and improved methods to identify and control insects, weeds, and diseases challenging Montana farmers and studied biological controls as low impact pest control options to promote sustainable practices. Producers and researchers continued to evaluate these new integrated pest management (IPM) methodologies so that Montana growers can maintain a competitive position in U.S. and world markets. In Montana and throughout the U.S., maintaining profitable agricultural enterprises while sustaining ecological systems has become a difficult balancing act that often results in changes in agricultural practices and environmental policies. COA/MAES and Extension professionals continued quality in-depth training programs for continued integrated pest management education to discover, evaluate or change new IPM priorities and projects. Additional outcomes included new products registered, an increased passing rate percentage for pesticide application licenses and a number of new broad-ranging stewardship practices were implemented. The importance of integrated pest management remained a consistently critical field as invasive plant and pest species continue to threaten Montana's agricultural economy as well as the global safety of the state's food exports.

Multistate projects included:

- **Locoweed and its fungal endophyte: impact, ecology and management Biological control in pest management systems of plants**
- **Sustainable solutions to problems affecting bee health**
- **Biological control in pest management systems of plants**
- **Marketing and delivery of quality grains and bioprocess coproducts**
 - Major goals:
 - Determine the ecology and physiology of locoweed plants in the western U.S.
 - Development management tools for locoweeds.
 - Survey indigenous natural enemies
 - Conduct foreign exploration and ecological studies in native range of pest
 - Determine systematics and biogeography of pests and natural enemies
 - Evaluate natural enemy efficacy and study ecological/physiological basis for interactions.
 - Evaluate the role and causative mechanisms of parasitic mites, viruses, and microbes in pollinator abundance and honey bee colony success
 - Asses the effects of exposure to pesticides and other xenobiotics on the survival, health and productivity of honey bee colonies and pollinator abundance and diversity.
 - Determine the effects of interactions among various factors affecting pollinator and honey bee colony health.
 - Characterize quality and safety attributes of cereals, oilseeds, and their processed products, and to develop related management systems.
 - Develop efficient operating and management systems that maintain quality, capture value, and preserve food safety in the farm-to-user supply chain.
 - Create a multi-institutional framework for the creation of measureable impacts generated by improvements in the supply chain that maintain quality, increase value, and protect food safety/security.

5.) Energy and Natural Resources

COA/MAES and Extension faculty continued to recruit competitive grant dollars and personnel to bolster current and forecasted research faculty lines, undergraduate and graduate students, programs and labs, as they relate indirectly and directly to the field of energy and natural resources. This program saw an increase of nine new Hatch projects, many of them interdisciplinary in nature - as they speak to research areas that rapid environmental change and natural resource and energy development has affected. The agricultural community in Montana wants to add value to Montana's high quality crop and livestock systems in ongoing adaptations in regard to the state's energy and natural resource base. Faculty in 2017 prioritized research exploring water, and researchers also explored climate in the wake of threatened natural resources. COA/MAES and Extension professionals continued to make advancements in this critical research agenda and continued excelling in the discovery and communication of how natural and managed environments and their elements function in an era of global climate change. With more than 60,000 miles of perennial streams providing irrigation, drinking water and recreation, Extension and MAES partnered with communities and citizens to involve local people with data collection to better understand surface and groundwater issues. In addition, forests cover large areas and contribute to the economic base of the state while also serving as a critical natural resource for wildlife, recreation, tourism and cultural purposes. Extension and MAES provide unbiased, science-based research, education and outreach related to preserving and supporting the best use and management of these resources. Multistate projects included:

- **Biobased fibrous materials and cleaner technologies for a sustainable and environmentally responsible textile industry**
- **Agrochemical impacts on human and environmental health: mechanisms and mitigation**
 - Major goals:
 - Develop biobased polymeric materials.
 - Develop and evaluate biobased fibrous products for eco-friendly crop protection
 - Develop and evaluate biobased products for health and safety applications

- Develop and evaluate methods to remove dyes and finishing chemicals from textile waste water.
- Characterize abiotic and biotic reaction mechanisms, transform rates and fate in agricultural and natural ecosystems.

6) Youth and Family Development: Multi-state efforts were primarily related to exchanges with other states, some multi-state work in family economics and occasional small projects with campus or other investigators.

7)

Healthy Living, Nutrition and Food Safety: One program in which MSU Extension had particular impact, was the multi-state, integrated Strong Hearths, Healthy Communities (SHHC) that ran through 2016: a rural community-based cardiovascular disease prevention program. Cardiovascular disease is the leading cause of death in the United States and places substantial burden on the healthcare system. Rural populations have considerably higher rates of the disease. SHHC aimed to reduce disease morbidity and mortality, improve quality of life and reduce the cardiovascular disease-related health burden in underserved rural communities. Twelve county faculty participated in this research by recruiting participants, hosting focus groups, providing regular update of metrics, education with clients, recommending changes for next steps, compiling data and more. Many of these continued services in 2017 beyond the study.

The Diabetes Empowerment Education Program (DEEP) is an evidence-based diabetes self-management program developed by the University of Illinois, Chicago, that has been shown to be successful in helping participants take control of their disease and reduce the risk of life threatening complications. MSU Extension partnered with Mountain Pacific Quality Health, Stillwater Billings Clinic, The Montana Geriatric Center of the University of Montana and the Montana Department of Health and Human Services to expand the implementation to Montana counties and reservations. To date, 54 Extension agents and health care providers in 36 counties have been trained as facilitators and research continues to measure the impacts and improve the program.

Two additional related to mental health are underway. **Youth Aware of Mental Health (YAM)** is a universal intervention (delivered to all youth of a group/class) mental health promotion program that aims to raise mental health awareness about risk and protective factors associated with suicide, including knowledge about depression and anxiety, and to enhance the skills and emotional resiliency needed to deal with stress and crisis. The format of the YAM intervention **empowers youth** to think, verbalize, and discuss important mental health issues, such as suicide, in a context that is meaningful to them. MSU Extension, in collaboration with the CMHRR and Bill Bryan of One Montana, received a USDA grant to evaluate delivery of YAM by Extension faculty in frontier and rural setting schools in Montana. A Montana Mental Health Trust Foundation grant is extending this work. The other program is an online depression intervention study led by **Dr. Mark Schure**, Assistant Professor of Community Health (MSU). Co-investigators include **Dr. Sandra Bailey**, Professor of Family and Human Development, MSU Extension; **Dr. Matt Byerly**, Director of MSU's Center for Mental Health Research and Recovery and Professor, Cell Biology and Neuroscience, MSU; and, **Dr. John Greist**, Professor of Psychiatry-Emeritus at the University of Wisconsin-Madison and Affiliate Professor, Cell Biology and Neuroscience, MSU.

8.) Community Development

Multistate projects included:

- **Sustainable families, firms and communities in times of change**
- **Agricultural literacy research**
- Major goals:
 - Determine and inform policy or practice related to family firms.
 - Identify and measure the sources of change and disruption in the family/household, the family firm, or the community.
 - Assess agricultural knowledge of Montana youth
 - Evaluate existing agricultural literacy programs and identify the program initiatives that relate to increases in agricultural literacy

**U.S. Department of Agriculture
National Institute of Food and Agriculture
Supplement to the Annual Report of Accomplishments and Results
Actual Expenditures of Federal Funding for Multistate Extension and Integrated Activities
(OMB 0524-0036)
Fiscal Year: 2017**

Institution: Montana State University

State: Montana

NIFA-REPT Final	Integrated Activities (Hatch)	Multistate Extension Activities (Smith-Lever)	Integrated Activities (Smith-Lever)
Established target %	5.80	1.16	2.00
This FY Allocation (from 1088) \$	2,752,471.00	2,739,719.00	2,739,719.00
This FY Target Amount \$	159,643.00	31,780.00	54,794.38

Title of Planned Program Activity	Integrated Activities (Hatch)	Multistate Extension Activities (Smith-Lever)	Integrated Activities (Smith-Lever)
Animal Sciences \$	22,520.00	2,415.45	6,342.39
Plant and Soil Sciences \$	98,909.00	1,651.54	12,800.74
Farm, Ranch and Business Management \$	0.00	11,896.27	19,032.52
Integrated Pest Management \$	25,034.00	6,560.67	12,647.80
Energy and Natural Resources \$	0.00	694.63	2,088.93
Youth and Family Development \$	0.00	34,693.57	50,401.53
Healthy Living, Nutrition and Food Safety \$	13,180.00	5,279.94	21,528.08
Community Development \$	0.00	1,563.43	6,201.97
Total \$	159,643.00	64,755.50	131,043.96
Carryover \$	0.00	0.00	0.00

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

Director(s):
Charles Boyer
Cody Stone

Date Submitted: 04/02/2018

**U.S. Department of Agriculture
National Institute of Food and Agriculture
Supplement to the 5-Year Plan of Work
Multistate Extension Activities and Integrated Activities
(OMB 0524-0036)**

Institution: Montana State University

State: Montana

1. Integrated Activities (Hatch Act Funds)

Estimated Costs

Title of Planned Program Activity	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Animal Sciences \$	22,520.00	22,520.00	22,520.00	22,520.00	22,520.00
Community Development \$	0.00	0.00	0.00	0.00	0.00
Energy and Natural Resources \$	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00
Farm, Ranch and Business Management \$	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00
Healthy Living, Nutrition and Food Safety \$	15,000.00	15,000.00	15,000.00	15,000.00	15,000.00
Integrated Pest Management \$	20,000.00	20,000.00	20,000.00	20,000.00	20,000.00
Plant Sciences \$	85,000.00	85,000.00	85,000.00	85,000.00	85,000.00
Youth and Family Development \$	0.00	0.00	0.00	0.00	0.00
Total \$	162,520.00	162,520.00	162,520.00	162,520.00	162,520.00

2. Multistate Extension Activities (Smith-Lever Act Funds)

Estimated Costs

Title of Planned Program Activity	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Animal Sciences \$	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00
Community Development \$	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00
Energy and Natural Resources \$	700.00	700.00	700.00	700.00	700.00
Farm, Ranch and Business Management \$	12,000.00	12,000.00	12,000.00	12,000.00	12,000.00
Healthy Living, Nutrition and Food Safety \$	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00
Integrated Pest Management \$	6,500.00	6,500.00	6,500.00	6,500.00	6,500.00
Plant and Soil Sciences \$	1,500.00	1,500.00	1,500.00	1,500.00	1,500.00

Estimated Costs

Title of Planned Program Activity	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Youth and Family Development \$	35,000.00	35,000.00	35,000.00	35,000.00	35,000.00
Total \$	65,200.00	65,200.00	65,200.00	65,200.00	65,200.00

3. Integrated Activities (Smith-Lever Act Funds)

Estimated Costs

Title of Planned Program Activity	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Animal Sciences \$	6,300.00	6,300.00	6,300.00	6,300.00	6,300.00
Community Development \$	6,300.00	6,300.00	6,300.00	6,300.00	6,300.00
Energy and Natural Resources \$	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00
Farm, Ranch and Business Management \$	19,000.00	19,000.00	19,000.00	19,000.00	19,000.00
Healthy Living, Nutrition and Food Safety \$	22,000.00	22,000.00	22,000.00	22,000.00	22,000.00
Integrated Pest Management \$	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00
Plant and Soil Sciences \$	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00
Youth and Family Development \$	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00
Total \$	131,600.00	131,600.00	131,600.00	131,600.00	131,600.00

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