Idaho (University of Idaho) Annual Report - FY2022

Report Status: Approved as of 06/29/2023

Contributing Organizations

University of Idaho

Executive Summary

Overview

Critical Issue: 4-H Community Youth Development

4-H

Progress by program/project and *topics of focus identified by Critical Issue group (PET)*

Reaching Underserved Audiences

- Juntos Family Engagement Workshop: making education a family goal
- School Science Fair: Job skills, education requirements and position options for various career fields including science
- Outreach to Military Youth Program: Resources for military children/families through service/deployment
- 4-H Circuitry Outreach Program: STEM programming with community partners
- Spark Your Imagination with Edison – Outreach: Individual equipment for youth during the pandemic
- Tribal Youth in Ag. Programming: Food production skills for better eating choices and understanding agricultural value
- 4-H Friday Friends: All-day Friday programming for elementary youth as educational childcare

Healthy Living

- Teen Health Advocates: Teaching younger children about nutrition, sharing health strategies with families and influencing community actions
- 4-H Create Art Now Pilot: Self-expression; express thoughts and emotions through creating artworks and learning critical thinking skills
- 4-H Healthy Habits in partnership with Eat Smart Idaho: Youth-obesity-rate nutrition-education
- Cooking Under Pressure for Youth: Cook meals, follow a recipe, use new kitchen appliances
- Satisfy Your Sweet Tooth: Science and chemistry terms while cooking
- Mobile COVID-19 Safe Tribal 4-H/Youth: Educational, healthy afterschool activities

4-H Science (including Animal Science)

- Animal Science: Requirements completed for livestock projects
- Teaching Livestock Evaluation: Livestock evaluation given by teachers
- Idaho 4-H Rangeland Skill-a-thon Online Workshops: Knowledge and understanding of Idaho rangelands
- State 4-H Livestock Skill-a-thon: Hands-on animal science learning experiences
- Idaho's Think Make Create Labs: A Low-Tech Mobile Makerspace Program: access to STEM, program support and professional development for volunteers/educators
- Bonneville County Livestock Judging Clinic: Livestock evaluation and selection.
- Caribou County Beef Cattle Judging: Experiential learning with knowledgeable instructors
- AmeriCorps Donnelly Afterschool Program: Safe place to provide childcare in afternoons
- 4-H Shooting Sports Online LMS modules: Multi-state, training requirements for shooting sports
- Planet Mars/Galaxy Quest: space exploration and colonization STEM activities
- Drone Camp: Comprehensive 5-day drone program

State conditions giving rise to our critical issues:

According to the U.S. Census Bureau, Idaho's population growth is the second highest rate in the nation with an increase of 1.8% from 2021 to 2022. This compares to the nation's rate of .4% during the same period. Urban areas are growing, but Idaho's rural communities still have small, isolated populations with limited resources.

As of 2021, Idaho has a 11% poverty rate, and 18 of 44 counties' populations have 10% or more people with limited access to healthy foods. There is a 10.5% rate of child food insecurity, and the obesity rate for Idaho youth ages 10 to 17 years is over 1 in 10.

Industries playing major economic roles include lumber, food-production manufacuturing, high-tech manufacturing, mining, and agriculture (wheat, cattle). Food-production employment is expected to grow 15.9% in next 10 years. Roughly 44 percent of the forests in the Idaho Panhandle (Boundary, Bonner, Kootenai, Benewah and Shoshone counties) are held and managed by 23,796 family-forest owners (owning five acres or more).

The average market value per farm of all agricultural products sold is increasing, with a 14% increase from 2007 to 2017. In 2021, Idaho had 11,500,000 acres in farmland, a third of which were irrigated. However, water availability is decreasing, and uncertainty about water resources is increasing.

References:

Idaho Department of Labor. (2022, December 23). *Industry wages: Quarterly census of employment & wages.* Retrieved February 8, 2023 from https://lmi.idaho.gov/qcew

Idaho Food Bank. (2022). *Hunger in Idaho.* https://idahofoodbank.org/hunger-in-idaho/

United States Census Bureau. (2022). QuickFacts Idaho. Retrieved February 8, 2023, from https://www.census.gov/quickfacts/ID

United States Department of Agriculture. (2022, October). *2022 Idaho annual statistical bulletin.* https://www.nass.usda.gov/Statistics_by_State/Idaho/Publications/Annual_Statistical_Bulletin/2022/ID_ANN_2022.pdf

Highlighted programs addressing critical issues:

- 1,935 participants from 30 states completed the Idaho 4-H Shooting Sports online training modules. Participation reduced the cost of additional meals and lodging for at least 75% of prospective instructors (n=1364) who have attended Level-1 training sessions (versus their counterparts prior to the initiation of these models). The estimated cost savings per person is $90, which is a projected overall cost savings of $122,760.

- 4-H Healthy Habits in partnership with Eat Smart Idaho offered 6 eight-hour nutrition-education sessions to 2431 limited-resource youth from grades 1-12. 94% of survey respondents (n=1417) indicated intent to increase recommended fruits and vegetables each day, as well 85% indicating intent to drink less sugary drinks. 96% of respondents intend to drink the recommended amount of water and 96% indicated intent to stay physically active every day.

- 150 participants observed demonstration plots in the Gooding community Garden, learning cover crops, composting, and water runoff. The garden produced more than 4,000 lbs of produce, donated to seven local institutions. Estimates of cost savings for this donated produce was $16,000.

- 45 youth participated in the Natural Resources Camp focus on water-themed education, learning five critical areas of natural resources management. 100% indicated a change in knowledge because of the lectures, labs, field experiences and investigative activities.

- Survey participants (n=235) in the Family Foresters Workshop indicated a 26% increase in knowledge of sustainable forest management as a natural climate solution to help or achieve global net zero emissions. 43% of participants reported an increase of knowledge of assisted migration. 69% of respondents increased knowledge of forestry podcasting as well as 68% increased knowledge in prescribed fire.

- By participating in Livestock Grazing Management, 35 participants showed an increase in knowledge of pasture-management principles and pasture management BMPs. Participants indicated an average increase in grazing days of 20%. With current hay costs ~$3.27 per cow/per day, so a 450-cow ranch would save $1500 per day in feed costs. A period of two weeks would save around $20,600 in feed costs.

- 260 participants in the Diabetes Prevention program lost an average of 6.5% of their body weight. Participants estimated a health-care savings per year of $278 which totals to $216,840 in overall estimated health-care savings for the three-year program.

- 849 youth participated in the Mobile COVID-19 Safe Tribal 4-H/Youth program's healthy, educational afterschool acitivties. In a post-test, 849 youth indicated they learned healthy ways to spend their afterschool time as well as healthy eating habits and leadership skills. This program lessened the community burden for afterschool help.

- 10 veterans in the Heroes Beginning Farming and Gardening program took the 10-month classroom and field training of community food production and small-farm entrepreneurship. They grew 1762 lbs of produce, saving an approximate amount of $3,400.

Performance Metrics for Research:

- Obtained $39.8 million in extramural funding.
- Faculty produced over 200 refereed journal articles and peer reviewed manuscripts.
- Awarded 5 PVPs: 1. UI Cookie-wheat, 2. Industrious-oilseed, 3. Impress-oilseed, 4. La Belle Russet-potato, and 5. Galena Russet-potato

Civil Engagement and Youth Leadership

- 4-H Adventure Camp: Outdoor education to mitigate negative physical and mental health problems in youth, and increase focus, build self-confidence, and retain knowledge
- Benewah 4-H Fun Fridays: Learning loss, social, emotional wellness and positive peer-to-peer interactions outside of the classroom
- 4-H STEAM Programs: Childcare, reaching underserved audiences, and expanding 4-H youth development STEAM programming by partnering with community organizations
- Leadership NOW! Advanced Leadership Program: Intentional leadership development and education
- 6th Grade Resource Tour: Managing natural resources for preservation

Adult Leadership and Volunteer Development

- Mental Health First Aid: Training to recognize and assist a person experiencing a mental health crisis
- Structure of Idaho 4-H and Delivery Methods: Engaging workshops for teens
- 4-H Child Protection: Training camp counselors in a manner to keep all youth safe
- 4-H Emotional Wellness: Open panel discussions to help partners learn how to share resources

Critical Issue: Community Development

Community Development

Progress by program/project and *topics of focus identified by Critical Issue group (PET)*

Develop and strengthen human, social, and cultural wealth

- Diversity Learning Circle: Diversity inclusion training; civil dialogue practice
- Ripple mapping for Valley County Opioid Recovery project collation: Data captured aids progress for grant goals
- Alternative Activities for Teens: Alternative activities to positively interact with peers instead of choosing to use drugs and alcohol
- Teton Food and Farm Coalition: Strengthening the Teton area food system

Develop and strengthen individuals and community financial resources

- Peer Learning Network: Increased relationships with community leaders
- Inland Northwest Artisan Grains Podcast: Producing higher-value crops; market options with a greater financial return on their investments than commodity markets
- Palouse-Clearwater Food Summit: Feeding Our Community in Challenging Times: understanding impacts of COVID-19 on the regional food system, increased emergency food services, opportunities to expand farm direct and intermediated marketing, and resources for mitigating economic impacts

Develop and strengthen spaces and places

- WCM Trails coalition: Upkeep of trails, map and web presence
- Teton Food and Farm Coalition: Networking for organizations/individuals interested in strengthening the Teton area food system
- Cascade Arts Walk Fish Gala and Auction: Downtown improvements to create a more walkable space

Critical Issue: Food Production Systems

Food Production Systems

Progress by program/project and *topics of focus identified by Critical Issue group (PET)*

Cereals

- Cereal schools: Profitable, environmentally sound farm practices which incorporated advanced technology tools in daily operations; increased efficiency, less harm to environment, reduced food contamination, reduction of the need for water and chemicals for crops, and increased profits

Pest management

- PNW Pest alert: Real-time information on pest outbreaks with control measure information
- Potato Conference: English and Spanish sessions; volunteer potato control in rotation crops including yield losses, perpetuation of diseases and viruses, interference in harvest
- Pesticide Safety Education--Recertification Program: State licensing-requirement fulfillment
- Pesticide Applicator Recordkeeping Project: Record pesticide applications for short-term/long-term planning; following federal WPS
- Statewide Pesticide Safety Education Program Recertification Webinars: Credits to maintain licenses

Livestock efficiency

- Idaho Young Cattle Producer Conference: Young cattle producers management, marketing, financing, and overview of cattle industry in Idaho
- Livestock Grazing Management: Proper grazing-management benefits to produce animal and pasture productivity
- Bull Evaluation and Selection (Bull Grading): Stringent, consistent bull evaluation and selection program to maintain and improve overall cattle quality in individually owned herds running in common during the breeding season; genetic tools improve marketability of cattle
- Ladies raising livestock: Livestock education for women at a time and place that accommodated their needs and circumstances

Forage crop systems

- Development of economic threshold for thrips: Thrips population dynamics as well as feeding effects on alfalfa crops; determining correct timing of thrips control measures; reduce input costs and achieve higher return on investments.
- Online Forage School: Current updates on alfalfa research throughout state

Rangeland management

- Idaho Range Livestock Symposium: Current issues and trends

Crops/livestock quality assurance

- BQA Smoking & Grilling Foods: Understanding meat science and the factors that affect eating quality of meat and meat products
- Quality Potato Research and Education: Tools to lessen Idaho potatoes rejection; mitigating risk; delivered in multiple presentations, newsletters, website postings, a bulletin, publications, videos in both Spanish and English on harvester and handling operations, and equipment stickers in English and Spanish

Other Unplanned

- Tractor safety: Bilingual trainings for dairy in farm and tractor safety to reduce the incidence of accidents and fatalities in agriculture

Food Safety

- Idaho Food Safety Cooperative Food Business Entrepreneurs: Training business compliance with FDA's Food Modernization Act
- Parma Cocoon Testing Laboratory: Quality assessments of pollinator heath to manage the longevity of high-quality alfalfa crop yields; producers can assess the need to purchase more bees to adequately pollinate their seed crop from the information gained from these analyses
- Customized Fresh Pak Potato HACCP Course online: Customized content to specific industries, made required food-safety plans

Alternative/specialty crops

- Idaho Hop Growers Commission 2021 Variety Plot: New hop lines for additional resource to PNW hop growers to meet the needs and everchanging demands of brewers

Estate planning

- Succession/Estate Planning 6-week Zoom: Estate planning to transition to the next generation of farmers

Germplasm

- Artificial Insemination Training: AI utilization improves herd genetics and economically important traits

- Scabinar: Control management guidelines for producers for Fusarium head blight

Economic evaluation of livestock & agricultural systems

- Reproductive Efficiency in Beef Cattle: Adopt reproductive technologies and management strategies that improve sustainability; bull management, nutrition in reproduction, hands-on artificial insemination and pregnancy detection training
- Ripple Effects Mapping for the Fort Hall Federally Recognized Tribal Extension Program: Success and stories of FRTEP project directors/educators shared at the national level

Variety trials

- Cereal and legume variety testing program: Robust data on variety performance so that material with the best agronomic performance and yield, superior disease resistance and ideal quality can be grown.
- Mudlake, Preston, and Blackfoot Forage School: Up-to-date research results from studies conducted in those areas

Educational programs in schools

- Ag Week- beef production field day for 5th graders: Educate youth about beef-production practices.

Pulses

- Cropping Systems Agronomye Aberdeen: Diverse crop options and diversified cropping systems under full and deficit irrigation

Nutrient management

- Cereal Forage Production in Southeastern Idaho: Identify the optimal timing of cutting for different species of cereal grains; identify the effect of N rate on biomass production and quality

Cover crops

- Western Cover Crop Council Intermountain Regional Conference: Resources, research, and technology to adopt regenerative agricultural practices

Critical Issue: Forest, Range, and other Natural Resources

Forest, Range, and other Natural Resources

Progress by program/project and *topics of focus identified by Critical Issue group (PET)*

Biodiversity and Wildlife Conservation

- Logger Education In Idaho Panhandle: Logger training to help Idaho forest-product companies maintain or increase Idaho's share of global markets for certified wood products
- Family Forest Owners in Idaho Panhandle: Forest ecology, silviculture, and related forest management techniques; sustainable production of more wood and biomass and simultaneously improve forest health, water quality, wild-life habitat and other forest values

Increasing public awareness of forest, range and other natural resource issues

- RREA at work for Idaho Forest Owners: Forest disturbance ecology, wildland fire and wildland/urban interface issues, ecosystem dynamics and processes; skills in forest management activities as well as forest management planning and business-related activities
- Designing, Interpreting, and Applying Rangeland Monitoring to Management: locating monitoring sites, rangeland monitoring, and some keys for data interpretation

Increasing public awareness of forest, range and other natural resource issues

- Foresters and Other Natural Resource Professionals in Idaho Panhandle: Sharpen skills and stay current on scientific and technological developments
- Noxious weeds video identification series: Simple, short YouTube videos that briefly identify and describe most of Idaho's noxious weeds

Wildfire Risk Reduction and Recovery

- Idaho Master Forest Stewards: Master volunteer program for forestry

Forest Management

- RREA at work for Idaho Forest Owners: Forest disturbance ecology, wildland fire and wildland/urban interface issues, ecosystem dynamics and processes; skills in forest-management and planning and business-related activities
- Clearwater Basin Elk: History, Research and Management: Elk-habitat management in the basin; build support for land-management actions to improve elk habitat

Pesticide Applicators Recertification

- Range Management: Targeted seminars for private and professional applicators in the county to maintain their licenses

Global Change and Ecosystem Resiliency

- Climate Change and Snake River and Pacific Coast Salmon: Info on climate change affects and projections on natural resources

Critical Issue: Health and Wellness

Health and Wellness

Progress by program/project and *topics of focus identified by Critical Issue group (PET)*

Social/Emotional Wellness

- "Five for Five" Physical Activity Program: Physical at the county, state and national levels
- Fitness, Healthy Lifestyles, Nutrition Consultations: Physical activity, nutritional programming and education
- Mental Health First Aid: Removing barriers to treatment for those who live with mental health disorders; training to provide early intervention and direction to appropriate care
- PICH - Extreme Adventure Club: Healthy-lifestyle activities at no-cost to them

Physical Wellness

- Canyon County Diabetes Prevention Program: Prevention or delay the onset of diabetes by 58%
- Community Walking Program (Walk & Talk" in-person) and ("Walk the Prairie" virtual): Physical activity programming and education

- Dining with Diabetes Email Challenge: Online instruction in diabetes management
- Performance Nutrition—Fueling for Success: Balanced nutrition, nutrient-dense food selections; optimal protein; adequate hydration; physical activity, regularly scheduled cardiovascular and strength training; inclusion of flexibility exercises; sleep: consistent sleep adequacy of seven hours or more/ 24 hours
- Whole Food Plant-Based Salads: Plant-based meals benefits and recipe demonstration

Consumer Food Safety

- Consumer Food Safety: Food-safety information; public health improvement; reduction of financial loss from food spoilage
- Food Safety, Nutrition, and home preserving in the Garden: Connecting youth to their food utilizing the school garden, will reach outlying schools and youth in the summer
- Healthy Meals for Busy Families: Quicker, healthier meals at home; cooking skills; nutrition and food safety for slow cooker meals, freezer meals and 20–30-minute meals
- Smoking and Grilling Foods Program: Consumer food safety and meat science in a hands-on workshop; meat quality and proper handling of foods from preparation to storage
- Preserve@Home: Home food-preservation training online

Environmental Wellness

- Eat Smart Idaho: Limited-resource individuals, families, and youth improve diet and physical activity behaviors for personal development; family/individual healthcare

- Idaho's Well Connected Communities Initiative: Cultivate wellness; access to recreation for exercise, safe communities, family and social support systems; access to clinical care

Master Food Safety Advisor

- Master Food Safety Advisor: Food safety and food-preservation practices

Financial Literacy

- Our Financial Conference: Plan including even the smallest community resource; small financial businesses
- Pirate Loot: Savings education; financial-management skills
- Social Security in Ag: Are you Leaving Money on the Table: Benefit implications of tax filings to qualify for social security
- Employment Feud: Training on applying and interviewing for youths' first jobs

General Resource Management

- Virtual Cooking Club: Kids in the Kitchen: Involving children in meal preparation
- That's Life High School Financial Education Simulation: Interactive, real-world simulation making financial decisions

Critical Issue: Horticulture and Small Farms

Horticulture and Small Farms

Progress by program/project and *topics of focus identified by Critical Issue group (PET)*

Small farms outreach and education

- Beginning Farmer Rancher Project: Skills in sustainable crop production
- Cultivating Success Sustainable Small Farm & Ranch Webinar Series: Production and marketing education to successfully manage small acreage ranches/farms
- Idaho Cultivating Success Finding Land to Farm Short Course: Tools for finding and assessing parcels of land; skills to determine financial readiness for land tenure arrangements
- Introduction to Small-Scale Grass-Fed Beef Production for the Rural Landowner: Grass-fed beef production; increase their lands' economic return
- Is a Small Farm in Your Future: Area resources for crop and livestock production, including production, pests, marketing, etc.
- Tuesday Community Market: Sell farmer/ranchers' products; hone direct marketing skills; network with farmers and ranchers with a range of experience
- Green Collar College Grower Training: Skills for adults to produce their own food

Urban horticulture outreach and education

- Harvest Heroes Veteran Beginning Farming and Gardening Program: Urban setting growing food; agricultural entrepreneurship to raise crops and livestock
- Idaho Victory Garden online open free of charge in response to pandemic
- Urban Pest Management Online: Green industry outreach and education; federal/state pesticide laws and rules; exam prep on pest management, pesticide use and safety

Master gardener volunteer development

- Advanced Master Gardeners: Customized curriculum; mushroom cultivation and import substitution for indoor environment
- Master Gardeners: Volunteers train new/beginning gardeners
- Pollinator Summit: Pollinator education enhance/create new pollinator habitats; reduce population decline

Small acreage outreach and education

- Cultivating Success Beginning Farmer Project: Soil, pest, irrigation and harvesting classes
- Farm to Early Care and Education: Address childhood obesity
- High Altitude Victory Garden Course: High-altitude, short-season classes
- Digging Deeper: Developing Your Idaho Market Garden Online: Market garden-education and hand-on activities related to inventory, recordkeeping, and other tasks

On-farm hands-on Cultivating Success modules: Hands-on, experiential, accessible learning on irrigation and soil health

Critical Issue: Water

Water

Progress by program/project and *topics of focus identified by Critical Issue group (PET)*

Improve environmental management in the livestock and dairy industries

- Dairy manure solids and nutrients separation: Liquid dairy manure solid/nutrient separation to improve manure management and reduce handling costs on dairies

Other Unplanned

- Gooding Community Garden: Production of vegetables in urban settings; adoption of conservation techniques to reduce water-use, water contamination, and nutrient losses in urban and agricultural settings; using demonstration units

Agricultural water quality

- Project WET Adaptations Video Series for Distance Learning: Service-learning experience provided experiential-learning opportunities; science learning for fifth through twelfth grade delivered via virtual NGSS-aligned science workshops
- Extension Water Outreach: Water-themed education programming camp

Balancing increasing demand for water related to food supply with no increase in water availability

- Cropping Systems Agronomye- Aberdeen: Crop water use and irrigation management tools.

Climate change mitigation and adaptation related to water resources

- Idaho Drought Severity Assessment- (all-year activity): Assess drought conditions regularly; recommendations to the US Drought Monitor for their weekly mapping

Best tools for understanding and modeling present and future conditions

- Snowpack monitoring by satellite remote sensing: Advancements in processing satellite data overcomes cloud interference; snow-cover data to be used for model input

Reduce negative environmental impact on soil, water, and air

- Soil Health Minute: Soil-health newsletter

Merit and Scientific Peer Review Processes

Updates

None

Stakeholder Input

Actions to seek stakeholder input that encouraged their participation with a brief explanation

None

Methods to identify individuals and groups and brief explanation

None

Methods for collecting stakeholder input and brief explanation

None

A statement of how the input will be considered and brief explanation of what you learned from your stakeholders

Highlights on what we learned from stakeholders:

- Learned information helpful to reach new, underserved audiences
- Interactive, web-based learning ranks high among adult participants
- Rising interest in senior-age support programs
- More education for general consumers on beef cuts and value is crucial.
- Dairy and beef cattle production basics remain important. Cattle must become pregnant in a timely manner for profitability to be achieved.
- Stakeholders would like to see more emphasis put in areas pertaining to water conservation and native plants.
- Growers are concerned about the water consumption of crops and lack of crop options in dryland areas.
- Wellness needs in the community are ever increasing. Physical, mental/emotional, and social needs have been greatly impacted by the COVID -19 pandemic, and we are focusing on helping communities move forward.
- Producers were wanting information on alternative forages.
- We will focus on intermediate market relationships between local producers and restaurants resulting in the expansion of online and other direct market opportunities
- There is opportunity to use podcasts to provide small farm education
- PLN input helped identify key issues across rural communities in Idaho, Montana and Wyoming. These issues include community engagement or volunteerism, placemaking, child-care availability, tttainable housing, broadband, workforce
- Responses to improved and revised Ready, Set, Food Safe curriculum; Development and collaboration of food-safety topic projects (reusable water bottle safety and cutting board safety)
- Youth are interested in learning more about food & culture, recruit more members, finances, goal setting, basic adult skills, and exploring different careers.

Highlighted Results by Project or Program

Critical Issue

4-H Community Youth Development

Positive Youth Development

Project Director

Holly Waters

Organization

University of Idaho

Accession Number

7000224

4-H Outside the Box

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Post-pandemic children are back in formal learning environments, but the COVID pandemic created learning gaps in many youth. Therefore, there are many Idaho youth statewide in need of additional learning support.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The 4-H Outside the Box (OTB) program offers three different subject matter learning labs. The program consists of learning labs (one per youth) containing supplies to complete 4 to 7 activities and lesson plans for caring volunteers to lead youth through the process. All activities utilize an experiential learning format providing an environment for youth experiment with learning, review what they learned and apply their learning in a new way.

Briefly describe how your target audience benefited from your project's activities.

An end-of-session survey (N=5118) indicated that a majority of youth learned key objectives stated for each of the activities. It also indicated that the majority of youth were able to participate in the activities with other youth and at least one adult volunteer, providing them with elements of positive youth development.

Briefly describe how the broader public benefited from your project's activities.

This program connects with our youth-development critical issue by reaching previously unserved or underserved youth audiences. These audiences have untapped potential for growth and contribution to the communities where they live.

Mobile COVID-19 Safe Tribal 4-H/Youth Program

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

To mitigate the threat to public safety due to severe cases of COVID-19 and the threat to public safety, the Fort Hall Tribal Business Council developed, implemented, and enforced strict tribal COVID-19 regulations. The regulations were designed to protect employees, tribal members, program participants and the community.

However, as part of these regulations, many educational programs including UI Extension and tribal 4-H/youth development programs could not be conducted. This impacted working parents and grandparents while youth programming was temporarily closed. There was a strong need for continued youth programming that met tribal standards.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

To provide 4-H youth educational programming and to provide guardians with childcare, we collaborated with the Fort Hall Early Childhood Afterschool Program, Fort Hall Elementary School, and the 477 Afterschool program to develop and provide mobile classes. We took 80 mobile classes to facilities that were COVID-19 safe.

Briefly describe how your target audience benefited from your project's activities.

The mobile tribal 4-H/youth program has a positive impact on tribal youth by providing youth with healthy, educational afterschool activities. Because of this, tribal youth are engaged in afterschool learning activities afterschool with adult volunteers.

In an end-of-session evaluation, 849 youth indicated they enjoyed 4-H afterschool programming and learned healthy ways to spend their time afterschool. They also learned healthy eating habits and leadership skills.

Briefly describe how the broader public benefited from your project's activities.

This program helped ease the community burden and resources as it provided needed afterschool help/care for the youth as well as their families/guardians.

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Critical Issue

Community Development

Enhancing Rural Economic Opportunities, Community Resilience, and Entrepreneurship

Project Director

Philip Watson

Organization

University of Idaho

Accession Number

1019043

★ FR - Enhancing Rural Economic Opportunities, Community Resilience, and Entrepreneurship

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project investigates the process of improving the economic, social, and environmental conditions of rural areas. It involves addressing the challenges faced by rural communities such as poverty, limited access to healthcare and education, inadequate infrastructure, and lack of economic opportunities.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

I have published 5 peer reviewed papers regarding rural economic development in 2022. These peer reviewed research papers help professionals and policy makers better understand the causes and nature of rural development.

Briefly describe how your target audience benefited from your project's activities.

Experts and policy makers have new and cutting edge insigts on the causes and nature of rural economic development.

Briefly describe how the broader public benefited from your project's activities.

Policy makers can use the information gernerated by my research to inform policy and make better decision to imporve social welfare.

Reproductive Performance in Domestic Ruminants

Project Director
John Hall
Organization
University of Idaho
Accession Number
7002131

AR- Impact of environment on cattle reproduction and performance

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Reproductive efficiency in beef cattle is important for sustainable production of protein for human consumption. Environmental factors, especially nutrition, at a variety of time points in prenatal and postnatal development can alter reproductive efficiency in cattle. This project examines the impact of a nutrient limited environment (range) compared to a nutrient sufficient environment (improved irrigated pasture) on reproduction and performance of beef cattle.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

There were three major activities associated with this project examining the effects of environment on 1) cow reproduction and calf performance, 2) post-weaning performance of steers and heifers, and 3) reproductive development in heifers.

Cow reproduction and calf performance

This was the 5th year of data collection on cow performance, cow fertility and calf growth. The data are being analyzed and manuscripts are in preparation for publication. Preliminary analysis indicates:

- Cows in the range environment experience nutrient restriction during the 1st and 2nd trimesters of gestation compared to cow in the improved irrigated environment.
- Cow reproductive efficiency was no altered by environment.
- At weaning, calves gestated and nursing their dams on range weighed 60 lbs (steers) and 48 lbs (heifers) less than their counterparts grazing improved irrigated pasture.
- There is some indication of intergenerational effects on birth weight in calves from the range environment.
- Prenatal and pre-weaning nutrient restriction resulted in differences in early life performance of calves.

Post-weaning performance of steers and heifers

This activity is in the 4th year of data collection. Data are being analyzed and publications are being prepared.

- Calves from the range environment exhibited compensatory gain (increased growth rate) compared to calves from the improved irrigated pasture when placed on the same post-weaning diet.

- Despite increased post-weaning growth rate, heifer calves from the range environment were lighter at breeding than heifers from the improved irrigated pasture.
- At harvest, steer calves had similar carcass weights and carcass quality regardless of environment of origin.
- It appears the level of prenatal and pre-weaning nutritional deprivation did not result in major post-weaning performance differences.

Reproductive development in heifers

This activity is in the 4th year of data collection. Data is being analyzed with some additional laboratory and video analysis needing to be completed. Work on ovarian follicular response to synchronization is ongoing. Publications are planned but their development will be after the publications in the other two areas. Early statistical analysis indicates:

- Prenatal and early postnatal nutrient restriction did not alter heifer reproductive development as indicated by reproductive tract scores and antral follicle counts.
- Response to estrous synchronization was similar among heifers from the two environments.
- Pregnancy rates were not different among treatments
- Despite differences in body weight between heifers from different environments, reproduction was not affected.

Briefly describe how your target audience benefited from your project's activities.

There are three major target audiences for this project: Beef Producers, Scientists, and Graduate/undergraduate Students

Beef Producers

Rangelands are extensively used in US beef cow-calf operations. Project benefits:

- This project provides evidence that calves produced on rangelands do not perform to their genetic potential. Therefore, beef producers have information they can use to value the grazing provided by rangelands. In addition, it suggests there may be management strategies (i.e. supplementation or early weaning) that may be beneficial.
- During the early post-weaning period calves from a range environment may be more efficient.
- Information on post-weaning performance and final product quality indicates that the early gestation and pre-weaning nutrient limitations experience by cattle that utilize rangelands do not appear to have lifelong effects. Therefore, calves from range should not be discounted in value.

Scientists

- Results from this project provides new information that limited nutritional restriction may produce different effects on development and lifelong impacts compared to more severe nutritional restriction normally tested in more controlled experiments.
- These result suggest the need for additional research into understanding the mechanisms of limited nutritional restriction and/or ability of nutritional management later in life to overcome impacts of early life nutritional insults.

Graduate/Undergraduate Students

- Students learned experimental designed and conduct of large-scale multi-year research projects.
- They were trained in research techniques including ultrasonography, blood sampling, forage analysis, laboratory methods and statistical analysis.
- They were given opportunities to produce publications and deliver scientific presentations.

Briefly describe how the broader public benefited from your project's activities.

The broader public benefited because this project has helped to identify limitations and strategies to improve the efficiency of cattle using extensive rangelands for production of protein for human consumption. Extensive rangelands occupy millions of acres in the US and the provide open space as well as recreational opportunities for the public. More efficient use of these resources increases the sustainability of rangelands.

Additionally, improving reproductive efficiency of beef cattle decreases the number of cattle and resources needed to produce food. In turn, this may decrease the cost of beef production.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Opportunities for training

- Two graduate students were trained on various research and laboratory techniques.
- Three undergraduate interns were trained on ultrasound pregnancy detection.
- Cattle from this project were used to teach ultrasound pregnancy detection to beef producers.

Dissemination of results

- Presented to beef producers through field days and popular press publications
- Information provided to scientists and graduate students by presentations at scientific meetings, webinars, and publication of abstracts and refereed journal articles.

Refereed Journal Articles

Stegemiller, M.R., G. K.Murdoch, T. N. Rowan, K. M. Davenport, G. M. Becker, J. B. Hall†, and B. M. Murdoch†. 2021. Genome-Wide Association Analyses of Fertility Traits in Beef Heifers. Genes 12, 217. https://doi.org/10.3390/genes12020217

Hall, J.B., M. R. Bloomsburg, and S. A. Goddard. 2022. Effect of a *Lactobacillus* fermentation product on postweaning heifer performance. *Translational Animal Science*, 2022, 6, 1–7 https://doi.org/10.1093/tas/txac015

Abstracts

Hall, J.B., J. E. Sprinkle, S. A. Goddard, J. Bret Taylor, J. B. Glaze, Jr., M. J. Colle and P.D. Bass. 2021. Comparison of range-based and irrigated cow-calf systems – post-weaning steer performance. Annual Meeting of the Western Section of the American Society of Animal Science. October 19, 2021. Fort Collins, CO Abstract PSIII – 4.

Oliver, K.F., J.B. Van Buren, **J.B. Hall**, M.L. Heimbuch, S. Jepsen, B. Epperson, J.A. Nasados, P.D. Bass, and M.J. Colle. 2022. Impact of maternal nutrition on postnatal growth of crossbred beef steers. 2022 Pacific Northwest Nutrition Conference.

Presentations

Speaker. **Hall, J.B**. Effect of gestation and early life environment on beef heifer development. Roy A. Wallace Symposium. Boise, ID. October 11-13, 2022

Speaker. **J. B. Hall**, J. Sprinkle, M. Ellison, S. Goddard, B. Murdoch, J.B. Glaze, P. Bass, M. Colle and K. Lee Irrigated vs Range-based Cow-calf systems project: Where do we go next? Rinker Rock Creek Ranch Research Webinar. March 1, 2022

Speaker. **Hall, J.B.** Findings from 5 years of comparison of range and irrigated cow-calf systems. Sage Brush Saturday/Rinker Rock Creek Ranch Field Day. June 4, 2022

Popular Press and Extension Publications

Hall, J. B. Capture Value of Range Calves This Fall. Owyhee Co. Cattlemen's Corner Beef Newsletter. July, 2022 p 5-6

Program Plans for Next Reporting Period

- Complete laboratory and statistical analysis
- Publish peer-reviewed journal articles
- Discuss future research directions with stakeholders
- Continue to train graduate and undergraduate students.

Epidemiology and management of virus diseases in Idaho

Project Director
Alexander Karasev
Organization
University of Idaho
Accession Number
7002108

AR - Epidemiology and management of virus diseases in Idaho

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The state of Idaho is the largest producer of several commodities in the U.S., leading in potato with about one-third of the national production in 2019. Idaho is also a leading producer of other crops which include alfalfa, dry and snap beans, peas and other cool-season food legumes. Management of virus diseases in these crops is a daunting task requiring understanding of the virus epidemiology and availability of methods to detect and control the disease. Understanding the infection cycle, virus-host interactions, transmission, epidemiology, and strain composition of these viruses affecting major Idaho crops is key in these efforts.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

1. Potato virus Y (PVY) has emerged as the main reason for potato seed lot rejections, seriously affecting seed potato production in the United States throughout the past 20 years. The dynamics of PVY strain abundance and composition in various potato growing areas of the U.S. has not been well documented and understood up to now. The objective of this study was to find out the prevalence of PVY strains in potato fields in the Pacific Northwest (PNW), including seed potato production systems in the state of Idaho, and commercial potato fields in the Columbia Basin of Washington State between 2011-2021.

Based on the testing of more than 10,000 foliar samples during Idaho seed certification winter grow-out evaluations of seed potato lots and seed lot trials in Washington State, a dramatic shift in the PVY strain composition was revealed in the PNW, between 2011 and 2016. During this time period, the prevalence of the ordinary, PVY-O strain in seed potato dropped 8-10 fold, concomitantly with the rise of recombinant strains PVY-N-Wi and PVY-NTNa, which together accounted for 98% of all PVY-positives by 2021. In Idaho seed potato, PVYNTNa strain associated with the potato tuber necrotic ringspot disease (PTNRD) was found to increase three-fold between 2011-2019, accounting for 24% of all PVY-positives in 2019. Relatively mild foliar symptoms induced by recombinant PVY strains may be partially responsible for the proliferation of PVY-N-Wi and PVY-NTNa in potato crops. The data on PVY strain abundance in the PNW potato crops suggest that virus management strategies need to consider the current dominance of the two recombinant PVY strains, PVY-N-Wi and PVY-NTNa.

2. Alfalfa is an important perennial forage crop in Idaho supporting dairy and cattle industries, typically grown in the same field for up to 4 years. To reveal the virome of the alfalfa crops grown in Idaho, alfalfa stands of different ages were subjected to screening for viruses using high-throughput sequencing and RT-PCR. The two most common viruses found were alfalfa mosaic virus and bean leafroll virus, along with *Medicago sativa* amalgavirus, two alphapartitiviruses, and one deltapartitivirus. Additionally, a new flavi-like virus with an unusual genome organization, dubbed Snake River alfalfa virus (SRAV), was discovered. The 11,745-nt, positive-sense (+) RNA genome of SRAV encodes a single 3,835-aa polyprotein with only two identifiable conserved domains, an RNA-dependent RNA polymerase (RdRp) and a predicted serine protease. In the RdRp phylogeny, SRAV placed inside the flavi-like lineage, as a sister clade to a branch consisting of hepaci-, and pegiviruses. To our knowledge, SRAV is the first flavi-like virus identified in a plant host. Although commonly detected in alfalfa crops in southern Idaho, SRAV sequences were also amplified from thrips feeding in alfalfa stands in the area, suggesting a possible role of *Frankliniella occidentalis* in virus transmission.

Briefly describe how your target audience benefited from your project's activities.

Understanding the prevalence of PVY strains circulating in potato fields helps growers to manage the virus in seed and commercial potato crops. The current dominance of recombinant PVY strains N-Wi and NTNa suggests the use of specific detection tools and approaches for diagnosis, and re-focus of the virus resistance breeding efforts on these two specific strains.

The discovery of a new virus present in alfalfa crops in Idaho necessitates development of new detection tools, and also brings up the question of the overall effects viruses may have on the alfalfa hay and silage production.

Briefly describe how the broader public benefited from your project's activities.

In parallel with research activities a robust outreach effort was projected through the participation in Idaho Potato Conference and Idaho Bean Schools, making sure the public is aware of the research findings. Several publications were made in popular press available to the broader public.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Student participation in the research project: 1) one graduate Ph.D. student (Lisa Tran), and 2) two undergraduate students (K. Wald and F. Pinney), were involved in the research.

Peer-reviewed publications:

1. Harveson, R.M., Al Rwahnih, M., Tian, T., **Karasev, A.V.**, Lenardon, S., and Gulya, T.J. (2022). The quest to identify a new virus disease of sunflower from Nebraska. *Plant Disease* **106**: 2773-2783 (https://doi.org/10.1094/PDIS-11-21-2402-FE).

2. Dahan, J., Wolf, Y.I. Orellana, G.E., Wenninger, E.J., Koonin, E.V., and **Karasev, A.V.** (2022). A novel flavi-like virus in alfalfa (*Medicago sativa* L.) crops along the Snake River valley. *Viruses* **14** (6): 1320 (https://doi.org/10.3390/v14061320).

3. Ding, P., Chen, D., Feng, H., Li, J., Cao, H., Muning, T., Li, J., Hao, X., Han, P., **Karasev, A.V.**, and Feng, X. (2022) Prevalence and strain composition of potato virus Y circulating in potato fields in China's north-central province of Shanxi. *Plant Disease* **106**: 1434–1445 (https://doi.org/10.1094/PDIS-09-21-1950-RE).

4. Tran, L.T., Green, K.J., Rodriguez-Rodriguez, M., Orellana, G.E., Funke, C.N., Nikolaeva, O.V., *Quintero-Ferrer, A., Chikh-Ali, M., Woodell, L., Olsen, N., and **Karasev, A.V.** (2022) Prevalence of recombinant strains of potato virus Y in seed potato planted in Idaho and Washington states between 2011 and 2021. *Plant Disease* **106**: 810-817 (https://doi.org/10.1094/PDIS-08-21-1852-SR).

5. Dahan, J., Cooper, W.R., Munyaneza, J., and **Karasev, A.V.** (2022) A new picorna-like virus identified in populations of potato psyllids *Bactericera cockerelli*. *Archives of Virology* **167**: 177-182 (https://doi.org/10.1007/s00705-021-05281-x).

Popular or trade publications:

1. Olsen, N. **Karasev, A.**, and Whitworth, J. 2022. Changing faces. How the industry can adjust to evolving PVY strains. *Potato Grower Magazine*, April 2022; pp. 30-31.

2. Olsen, N., Whitworth, J. and **Karasev, A.** 2022. New kids on the block. Success in PVY-resistant varieties. *Potato Grower Magazine*, May 2022; pp. 32-33.

Cooperative Extension Bulletins:

1. Duellman, K., Woodhall, J., **Karasev, A.V.**, Olsen, N., and Whitworth, J.L. (2022) Potato mop-top virus: biology and disease management. *University of Idaho Extension Bulletin 1017*: June 2022; 5pp.

Weed seedbank control in rotational crops as a proactive herbicide resistance management strategy

Project Director
Albert Adjesiwor
Organization
University of Idaho
Accession Number
7002240

AR - Weed seedbank control in rotational crops as a proactive herbicide resistance management strategy

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Herbicide-resistant weed populations are evolving rapidly and threatening the sustainability of crop production. In a bid to manage the current threat of herbicide-resistant weeds, weed scientists continue to recommend crop rotations that include competitive crops like wheat and alfalfa. This research project seeks to answer the following questions: (1) what happens to the weed seeds in the soil when wheat is planted in rotation with alfalfa? (2) is it better to rotate wheat with alfalfa or other annual crops to manage troublesome weed seeds in the soil?

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

A 4-year crop rotation study was initiated in 2021 at the University of Idaho Kimberly Research and Extension Center to evaluate weed control and seedbank dynamics in wheat-alfalfa vs wheat-annual crop (corn and dry bean) rotations. After two years of different crops and herbicide treatments, it was observed that weed seedbank density was reduced from 1734 to as low as 578 to seeds per 10 square ft in some treatments. Weed seedbank density tended to be higher in the untreated checks and there was a trend of the addition of residual herbicides treatments slightly reducing weed seedbank density compared to foliar-applied only treatment. Weed density within the crops during the growing season was influenced by the type of crop as well as the herbicide treatment. The combinantion of fewer weeds and greater crop yield in the addition of residual herbicides treatments holds promise for reducing weed seedbank and potentially improving crop productivity and economics.

Briefly describe how your target audience benefited from your project's activities.

The results from the study was presented to stakeholders during the 2022 Weed Tour at the University of Idaho Kimberly Research and Extension Center. Stakeholders were able to observe crop rotation sequences and impact on weed density. This demosntartion and ability to interact with stakeholders allowed for stakeholders to ask specific questions as they relate to their crop production systems. In addition, the results would enable farmers to assess how best to incorporate herbicdes into their rotations for reducing weed seedbanks and proactive herbicide resistance management.

Briefly describe how the broader public benefited from your project's activities.

Herbicide resistance is a problem faced by nearly all farmers across the United States. Results obatined from the study are import for proactive and integrated management of herbide resistant weeds. Results preseented at extension events and professional meetings is expected to benefit farmers across the United States.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

A graduate student is being trainned as part of this project. Because of the results obtained from the first two years of the study, the graduate student working on the project is in the process of applying for PhD to continue working on the project.

Enhancing the Efficiency of Nutrient Utilization in Beef Cattle

Project Director
Gwinyai Chibisa
Organization
University of Idaho
Accession Number
7001024

Enhancing the efficiency of nutrient utilization in beef cattle

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Feed costs account for over 60% of total operational costs on cattle operations, which necessitates use of cost-effective alternative feedstuff to ensure/increase profitability at a time when profit margis are narrow. However, there is still paucity of information on the nutritive value, and the environmental impact and potential ancillary benefits (e.g., increase in the health value of beef lipids) of feeding a number of available alternative feedstuff in beef cattle diets. Therefore this project is be focused on the development of dietary strategies to enhance the use of alternative feedstuffs in cattle diets so as to reduce feed costs, maximize production performance and limit the excretion of nutrients to the environment.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Feeding trials were conducted to evaluate the impact of feeding various by products (e.g., grape pomace) and supplements (e.g., zeolite) on ruminal and post-ruminal nutrient supply, nutrient excretion and reactive nitrogen emissions and product quality. This work resulted in 1 paper published in a peer-reviewed journal and 2 abstract and data presented at regional and national/international conferences.

Briefly describe how your target audience benefited from your project's activities.

The results were presented at the 2022 Pacific Northwest Animal Nutrition Conference and 2022 American Society of Animal Science (ASAS) meetings and also published; the audience were scientist from around the world, faculty and students from other US universities, industry representatives (animal nutrition, health, welfare etc), policy makers and the general public. The new information generated on the impact of feeding different products/feeds to beef cattle on nutrient supply, production performance, nutrient excetion and reactive nitrogen emissions will enable the creation of judicious feeding standards that the target audience can advocate for and also implement to ensure sustainability of the beef industry. The new information will also provide direction for future studies to answer additional questions related to use of alternative feeds in beef cattle diets.

Briefly describe how the broader public benefited from your project's activities.

The judicious use of alternative feeds based on information generated from project activities benefited the public by ensuring the production of nutritious food in a manner that limited wastage of nutrients and subsequent emission of compounds like ammonia that harm the environment and also compromise respiratory health. The project activities also generated data that showed that feeding certain feeds to cattle increases the health value of lipids in beef. Therefore, this benefited the broader public in that beef producers have an opportunity or another incentive to produce products that can help in limiting several diseases like coronary heart diesease.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Nitrogen Management Strategies for Idaho’s Small Grain Production

Project Director
Jared Spackman
Organization
University of Idaho
Accession Number
7000899

Barley Yield and Protein Response to Nitrogen and Sulfur Rates and Application Timing

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The University of Idaho nutrient management guidelines for barley were last updated in 2003 using data from the early 1980's to late 1990's. Changes in field management practices and new barley varieties require a re-assessment of N and S guidelines. The objectives of this study are to:

1) Assess the effect of nitrogen (N) and sulfur (S) availability on three barley classes (food, feed, malt) grain yield and protein, plant nutrient utilization, and soil nutrient availability

2) Identify the critical concentration ranges of N and S for developing correlated tissue test guidelines for malt, feed, and food barley under Idaho growing conditions

3) Develop a correlation-calibration response curve to establish the relationship between plant tissue N and S content with active canopy sensors for Idaho growing conditions

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

I successfully established field plots at the University of Idaho Aberdeen Research and Extension Center and Brigham Young University-Idaho during the 2022 growing season. I applied eight N fertilizer treatments (0, 40, 80, 120, 160 lb N ac-1 as urea at planting; 40/20, 40/40, or 40/80 lb N ac-1 split applied as urea at planting/jointing) by three S fertilizer treatments (0, 15, 30 lb S ac-1 as potassium sulfate applied at planting) (Goal 1, Objective 1). All 24 of these treatments were applied to Claymore (feed), Julie (food), and M179 (malt) barley for a total of 72 treatments and 576 plots.

Soil samples were collected at pre-plant and analyzed for complete nutrient analysis. Additional soil samples were collected from each plot at 1-foot increments down to 2 feet at jointing, flowering, and post-harvest for a total of 3,460 soil samples. These soil samples were analyzed for a complete nutrient analysis from the top foot and nitrate and sulfate content in the second foot. We also took bulk density samples from the 0-1' and 1-2' depths. These values will be used to create correlation-calibration relationships of soil fertility to plant tissue nutrient concentrations and yield.

Crop canopy greenness was measured from each plot using the Apogee, SPAD, and Greenseeker sensors at jointing and flowering (3,456 measurements) (Goal 1, Objective 4). Whole plant tissue samples were collected from each plot at jointing, flowering, and immediately before harvest by harvesting 1 meter of row (Goal 1, Objective 3). Samples collected before harvest were partitioned into heads and straw. The number of heads were counted and then threshed to quantify the number of viable heads per meter of row and the average number of kernels per head. All plant tissue samples were dried analyzed for a complete nutrient analysis (2,304 samples). Additional measurements collected from each study were yield, plumps and thins, test weight, and grain protein content. These values will be used to create correlation-calibration relationships of plant tissue nutrient concentrations to canopy sensing measurements and yield.

A water sample was collected at each irrigation event and analyzed for nutrient content including nitrate-N and sulfate-S. Averaged over the growing season, Aberdeen irrigation water supplied 70 lb sulfate-S and 15 lb nitrate-N per acre-foot of water while Brigham Young University-Idaho supplied 30 lb sulfate-S and 4 lb nitrate-N per acre-foot of water.

I hired a research technician in July 2021 who had experience with wheat breeding. He was able to rapidly adjust to barley research and is doing an excellent job of keeping the project samples organized and processed in a timely manner. For FY22, I successfully competed for and received funding for a University of Idaho Extension Intern. This undergraduate intern was hired from Idaho State University. I also hired four high school students and two undergraduate students from Brigham Young University – Idaho to help with this project during the summer of 2022. They were able to use this project to gain research experience and share their experience with their peers.

Briefly describe how your target audience benefited from your project's activities.

The results from this study were presented as an oral and 2 poster presentations at the American Society of Agronomy-Crop Science Society of America-Soil Science Society of America annual conference in Baltimore, Maryland in November 2022. Results were also presented to Extension educators at the University of Idaho Annual Extension Conference; Idaho barley producers at the Aberdeen Field Day, the Southeastern Idaho Winter Cereal School; and to barley agronomists, breeders, and other researchers at the 23rd North American Barley Researchers Workshop in Sacramento, CA. Participants learned about nitrogen and sulfur management practices, the importance of measuring bulk density for making accurate nutrient applications, and that irrigation water derived from the Snake River can supply agronomically significant amounts of sulfur and other nutrients. My high school students, undergraduate student intern, and graduate students learned how cereals develop and how to perform agronomic research.

Briefly describe how the broader public benefited from your project's activities.

The information being developed from this study will help small grain growers be sustainable through improved nutrient management. When growers apply the appropriate amounts of nutrients to achieve target yield and quality goals while minimizing nutrient losses to the environment, they conserve energy and fertilizer input resources, reduce greenhouse gasses, and have a greater economic return on their investments.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

One challenge to this study was that irrigation water derived from the Snake River and Snake River aquifer contains 30 to ~70 lb sulfate-S per acre-foot of water. This is enough available sulfur to mask any effect of sulfur fertilizer application for barley production. For the 2022 growing season, we thought that if we selected field sites that derived their irrigation water from deep wells, that we would avoid the high sulfate content in our irrigation water. However, we found elevated sulfate-sulfur content in well-derived irrigation water.

Mitochondrial Function in Relation to the Elevated Energy Demand of Lactation and Heat Stress in Dairy Cattle

Project Director

Amy Skibiel
Organization
University of Idaho
Accession Number
1026153

AR - Mitochondrial Function in Relation to the Elevated Energy Demand of Lactation and Heat Stress in Dairy Cattle

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Global climate change, particularly continued increases in air temperature, have catastrophic economic consequences for the dairy industry due to impaired milk synthesis and increased risk of health issues in cows. The goal of this research is to understand the cellular mechanisms underpinning heat-induced lactation depression. Specifically, understanding mitochondrial physiology during a typical lactation period and investigating mitochondrial function in lactating cows under conditions of heat stress are important undertakings that may lead to new strategies to combat health issues and poor performance resulting from hyperthermia.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The goal of our study is to use a two-tiered approach to understand how low milk yield in heat stressed dairy cows may derive from changes in mitochondrial function. We proposed to establish functional connections between mitochondria and milk production by assessing variation in mitochondrial function across a typical lactation under non-heat stressed conditions. Second, we proposed to experimentally induce heat stress in a group of cows and compare aspects of mitochondrial activity and structure to a non-heat stressed group in order to identify potential aberrant patterns of mitochondrial function and regulation associated with exposure to heat. Lastly, an important objective of the Hatch grant is to provide experiential learning opportunities for students interested in animal science and thereby contribute to training the workforce of future agricultural researchers and industry professionals.

We have made substantial progress towards the objectives outlined in our non-technical summary. For the first objective (assessing changes in mitochondrial biogenesis and function in association with shifting energy demands across lactation and milk production), we conducted a study on cows where biopsies of liver and skeletal muscle, two key metabolic organs, were collected throughout the lactation period of dairy cattle under non-heat stressed conditions. In these tissues we measured mitochondrial activity, reactive oxygen species (ROS) production, activity of antioxidants that neutralize ROS, oxidative damage to tissue proteins and lipids, and expression of genes involved in mitochondrial energy production, mitochondrial propagation, and mitochondrial defense against oxidative stress. These variables were analyzed in relation to changes in milk production at early, peak, and late lactation to characterize the typical mitochondrial adaptations that enable milk synthesis in healthy, non-stressed, cows. Briefly, we found that lactation adaptations include enhanced liver mitochondrial activity, which is associated with elevated milk synthesis and minimal cost in terms of oxidative damage to the tissue. Mitochondrial function is consistent across lactation in skeletal muscle, likely to maintain basic tissue function without heavily drawing on substrates needed by the mammary gland for milk synthesis. This work resulted in two conference presentations, two published abstracts, and two published manuscripts.

For the second main objective (identify tissue-specific changes in mitochondrial function that underlie heat-induced lactation depression, and endocrine signaling pathways that may orchestrate mitochondrial responses to heat), this past year we conducted a second animal trial identical to the previous year, with 14 additional animals to achieve sufficient statistical power. Like the previous trial, the animals were grouped into a heat-stressed group, fitted with an electric heat blanket to induce elevated body temperature, and a pair fed (fed same amount as heat-stressed group), normo-thermic group. We collected the same samples (milk samples blood samples, mammary and liver samples), and conducted the same measurements (rectal temperature, respiration rate, body weight, etc.) as for the previous trial. We finished many of the laboratory assays for these samples, including measuring tissue mitochondrial function, ROS production, antioxidant activity, oxidative damage, and expression of genes involved in mitochondrial activity. We are currently in the process of measuring various aspects of mitochondrial morphology from transmission electron microscopy images of mammary and liver tissue. We are also preparing to conduct western blot assays to quantify mitochondrial protein expression and enzyme complex assays to measure the function of each individual protein complex in the electron transport system. With the additional animals included in the statistical analyses, our data are still suggesting that heat stress has little direct effect (i.e. not mediated by effects on feed intake) on mitochondrial function. However, the heat stress induced by the heat blankets was mild and more moderate to severe thermal conditions could have more exaggerated impacts on mitochondrial physiology. Thus far this work has resulted in a review paper, which will be submitted for scientific review shortly, a published abstract, and a conference presentation. Our work was also shared with the larger dairy science community, reaching stakeholders, industry representatives, veterinarians, students, and animal scientists through my graduate student's and my participation in the Professional Dairy Producers (PDPW) Dairy Signal podcast.

In addition to the aforementioned objectives, my Hatch research aims to contribute to animal science education by providing hands-on learning opportunities for undergraduate and graduate students who will become the next generation of professionals in the dairy field. Through my Hatch research projects, thus far I have trained 4 graduate students and 10 undergraduates in cattle handling, on-farm data collection, laboratory techniques, and the development of critical thinking and other academic skills. These students have improved their technical proficiency, laboratory skills, scientific prowess, and animal science education through the process. Graduate students have also refined their scientific communication skills and learned the importance of research dissemination through participation in professional conferences and extension programs.

Briefly describe how your target audience benefited from your project's activities.

The targeted audience for our Hatch work includes scientists with interests in mitochondrial biology, lactation biology, and stress physiology, producers, animal scientists, and undergraduate and graduate students. Efforts involve incorporating results of the proposed project into formal classroom instruction (courses in lactation physiology and environmental physiology), through formal and information education and training of graduate and undergraduate students in research endeavors, and presentations and publications that will disseminate results to the scientific community.

Thus far, the Hatch project has resulted in three MS theses, two published papers, two additional manuscripts in preparation, three published abstracts, and three presentations at national conferences, thus achieving our objectives to educate students and other scientists about mitochondria in general, and the mitochondrial adjustments in metabolic organs that support the energetic demands of lactation and to cope with environmental stressors. I have also used the scholarly outcomes of the Hatch projects to inform my teaching and the development of materials for undergraduate and graduate courses, including a lactation course, an environmental physiology course, and a course on mitochondrial biology. Furthermore, many graduate and undergraduate students have gained hands-on experience working with dairy cattle on-farm and processing and analyzing samples in the lab. Some of these students have since graduated and are now in veterinary school or are pursuing advanced degrees in animal science.

Briefly describe how the broader public benefited from your project's activities.

My research is contributing fundamental knowledge on the tissue-specific changes in metabolism and cellular activity that are critical for successful lactation and advancing our understanding of how mitochondrial dysfunction could contribute to metabolic disorders associated with transition to a lactating state. Additionally, through our Hatch work, we are building a strong foundation upon which further targeted interventions can be developed to facilitate advances in mitigating heat stress effects on cattle health and production at the cellular level. In doing so, we are contributing to improving farm profitability, availability of highly nutritious dairy food products, and food security. In sharing information gleaned from our projects and conversing with dairy extension agents and industry professionals, the results of our studies are reaching the greater farming community. Furthermore, many students who have been involved in this research belong to farming families who are now more knowledgeable regarding heat stress effects in cattle and are aware of current strategies to that can be employed on their farms to alleviate adverse effects of elevated heat load on cattle performance.

Particulate Reactivity and Cycling in a Changing Environment: Implications for Agriculture and Human Health

Project Director
Daniel Strawn
Organization
University of Idaho
Accession Number
1025603

AR - Particulate Reactivity and Cycling in a Changing Environment: Implications for Agriculture and Human Health

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

We are researching chemical processes that occur in soils that affect uptake of nutrients and contaminants into plants. This includes investigating recovery of nutrients from dairy waste for use as soil amendments and evaluating uptake of cadmium from agricultural soils into plants. Results will provide new technologies and best management strategies for soils to support crop growth and food safety.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

One strategy for recovering phosphorus from dairy waste is treating waste waters from the dairies with a biochar material that can adsorb phosphorus. The recovered biochar and phosphorus are then tested as amendments in soils to determine their effectiveness as alternative soil fertilizer sources. We are using advanced spectroscopic characterization to understand the phosphorus reaction processes, which is a key factor in developing the best management practices for the recycled dairy nutrient.

We evaluated uptake of cadmium by wheat plants from several different soils across Idaho to assess how cadmium uptake varies as a function of plant variety and soil properties. Soil physicochemical properties are being correlated with plant uptake to allow for better models to be developed that will predict plant uptake. These models are needed to produce food products that have lower amounts of cadmium that will increase food safety.

Briefly describe how your target audience benefited from your project's activities.

Results from the recycling of nutrients from dairy wastewater were shared at a stakeholder meeting that included industry representatives, regulatory agencies, and scientists. Results from the cadmium uptake by plants study were published in peer reviewed journals so that scientists and stakeholders can access and evaluate the scientific data.

Briefly describe how the broader public benefited from your project's activities.

Results from the research are producing critical data needed for establishment of best management practices to recycle nutrients form dairy waste and reduce cadmium uptake by plants. The scientific data were presented at meetings and publications, which allows regulators, scientists and industry to integrate new findings in agricultural practices that will benefit the broader public by making dairy more sustainable and food products safer.

Improving Crop Diversity for Cropping System Productivity and Sustainability in Eastern Idaho

Project Director
Xi Liang
Organization
University of Idaho
Accession Number
1023335

★ Improving Crop Diversity for Cropping System Productivity and Sustainability in Eastern Idaho

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

My project aims to improve the sustainability and productivity of agroecosystems by diversifying cropping systems (e.g., alternative crops, rotations, and intercropping). These cropping systems are expected to have better tolerance to abiotic and biotic stresses (e.g., nutrient deficiency, drought, heat, disease occurrence, insect pressure, weed competition, etc.) and produce good yield and quality.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Field experiments of alfalfa-grass intercropping systems and cereal intercropping and rotational systems were carried out under full and deficit irrigation conditions. Plant and soil samples were collected during the growing season. Crops were harvested to estimate growth and yield. The harvested wheat grain was also analyzed for end-use quality. Preliminary results were delivered as 5 presentations at professional conferences.

During field days and field tours, the field experiments were demonstrated to the audience. Preliminary results from these experiments were presented at growers' meetings and workshops (e.g., Cereal School, Forage School, NRCS 5 for 5 Soil Health webinar, etc.). Preliminary results have been published as 1 Extension bulletin and 3 abstracts. I was interviewed for my program activities, and the progress and preliminary results were reported in local newspapers.

Briefly describe how your target audience benefited from your project's activities.

Researchers and graduate students learned about agroecology, crop physiology, and soil health in diverse crops and cropping systems under different water regimes through publications and conference presentations.

Growers, industry representatives, and extension educators learned about diverse crop options and cropping system agronomy at Extension events
(e.g. Twilight tour, field days, workshops, etc.) and from extension publications. The progress of my program was highlighted on our college website and reported in local newspapers, where readers can learn about my project activities.

Briefly describe how the broader public benefited from your project's activities.

The broader public started to become aware of sustainable agriculture and food systems, such as irrigation water use, soil health, farming productivity, organic farming, climate change, etc.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

My Hatch project has been expanded into a few projects by collaborating with other colleagues as well as USDA and commodity groups:

1: Field experiments to incorporate pulse crops in barley cropping systems and assess soil health and water use efficiency

2: Developing wheat intercropping systems in southern Idaho

3: Cereal-pea intercropping systems during the organic transition

4: Increasing yield, quality, and economy of alfalfa hay through grass species selection and planting configuration

Under my supervision, 1 MS and 2 Ph.D. students were working on the projects mentioned above, and 2 high-school interns assisted in all 4 projects in FY2022.

Selection and Management of New Potato Varieties Adapted to Southwest Idaho

Project Director
Mike Thornton
Organization
University of Idaho
Accession Number
1023308

Selection and Management of New Potato Varieties Adapted to Southwest Idaho

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

There is a need for more rapid adoption of new potato varieties with increased pest and stress resistance. During the adoption phase producers need reliable information on cultural management to optimize the productivity of these new varieties. One of the newest management tools is use of plant growth regulators to modify stem number and tuber set to consistently meet market requirements and incentives for specific tuber size profiles.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We continued agronomic screening trials of new promising selections from the Northwest Potato Variety Development program at the Parma Research and Extension Center. This location lived up to it's reputation as a good location to screen for stress resistance due to excessive temperatures in July and August (27 days over 100F during 2022). Russet-skinned, and red, yellow and purple-skinned specialty potato types were evaluated compared to check varieties commonly grown in this region.

A second year of trials was conducted to evaluate the influence of seed treatments of gibberellic acid and napthalene acetic acid on stem number, tuber set and final tuber size distribution in the variety Chieftain. This trial has allowed us to identify the optimum rate of these growth regulators that results in the optimum size profile and maximizes economic returns. We will use these results in future trials to identify how growth regulator treatments interact with other management practices (seed spacing and vine kill date).

Briefly describe how your target audience benefited from your project's activities.

The potato industry was provided with information on 11 russet-skin breeding selections and 8 specialty selections to compare with commonly grown commercial varieties. Several of these selections have been in trials throughout the western U.S. for three years and are under consideration for release as newly named varieties. The benefits of adoption of new varieties such as Clearwater Russet with better stress tolerance were clearly evident again in 2022 due to record high temperatures across PNW growing regions. The industry is reporting that yield and quality of this variety was much more consistent than for Russet Burbank or Ranger Russet during 2022.

Briefly describe how the broader public benefited from your project's activities.

The public continues to benefit from this project due to the continued adoption of new varieties with enhanced agronomic performance. We have documented that new varieties are more productive per unit of water, fertilizer and pesticide input compared to Russet Burbank (the long-time industry standard). We have also documented that new varieties perform more consistently across years and growing conditions, leading to a more stable supply of product for fresh and process markets. Therefore, each acre planted to a new variety in place of Russet Burbank leads to more consisten food availability, less environmental impact, and less food waste.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

No major changes or problems were encountered during 2022. The results of this project were disseminated to communities of interest through publication of refereed journal articles (2), abstracts (5), popular press articles (3) and at presentations at national, regional and local meetings (14).

For the 2023 growing season we plan to continue the agronomic evaluations of new breeding lines for several market classes. We will also initiate a two-year study on the interaction of growth regulators with seed spacing and vine kill date.

Selection, Management, and Storage of New Potato Varieties

Project Director
Rhett Spear
Organization
University of Idaho
Accession Number
1023336

AR - Breeding & Agronomic Trials

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project focuses on developing new potato varieties that bring enhanced traits to the potato industry including cold-sweetening resistance, improved yields and quality, disease and pest resistance, and improved nutrient and water efficiency. Commonly used varieties that have been on the market for many years often limit grower's ability to produce quality potatoes due to genetic shortfalls. The result is less than ideal potatoes for the public and inefficient processability and storability.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

This project has produced recommendations for planting conditions, ideal spatial arrangement, best use for different varieties, and ideal storage conditions to maximize quality and processability. These major accomplishments have helped us acheive our goals of providing recommendations to potato growers, processors, and fresh pack sheds on variety selection, in-season activities such as fertility and water application, and how to store potatoes to maintain quality throughout 9-11 months.

Briefly describe how your target audience benefited from your project's activities.

Our target audience benefited from the recommendations that we were able to share based on in-field trials. They have been able to make adjustments in their commercial operations to maximize yields and quality, understand the needs, and benefits, of new varieties, and have a starting point for making mid-season decisions based on environmental conditions.

Briefly describe how the broader public benefited from your project's activities.

The broader puclic as a whole has benefited from this project's activities by being able to consume healthier potatoes that were grown with less inputs including fertilizer and pesticides. Additional benefits also include reductions in possible carcinogens like acrylamide that can form when starchy products are exposed to high heat. A major focus of this program has been to breed and select varieties that have inherently lower concentrations of precursors like asparagine or reduced activity of enzymes like invertase that are partially responsible for the formation of acrylamide.

Production Efficiency, Profitability, and Sustainability

Project Director
NaveGhimire
Organization
University of Idaho
Accession Number
7000016

Livestock Grazing Management

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Pastures across Idaho provide the most economical feed source for livestock owners. Proper grazing management benefits animal and pasture productivity. Pasture managers can often double production by implementing best management practices. However, pasture production is often limited by poor grazing management practices.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

To improve grazing and livestock efficiency, we offered the Lost Rivers Grazing Academy program, a four-day, hands-on workshop designed to help producers improve their understanding and application of best management practices in grazing.

Briefly describe how your target audience benefited from your project's activities.

Our target audience was livestock owners, grazing managers, and grazing advisors (Extension and NRCS). A total of 35 program participants responded to pre- and post-evaluation surveys. All participants showed an increase in knowledge of pasture-management principles.

Evaluation data indicated participants had an average increase in grazing days by 20% (based on a 6-month grazing period per year, as noted by BLM in Idaho). The average herd size of participants' ranches was 450 head per ranch. With current hay costs of ~$3.27/cow/day (not including fuel or labor), each additional day that the cattle can graze due to improved management would save a 450-cow ranch nearly $1,500/day in feed costs. Two additional weeks of grazing would save around $20,600 over feeding hay. For 36 days per ranch, that is a cost saving of $ 54,000 in feed– that means a total saving of $1,890,000 for the 35 participating farms.

Briefly describe how the broader public benefited from your project's activities.

Improving grazing efficiency directly relates to improving livestock efficiency. This will help improve the quality of Idaho livestock production and the overall ag economy.

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Briefly describe how the broader public benefited from your project's activities.

Improving grazing efficiency directly relates to improving livestock efficiency. This will help improve the quality of Idaho livestock production and the overall ag economy.

National Animal Genome Research Program

Project Director
Brenda Murdoch
Organization
University of Idaho
Accession Number
1020947

AR - University of Idaho cattle and sheep genomics

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

As the global population increases so does the need for sustainable food production emphasizing the importance of efficient usage of both land and animal resources. Livestock, specifically cattle and sheep, are an important resource towards this goal, as they can capitalize on land that is not suitable for food crop production while further producing essential foodstuffs. Idaho is an important livestock production state in the U.S. and in 2021, ranking 3rd in milk production, 11th in total number of cattle and 7th sheep, lamb and wool. Genetic and genomic data and technologies are useful tools for the identification and the selection of efficient and optimal livestock breeding. These studies will identify genetic variation related to improved growth traits, reproductive fitness, and rangeland usage and data for both Idaho cattle and sheep populations.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The goal of this research is to advance relevant genomics information by contributing genetic variation and phenotypic data from Idaho sheep and cattle herds. This is accomplished through the combined collection of single nucleotide polymorphism (SNP) and sequence derived genotypic variants paired with refined phenotypic data pertinent to the production system.

Gather and integrate genetic and phenotypic information from crossbred cow-calf herds and sheep flocks to perform genome-wide association studies, this will allow us to better understand and predict economically important traits. We will capitalize on resources available at the University of Idaho, reproductive tract scores, for more extensive reproductive trait association analyses.

Towards these goals we collected samples from the UI NMCREEC cows and their calves as well as ewes and lambs samples from the Sheep Center for DNA extraction, storage, and use. We performed association analyses for reproductive and growth traits measured at each of the units. In doing this we provide genetic research experiences to graduate students and enhance this EPCOR state University’s capacity for cattle genomics. Furthermore, we provide information and educational resources regarding the phenotypic and genotypic data, results, conclusions and strategies to cow-calf producers and the beef industry.

Briefly describe how your target audience benefited from your project's activities.

This study allowed us to gather the necessary genetic and environmental data, along with enhanced phenotypic characterization to both identify strategies for improved grazing strategies, growth and reproductive traits through genetic selection and deliver a science-based resource to producers allowing for practical decisions towards improving production efficiency of sheep and cattle.

Furthermore, I provide the livestock community genome and genome annotation information for both the cattle and sheep genome. I organized the NRSP8 meetings and conferences to extend the communication efforts of this community across the US. I served as a communication conduit for the NRSP8 initiatives and Animal Scientist at the University of Idaho and upon request contribute to UI field days, workshops, and training sessions.

Briefly describe how the broader public benefited from your project's activities.

I provide consultation for other faculty, extension educators and livestock stakeholders in the field of livestock genomics and the application of genomic tools for livestock. Furthermore, I provide information to a large number of stakeholders, help with data interruption, and contribute to the overall assessment of the usefulness and limitations of the various genomic tools available to the livestock industry.

One example is the production, application, and interpretation of Flock54, a sheep genotyping panel. This panel was designed by the University of Idaho and consists of approximately 1000 SNP markers that allows stakeholder to perform parentage analysis (Heaton *et al.,* 2014) and assess approximately forty additional Mendelian traits (Lenffer *et al.,* 2006) including the identification of carriers for a number of diseases. Examples of the disease markers include scrapie (codon 136, 154 and 171 of *PRNP*), spider lamb (*FGFR3*), and Ovine progressive pneumonia marker *TMEM154.*

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

During this reporting period I have delivered 10 invited seminars to stakeholders and the scientific community. Furthermore, we have published 9 peer reviewed manuscripts and or proceedings, and 11 abstracts in this reporting period. A total four PhD and one MS graduate students have benefited through research and training opportunities from this hatch program.

Our ongoing projects include participation as project director or co-director roles in the sheep and cattle pangenomes, pan epigenome and the development of telomere to telomere genome assemblies of sheep and cattle.

Closing Out (end date 06/07/2024)

Decompostition of Demand for Crops Grown in Idaho and the US Pacific Northwest

Project Director
Patrick Hatzenbuehler
Organization
University of Idaho
Accession Number
1019181

AR - Demand and price datasets compiled, and general market model designed

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The goal of the project is to obtain a more detailed and comprehensive understanding of the demand components for crops grown in Idaho and the PNW than currently exists. This goal will be achieved through the following objectives:

Objective 1: Quantify the demand for crops in Idaho and the PNW in terms of their subcomponents (e.g., feed, food, exports, fresh, processed).

Objective 2: Estimate the income and own price elasticities of demand, in total and for each subcomponent, for each crop.

Objective 3: Develop market models that can be used to project expected market changes caused by short-run (e.g., supply shock) and long-run (e.g., average per capita income) factors.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Efforts to achieve objective 1: Continued the review of literature and secondary data sources to identify the principal crops for Idaho and PNW on which to focus the analysis. Updated an existing list of the principal crops and continued market data acquisition on supply and demand related variables from sources such as the USDA, U.S. Department of Commerce, and the Idaho Barley Commission. A dataset on supply and demand for feed crops in Idaho was compiled and is currently being used for preparation of a journal article and Extension bulletin. A dataset on wheat prices of different classes in various markets throughout the PNW was constructed and used for estimation of price linkages in different periods with hypothesized variation in demand conditions, and the analysis results were presented at a professional conference. Data on supply of bast fiber crops (e.g., flax, industrial hemp) was gathered and is currently being used for completion of an Extension bulletin on current and potential bast fiber crop markets in the PNW.

Efforts to achieve objective 2: Continued the review of the literature on demand estimation, demand elasticity estimation for main crops in Idaho and the PNW, and obtained data needed to estimate demand models. A general framework for estimation of supply and demand elasticities was initiated, and an initial dataset for implementation for the potato market was constructed.

Efforts to achieve objective 3: Continued the review of the literature on development of market models for use in economic projections. The framework for estimation of potato demand and supply parameters will be used in a market outlook analysis and presentation.

Briefly describe how your target audience benefited from your project's activities.

A presentation on price linkages for different classes of wheat in various markets throughout the PNW in different periods with hypothesized variation in demand conditions relating to supply-demand changes in a primary competing exporting country, Australia, was delivered at the Western Agricultural Economics Association Annual Meeting in Santa Fe, NM in June 2022.

Agricultural economist professional peers are a key audience for the research undertaken in this project, and they were supportive of the endeavor and provided useful feedback for next steps.

Briefly describe how the broader public benefited from your project's activities.

A popular press article that used much of the logic and ideas in the literature review pertaining to the importance of demand elasticities in explaining changes in prices and producer revenues was published in August 2022. The print circulation for this publication is 11,300.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Publications

Presentation

Hatzenbuehler, P., H. Tejeda, and D. O'Brien. 2022. Marketing between two demand sources: Pacific Northwest U.S. wheat price dynamics. Presentation at the WAEA Annual Meeting, Santa Fe, NM, June 26 – 28.

NIFA support acknowledged: YES.

Popular press article

Hatzenbuehler, P. How much does the 'natural hedge' apply in Idaho? Idaho AgProud, August 2022.

NIFA support acknowledged: NO.

Planned activities for FY2023

Planned activities to achieve objective 1: Continue an ongoing survey to obtain estimates on processing capacity for the major crops in Idaho and the PNW. Encompass the gathered data into journal articles and extension bulletins. One journal article and related extension bulletin that focus on the supply and demand for Idaho feed crops over the past two decades (2002-2021) are in progress and will be completed in early 2023. Expanding the analysis for other crops and for the PNW will be ongoing. Other extension bulletins that encompass the remaining needs in the analysis to achieve objective 1 remain in progress.

Planned activities to achieve objective 2: Quantification of the demand for crops in Idaho will be done as part of the activities to achieve objective 1. A general system for estimation has been developed based on the review of the literature. Initial estimates for the potato market were obtained for Idaho, and these will be expanded for the full PNW market and compared to those in the literature. The empirical estimates of demand elasticities will be compared to those for which estimates were also available in the literature (e.g., potatoes).

Planned activities to achieve objective 3: Design market models based on the estimates obtained in objective 2 with an emphasis on pursuing those that can be used by stakeholders and interpreted by a wide audience. The potato market model, for which initial estimates have been obtained, will be completed first, and that will be used as a basis for market models of the other crops.

Closing Out (end date 06/07/2024)

Improving the Resiliency and Diversity of Cereal-Based Cropping Systems in the Pacific Northwest

Project Director
Kurtis Schroeder
Organization
University of Idaho
Accession Number
1019455

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project is addressing several issues that are of particular concern to rainfed, cereal-based cropping systems in northern Idaho. The first is soil acidification which has been an emerging problem in the inland Pacific Northwest over the past couple of decades. However, critical soil pH thresholds are now being crossed and crop performance is being negatively impacted in some fields as a result of increasing aluminum toxicity resulting from the low soil pH. A second issue revolves around increasing the resiliency of the cropping system in northern Idaho through developing strategies to seed alternative fall crops. In recent years, conditions in the spring have not always been favorable for spring seeded crops. There are several recent examples of significantly delayed seeding or prevented seeding due to unusually wet and cool conditions in the spring, and in 2021 there was severe drought throughout the northwest resulting in extremely low yields for spring crops. Adding additional fall seeded crops to complement winter wheat production could improve the resiliency of the regions cropping system. A third issue is the need to maintain the best genetics in the region to maximize productivity. This requires that new breeding lines and cultivars of important crop species for the region are assessed for regional adaptability.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Soil acidification and aluminum toxicity:

Field trials were continued at four locations in northern Idaho that had varying rates of lime applied in 2016. Each location had a different crop seeded and included winter wheat, spring wheat, and spring canola. There was a significant and proportional increase in crop yield with increasing lime rate at all sites. Nearly 5 years after liming, the soluble aluminum is still substantially lower in 2 and 3 ton/A plots. Combined with previous years data, there are now 22 site-years of data on the impact of liming in northern Idaho. There has been an average yield increase of 14, 17 and 20% for the 1, 2 and 3 ton/A rates of lime respectively. The total return over six years for each site after accounting for the annualized cost of lime ranged between $370 to $1,653/A. These data indicate that liming is cost effective in northern Idaho when soils have a pH below 5 in the upper 6 inches. Other challenges, such as how to pay the liming costs on leased ground still remain to be solved.

In addition to the liming study, efforts to screen for tolerance to aluminum toxicity in wheat germplasm continues. A total of 212 entries of winter and spring wheat were tested during 2022. These included both released cultivars and experimental lines from public and private sources. The screening site has a pH of about 4.2 and high soluble aluminum, making this an ideal screening site. Data from 2022 has been compiled, but is awaiting analysis. However, there is a wide range of tolerance and susceptibility within germplasm that was screened.

Alternative fall seeded crops:

Field trials were established at two locations in northern Idaho to more closely examine the impact of seeding depth and seeding rate on the winter survival and productivity of winter pea. Seeding depths of 1, 2, 3 and 4 inches are being examined as well as seeding rates of 8, 9, 10, 11 and 12 seeds per square foot. This project is specifically focusing on fall seeded, food-quality winter pea. Recently released food quality varieties from the USDA-ARS and ProGene were selected for this project. Data was collected during 2022 and is being analyzed.

Elite winter barley lines were tested in a trial near Genesee, WA. This trial included 30 entries of food barley and 30 entries of malt barley. Data from this trial was shared with the barley breeder to aid in selection of material most suitable for the northern Idaho climate.

Variety testing

During 2022, trials were established at strategic locations throughout northern Idaho to examine the adaptability and agronomic performance of winter and spring wheat, spring barley, winter and spring pea, lentil and chickpea. A total of 31 replicated field trials were conducted from near Grangeville, ID to as far north as Bonners Ferry, ID. A total of 233 entries across all cereal and legume crops were tested. Yields for most crops in 2022 were near normal or above normal, particularly for the fall seeded crops. Trials were featured in field days and data from these trials were shared in various formats with growers, plant breeders and the seed industry throughout the Pacific Northwest.

Briefly describe how your target audience benefited from your project's activities.

Data generated from the liming trials will aid growers in the short and long-term management of soil acidification in the region. In previous years, aluminum tolerant cultivars have been identified that are well adapted to the region. The effort to screen for aluminum tolerance in winter and spring wheat will continue as new varieties are developed for the region. Likewise, knowledge gained from the liming studies will assist growers and landowners in making informed decisions about strategies for liming acidified soils in the region.

The introduction of more fall seeded crops into existing rotations has the potential to reduce risk associated with spring planting. With greater variability in rainfall and temperature patterns being experienced in the spring, there is greater risk in seeding spring crops either due to wet springs or very dry springs combined with warmer summer temperatures. Conditions are less variable in the fall, and plants are already established prior to the spring, resulting in less impact of wet springs or dry springs. In addition, a fall seeded crop will mature earlier than a spring planted crop, allowing the fall seeded crop to produce seed and mature before hot summer weather arrives.

Data generated by the variety trials is widely sought after by growers and seed producers. Data produced from the University of Idaho trials provides an objective evaluation of the agronomic performance of these varieties. These trials are important for identifying the regions of north Idaho where cultivars are best adapted as well as educating growers and the industry about the performance and traits of new varieties of crops being introduced to the region.

Briefly describe how the broader public benefited from your project's activities.

The studies for this project are designed to improve the northern Idaho cropping system. With improved productivity and resilience of the north Idaho cropping system, the productivity and success of agriculture in the region will improve. Since the regional economy is highly reliant on agriculture, improved resiliency will result in a more stable economy for the region. Furthermore, improving crop performance via liming to eliminate soil acidification and integrating more fall seeded crops will also provide increased ground cover and could decrease the rate of soil erosion in the region. The rolling hills of northern Idaho increase the risk of water erosion, but greater ground cover during the winter months as well as greater biomass would reduce the impact of erosion. Improved biomass production would also increase crop competitiveness with weeds, reducing the reliance on pesticides for management.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

No major changes or problems were encountered. The projects outlined above allowed for the training of one PhD graduate student and four undergraduate workers who gained knowledge of the north Idaho cropping systems and receive hands-on experience in agricultural research.

Data were disseminated to stakeholders through a variety of avenues. These included written reports to crop commodity groups; summaries of crop performance distributed via email to growers, breeders and other stakeholders; three field day events where results from the trials were discussed with attendees; a presentation to the Tri-State Grain Growers Association; posters at professional research meetings and grower meetings; and a virtual Winter Cereal School.

Management Systems to Improve the Economic and Environmental Sustainability of Dairy Enterprises.

Project Director
Mireille Chahine
Organization
University of Idaho
Accession Number
1019727

AR-Evaluate whole farm system components and integrate information and technology to improve efficiency, profitability, environmental sustainability and social responsibility.

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The project adresses the sustanability of the dairy enterprise by striving to reduce environmetal impacts while optimizing farm profitability. An integrated systems approach is used to improve environmental, economical, and social sustainability associated with dairy production.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We continued work on the Idaho Sustainable Agriculture Initiative for Dairy (ISAID) with the objective of optimizing the use of N and P from dairy production to produce useful bioproducts that can be transported and used in other geographical areas for crop production or value-added products such as bioplastics and fertilizers. We have also initiated a survey that was sent to all Idaho dairies to examine the use of beef semen on Idaho dairies with the objective of better understanding the newer trend of producing beef on dairies.A thrid project has focused on addressing robotics on Idaho dairies.

Briefly describe how your target audience benefited from your project's activities.

Dairy producers and allied industry will have more tools to add value to their farms and improve their livelihood.

Briefly describe how the broader public benefited from your project's activities.

Developing management practices to improve the environmental and economical sustainability of the dairy industry has a direct impact on the environment and on our rural economies. It contributes to the long term resiliency of our Food Production Systems and more specifically our Livestock Production Systems as well as our rural communities. The first project significantly decreases the likelihood of dairy waste contaminating water and/or air and the second project helps us understand how to otpimize beef production on dairies. The third project associated with robotics is very impactful for small and medium size dairies who struggle withe their labor supplies and thus have a major impact on rural economies.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

A series of presentations addressing technologies on dairies were deliverd accross Idaho and Utah. A series of presentations targeting bilingual (English and Spanish) Middle Herd Managers have also been delivered. Robotics workshops were delivered across Southern Idaho and were posted online. An online class was also developed and posted at the Extension.org website.

Closing Out (end date 06/07/2024)

Molecular Dissection of the Defense Signal Transduction in Tomato

Project Director
Fangming Xiao
Organization
University of Idaho
Accession Number
1019804

AR - Molecular Dissection of the Defense Signal Transduction in Tomato

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The overall goal of the research project is to provide fundamental knowledge for improvement and sustainability of agricultural plant production. Particularly, it will help understand disease resistance mechanisms in crops, especially for other economically important crops in *Solanaceae* family, such as potato, pepper, and eggplant. We seek to elucidate the ubiquitination regulation of defense-related transcription factor *Sl*NAC1 and the role of the cognate ubiquitin ligase *Sl*SINA3 in defense response, and to investigate genes regulated by *Sl*NAC1 as a means of manipulating defense signaling.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Objective 1. Determine the mechanistic basis of SlNAC1 regulation by the ubiquitin ligase SlSINA3 and the resistance protein Prf.

We have found the SlNAC1 transcription factor is degraded by proteasome through the ubiquitination-mediated proteolysis. Further in vivo and in vitro analyses suggested that the activated Prf stabilize SlNAC1 through interference with its ubiquitination by SlSINA3, thereby preventing SlNAC1 degradation.

Objective 2. Determine the role of SlSINA3 and the involvement of SlSINA3-mediated ubiquitination in disease resistance in tomato.

We have generated transgenic tomato plants that either overexpress SlSINA3 or have SlSINA3 gene knocked out by CRISPR-Cas9 technique. Genetic analyses on these transgenic plants have been conducted. Interestingly, we have conducted Pseudomonas assay on both SlSINA3-Ox and SlSINA3-KO transgenic plants and did not find any significantly altered resistance to Pseudomonas in these transgenic tomato plants, suggesting functional redundancy among SINA family members in tomato.

Objective 3. Investigate genes regulated by SlNAC1 as a means of manipulating defense signaling.

We have completed RNA-Seq analyses on Wild type and 35S::SlNAC1 transgenic tomato plants (RioGrande PtoR). The results indicate that 1167 genes are significantly up-regulated (>2 fold) in the 35S::SlNAC1 transgenic tomato compared to the non-transgenic WT tomato plants. As expected, among these SlNAC1-regulated genes, more than 600 genes are involved in defense signaling. Further determination of direct target genes of SlNAC1 by ChIP-Seq is in progress. Significantly, using both EMSA and Chip-PCR assays, we have determined that the PR7 gene is the direct target of SlNAC1 transcription factor.

Objective 4. Generate and assess transgenic tomato plants expressing a stress-induced and stable SlNAC1 mutant.

We have successfully generated multiple transgenic tomato lines expressing a stable SlNAC1 and functional mutant. Significantly, the expression of the SlNAC1 mutant is controlled by a pathogen (Pseudomonas)-inducible promoter. The dynamic expression of the SlNAC1 mutant upon Pseudomonas infection has been verified. Further characterization of these transgenic tomato plants on the resistance to Pseudomonas bacteria is in progress.

Briefly describe how your target audience benefited from your project's activities.

Three graduate students and two undergraduate students have been trained in the PI's laboratory during the report period time. Particularly, these students have acquired training in cutting edge molecular, biochemical and genetic approaches to understand complex biological process at the molecular, cellular, and whole-plant levels.

Briefly describe how the broader public benefited from your project's activities.

The PI explored local community outreach by training one junior student from local high school in laboratory during the report period time. The student worked for eight weeks as a full-time summer intern, which had a great impact on student considering a future career in biological sciences.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

N/A

Closing Out (end date 06/07/2024)

Managing current-season spread of Potato virus Y in the Pacific Northwest using crop oils and insecticides

Project Director
Erik Wenninger
Organization
University of Idaho
Accession Number
1018640

AR - Managing current-season spread of Potato virus Y in the Pacific Northwest using crop oils and insecticides

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Potato virus Y (PVY) is the most important virus affecting potato, reducing yield and quality, especially in the seed crop. Decades of research in potato-growing regions other than the Pacific Northwest have demonstrated the utility of crop oil sprays in reducing the spread of PVY and other aphid-borne viruses. The aim of this project is to develop best management practices for incorporating crop oil into management of current-season spread of PVY in potato under Idaho field conditions.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Objective 1

A field study was conducted comparing weekly crop oil sprays with and without fortnightly insecticide applications and/or with and without at-plant insecticide. We collected data on aphid abundance adjacent to the crop and collected tuber samples from each plot for later assessment of PVY incidence. Processing of samples is in progress and analyses are ongoing. Results from the previous two years suggest that PVY incidence tends to be higher for the non-treated check and for treatments with only insecticides (i.e., without crop oils), but more analyses and more years of data are required to confirm this.

Objective 2

Aphids were monitoring weekly in four seed potato fields to clarify seasonal movement of aphids into potato fields. Aphids were counted in all samples, but identification of aphid species and analyses of data are still in progress.

Objective 3

An greenhouse irrigation system was built to simulate outdoor overhead irrigation required for these studies. We have begun these studies and will continue them into the coming review period.

Objective 4

Presentations were made at the Idaho Potato Conference, the Idaho Association of Plant Protection, and at field days at the Kimberly Research & Extension Center.

Briefly describe how your target audience benefited from your project's activities.

Our target audience benefited by learning of our ongoing work on this project, including our preliminary results and the importance of staying tuned for forthcoming progress updates.

Briefly describe how the broader public benefited from your project's activities.

Direct benefits to the broader public are yet unrealized. Our goal is to develop best management practices for use of crop oil that would also reduce use of insecticides. When this is achieved, more benefits to the broader public may be achieved, such as reduced use of insecticides for management of PVY.

[Associations between livestock grazing and Greater sage grouse habitat in Idaho]

Project Director
Melinda Ellison
Organization
University of Idaho
Accession Number
1018531

AR - Associations between livestock grazing and Greater sage grouse habitat in Idaho

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project evaluates associations between livestock grazing management and sage-grouse habitat and provides professional development and mentoring opportunities for graduate and undergraduate students.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Four seasons of data have been collected and final results have been written up in three manuscripts, two of which have been published and one in review. A Master's thesis was produced in 2021and a fact sheet has been completed. Additional funding that was previously secured through the Idaho Natural Resources Conservation Service and the University of Idaho David Little Endowment continued to support this research. Two Master's students and several undergraduate technicians have been trained and mentored and have delivered presentations to stakeholders and scientists about their preliminary and final findings.

Briefly describe how your target audience benefited from your project's activities.

To-date, we have delivered preliminary and final results to all of the stakeholders identified in the original proposal through oral and poster presentations at scientific meetings, attending stakeholder meetings, and providing on-site tours and field days. Furthermore, we regularly update stakeholders through the University of Idaho Rangeland Center (website and advisory board).

Briefly describe how the broader public benefited from your project's activities.

Two Master's students have been trained in scientific design, data collection, data analyses, and scientific writing. Additionally, both graduate students have participated in delivering their findings to the scientific community and to stakeholders through oral and poster scientific presentations and participating in field days. Several undergraduate students have been trained in vegetative monitoring techniques and cattle handling through assisting graduate students with data collection.

[Biological Control in Pest Management Systems of Plants]

Project Director
Mark Schwarzlaender
Organization
University of Idaho
Accession Number
1018532

FR - Biological Control in Pest Management Systems of Plants -Biocontrol of houndstongue

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project explores a novel and alternative approach to assess the environmental safety of classical biological weed control agent candidates. Specifically, to better interpret results from no-choice and choice developmental host range testing, we are studying the host finding behavior of biocontrol agent candidates and the underlying phytochemical and visual physiological processes. We take advantage of an unusual circumstance that allows us to study the host selection behavior of a biocontrol candidate that has naturally migrated from Canada into the United States, which allows us to conduct some experiments outside of quarantine conditions in field cages. This insect is the root-mining weevil, Mogulones crucifer, officially released for the biological control of houndstongue (Cynoglossum officinale L.) in Canada in 1997. The weevil is widespread in Canada and has been credited with the suppression of the invasive plant. The weevil is currently not permitted for release in the USA because of concerns it may attack confamilial Boraginaceae species. In addition to the root-mining weevil M. crucifer, we are also studying a sibling weevil species, Mogulones borraginis, which feeds on the seeds of C. officinale. We use this model system to compare behavioral host selection data sets for the two weevil species and also to investigate whether two congeneric biocontrol agent candidates occupying different niches of their shared host plant use the same or differing plant cues during host selection. The goal of this project is to receive permission for field release of both biocontrol agents for release in the USA and to provide an additional layer of host-specificity data that facilitates environmental risk assessments of biological control agent candidates.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We use several rare native North American and very closely related Eurasian confamilials of C. officinale to describe with chemical ecological studies at what level of relatedness host plant discrimination of M. crucifer and M. borraginis occur. We also study whether the root miner M. crucifer responds to floral olfactory and visual plant cues and whether the seed-feeder M. borraginis responds to foliar olfactory and visual plant cues, respectively. While these research questions are important to better design future bioassays for other biocontrol agents, we have (1) submitted a petition for introduction and field release of the seed-feeding weevil Mogulones borraginis based on our chemical ecological data, which was favorably reviewed by the Technical Advisory Group (TAG). We expect a release permit for this weevil in 2023. We have also completed studies on the host selection of Mogulones borraginis and are in the process of submitting the petition for field release for this biocontrol candidate.

Briefly describe how your target audience benefited from your project's activities.

The target audience for this research are weed biocontrol practitioners who seek to obtain release permissions for weed biological control agents in the USA in the most streamlined fashion and land managers in federal, state, local and tribal agencies as well as the general public with an interest in biologically-based management of noxious weeds. Cynoglossum officinale is a major weed of western range and grasslands and forests in Idaho, Wyoming, Montana, Oregon and Washington. Release of the two weevils as biological control agents in the USA will in all likelihood control C. officinale and no longer cause any adverse effects on agricultural production or recreational activities.

Briefly describe how the broader public benefited from your project's activities.

Houndstongue is not only toxic to livestock it is also a nuisance weed to the general public, especially recreationists: The seeds of the plants stick to shoelaces, clothing and fur of dogs. Successful management of the plant will benefit the general public accordingly.

Mastitis Resistance to Enhance Dairy Food Safety

Project Director
Pedram Rezamand
Organization
University of Idaho
Accession Number
1018429

FR - The relationship between nutrient metabolism and health measures during the periparturient period in Pacific Northwest dairy herds

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The objective of this study was to determine the relationship between serum metabolites (cow and calves) and health status (mastitis in cows) during periparturient period in commercial farms in the western US.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Rezamand lab continues to work on identifying relationships between nutrient metabolism during the periparturient period and health issues (mastitis) in Pacific Northwest dairy herds. An objective of the study is to assess the relationship between the milk fatty acid profile of dairy cows with mastitis status of the cows during the periparturient period. Results showed that mastitic cows had greater serum retinol compared with healthy cows at postpartum, whereas serum α-tocopherol was affected by time, seasons, and mastitis interaction (in one group but not the other gourp). Mastitic cows had lower serum α-tocopherol and β-carotene. Cows with retained placenta (**RP**) had lower serum retinol and tended to have a decreased serum retinol in their calves (cohort B). Serum glucose in calves was greater when the calves were born from the RP dams. No significant difference in milk fatty acid profile between diseased and healthy cows was observed. We are working on oxylipid analysis of serum samples; a method we just optimized in our lab (see below).

In summary, diseases affected the lipid-soluble vitamins status and serum metabolites of periparturient cows, hence may leadi to affect their new born calves' health. Future studies should focus on milk lipid-soluble vitamins and expand this effort to cover larger areas with more diverse production settings.

We were also able to optimize a method through wich we can measure oxylipid in cows and identify diseased animals. This was achived by combining two methods reported previously (extraction as detailed by Teixeira et al. (2021) with modifications and analysis according to Mavangira et al. (2015) with modifications) and optimizing it in our setting at the University of Idaho.

Briefly describe how your target audience benefited from your project's activities.

Students, nutritionists, and veterenarinas could benefit form finds of this project in that they could set up proper nutrition and also look for markers of diseases and identify them early enough so the overall costs of treament may be lower. Graduate and undergraduate students helping with the project received a good deal of training on analytical procedures (e.g., HPLC analysis of serum and milk samples)

Briefly describe how the broader public benefited from your project's activities.

Mastitis continues to be a very costly disease; prevention and redcuing mastistis cases is of a huge economical importance as well as prodcucing milk with high quality for conusmers. Mastitis affects every dairy farm and approximately 38% of dairy cows in the United States. The National Mastitis Council estimates that this disease costs the dairy industry more than 2 billion dollars per year or approximately $180.00 per cow. These losses are primarily related to lost milk production, increased veterinary costs and cow mortality, and discarded milk

Enhancing the Competitiveness and Value of U.S. Beef

Project Director
Michael Colle
Organization
University of Idaho
Accession Number
1017957

Improving shelf-life of beef with natural antioxidants.

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Acceptability of meat color decreases the longer the product is aged and the longer it is displayed in the retail case. Additionally, transportation of exported beef often takes 21 days or longer resulting in shorter shelf-life. Therefore, improving shelf-life of longer aged beef products will improve the competitiveness of US beef in international markets.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Antioxidant treatments of acerola cherry powder and rosemary extract improved chuck roll and bone-in short rib steak lipid oxidation and redness during retail display from beef aged 28 d postfabrication. Topical applications at the retail level following extended aging due to prolonged storage or transportation time, can extend the shelf-life stability of fresh beef bone-in short ribs and chuck rolls. Using acerola cherry powder and rosemary extract on low color stable muscles or frozen beef may provide more opportunities for extending beef shelf-life.

Briefly describe how your target audience benefited from your project's activities.

Idaho published 3 peer-reviewed manuscripts and 5 abstracts; all related to beef quality and improvement. Additionally, Drs. Bass and Colle were frequently invited speakers at state and regional events. Furthermore, 2 graduate students from the lab completed their M.S. Degrees and 2 undergraduate students completed their B.S. Degrees. Below are a summary of peer-reviewed articles and abstracts from this reporting period.

Lancaster, J.M., J.H. Smart, B.J. Buseman, T.M. Weber, J.B. Van Buren, K. Insausti, J.A. Nasados, B. Glaze, W.J. Price, M.J. Colle, and P.D. Bass. 2022. Assessment of dry-aged beef from commercial aging locations across the United States. Gastronomy and Food Science. 27. doi.org/10.1016/j.ijgfs.2022.100466

Lancaster, J.M., T.M. Weber, J.B. VanBuren, J.H. Smart, B.J. Buseman, J.A. Nasados, G.K. Murdoch, W.J. Price, M.J. Colle, and P.D. Bass. 2022. Effects of beef carcass size, and subsequent aging time on yield and color characteristics of top round steaks. Meat and Muscle Biology. 6(1):13219 1-9. doi.org/10.22175/mmb.13219

Van Buren, J.B., B.J. Buseman, T.M. Weber, J.A. Nasados, J.M. Lancaster, J.H. Smart, J.A. Church, W.J. Price, P.D. Bass, and M.J. Colle. 2022. Extending the shelf-life of beef steaks using acerola cherry powder and rosemary extract. Meat and Muscle Biology. 6(1):13217 1-10. doi:10.22175/mmb.13217

Van Buren, J.B., K.J. Puga, K.C. Hoffman, J.A. Nasados, P.D. Bass, and M.J. Colle. 2022. Water binders in beef patties increase yield and extend shelf life. Proc. 2022 Reciprocal Meat Conf. 18.

Jepsen, S.M., J.B. Van Buren, B.S. Epperson, M.L. Heimbuch, K.F. Oliver, J.A. Nasados, M.J. Colle, and P.D. Bass. 2022. Alternative fabrication and muscle profiling of the beef top sirloin butt. Proc. 2022 Reciprocal Meat Conf. 110.

Epperson, B.S., J.B. Van Buren, M.L. Heimbuch, S.M. Jepsen, K.F. Oliver, J.A. Nasados, W.J. Price, M.J. Colle, and P.D. Bass. 2022. Identifying alternative beef cuts suitable for use as beef finger steaks. Proc. 2022 Reciprocal Meat Conf. 20.

Dahlgren, C., H. Goodson, S. Wang, A. de Mello, M.J. Colle, W. Schilling, and T. Dinh. 2022. Effect of electrical stimulation on total peptide and free amino acid content in beef. Proc. 2022 Reciprocal Meat Conf. 113.

Oliver, K.F., J.B. Van Buren, J.B. Hall, M.L. Heimbuch, S. Jepsen, B. Epperson, J.A. Nasados, P.D. Bass, and M.J. Colle. 2022. Impact of maternal nutrition on postnatal growth of crossbred beef steers. 2022 Pacific Northwest Animal Nutrition Conference.

Briefly describe how the broader public benefited from your project's activities.

The previous and ongoing research at Idaho continues to work to improve product quality, consistency and overall shelf life of beef products. Doing so will increase demand for US beef in the international market. This will add value to cow/calf, feedlot, and processors which intern support their local economies. The main goal is always to find ways to increase beef consumption and acceptance which thereby adds value to all segments of the beef industry.

Variability, Adaptation and Management of Nematodes Impacting Crop Production and Trade

Project Director
Louise-Marie Dandurand
Organization

University of Idaho
Accession Number
1017764

AR-Management of Nemtodes impacting crop production and trade

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Currently, resistance to *Globodera pallida* in commercially relevant potato varieties for US growers does not exist. Through collaborations with breeders and plant geneticists, research has focused on breeding resistance into russet type potatoes for the US industry. Clones with partial resistance have been developed, and future efforts are focused on incorporating pyramiding different sources of resistance to achieve higher levels of resistance to *G. pallida.*

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

One major activity is to screen potato clones from potato breeders that are incorporating potato cyst nematode resistance into russet-type potatoes to determine the level of resistance in each clone. Breeding for resistance to potato cyst nematodes will allow growers to return to potato production in infested fields that have been de-regulated and will protect the potato industry from further invasions of this quarantine nematode pest.

We are also developing a cropping rotation plan for deployment of resistant potatoes to maintain populations of potato cyst nematode below detectable levels, and to return productive agricultural land to potato production. We have found that rotating with the trap crop, Solanum sisymbriifolium, then a resistant potato variety, followed by a susceptible variety reduces the nematode rapidly.

Briefly describe how your target audience benefited from your project's activities.

Our targeted audience is the potato industry affected by the presence of the quarantine potato cyst nematode, *Globodera pallida.* Once high levels of resistance are achieved then producers that deal with an infestation will have additional strategies to deal with the infestation.

Briefly describe how the broader public benefited from your project's activities.

Once resistant potato varieites are developed than the risk from economic losses caused by an infestation will be reduced because control of the nematode can be achieved with resistance and rotation.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

NA

Enhancing the Competitiveness and Value of U.S. Beef

Project Director
Phillip Bass
Organization
University of Idaho
Accession Number
1016913

Adding value to beef carcasses and cuts

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Goal 1 of the project, "Improve quality, safety, and domestic and international marketability of US beef products..." is being addressed with the current research. Differences in retail color stability were observed between the different sizes in beef carcasses. More research is expected to be conducted in this area.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Adding value on novel beef cuts can continue to improve carcass values. Muscle profiling research must be conducted in order to upgrade under-utilized beef cuts. Over the last decade novel beef cuts such as the flat-iron steak, Denver cut, Delmonico steak and Bonanza cut were developed by exploring different fabrication techniques. Continuing this line of research is essential to increase the number of alternative cuts for export. Seeking new sustainable and efficient beef production practices will contribute to reduced production costs, which is also a priority for the industry since the majority of both national and international markets are sensitive to price changes. Furthermore, developing new alternative beef cuts that fit in international markets may also increase exports and internal revenues. Moreover, working to address challenges with very large beef carcasses will help to improve value for those carcasses.

The contribution to the objectives will serve students, the beef industry, and the greater US and international beef consumer community by enhancing the understanding of fresh beef quality and value.

Briefly describe how your target audience benefited from your project's activities.

Target audiences for this research were producers, packers, processors, and merchandisers of beef and beef cattle products in the Northwest US and nationally. Producers and packers were engaged throughout the year where research relevant to the presentation was discussed. A graduate student working on a Ph.D. will complete her degree in meat science in May 2025. She is conducting research on carcasses of sizes that are currently receiving less value per pound than carcasses of which would be considered "average" size to the beef industry. Research findings have been shared with the Idaho Cattle Association as well as beef producers both regionally and nationally. Furthermore, a graduate student working on a Master's Degree will complete her degree in December 2022. Her research was conduced on alternative fabrication of beef top sirloins. Better understanding of this subprimal will help to better merchandise that cut.

Briefly describe how the broader public benefited from your project's activities.

The research has enhanced understanding of beef carcasses that are very large and are having trouble with cooling properly. Better management of large carcasses will aid in better shelf-life and potentially lessen food waste. Furthermore, better profiling beef carcass subprimals, such as the beef top sirloin, will help the packers and processors generate more desirable cuts for the greater consuming public, again providing what consumers want and limiting waste.

Closing Out (end date 06/07/2024)

Building Agroecosystem Resiliency to Climate Variability through Soil Health

Project Director

Jodi Johnson-Maynard

Organization

University of Idaho

Accession Number

1016435

AR - Building Agroecosystem Resiliency to Climate Variability through Soil Health

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Climate change impacts agriculture in significant was and currently posses a major threat to dryland production of wheat and other crops in the Inland Pacific Northwest. Improving soil health is viewed as one method to help build resilience to climate change. This project focuses on the impact of crop diversification and organic production on soil health and resulting changes to yield stability.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Goal 1) Determine how diversification of wheat-based rotations in the inland Pacific Northwest (iPNW) affects yields and physical, chemical and biological indicators of soil health.

Major Activities: Sampling of large replicated plots in St. John, WA and Genesee, ID was completed last year. Laboratory analyses were completed in 2022 and data analysis is ongoing.. Data collected include pH, plant available nitrogen, organic matter, earthworm density, water extractable organic carbon and nitrogen, POXc, carbon and nitrogen mineralization, solvita carbon dioxide, and H3A extractable nutrients. Data from years one through five were presented at the annual meeting of the Soil Science Society of America, an international soil science conference and shared with growers during a training seminar. This data provides a quantitative assessment of how soil health metrics vary from year to year and correspond to differences in environmental conditions, crop diversity and yield.

2) Conduct a survey to determine the current use of soil health and fertility testing programs on organic farms in northern Idaho

Major activities: Work under this objective was completed in 2019. Results were incorporated into a proposal that was submitted and funded. The proposal is focused on understanding soil health in organic certified systems.

3) Determine the ability of relatively new soil health tests to be used as indicators of nitrogen supply and in the calculation of nitrogen fertilizer application rates in organic systems.

Major activities: Work under this objective included sampling of replicated plots in two different climate zones and analysis of both H3A and KCL inorganic nitrogen. A total of 10 organic certified sites were also sampled in 2021 and 2022. Three different measurements of nitrogen availability were made. These sites are currently being sampled again this spring. When completed these data will allow us to assess the relationship among different measures of nitrogen availability. The results will aid farmers interested in streamlining their soil testing program and allow them to better utilize soil test data in decision making.

Briefly describe how your target audience benefited from your project's activities.

Currently, farmers across the Inland Pacific Northwest are working towards building soil health in order to decrease crop loss due to climate variability and build long-term sustainability. This project is providing quantitative data and improved knowledge of 1) expected annual variability of a wide range of commonly used soil health metrics, 2) relationships between soil health metrics and yield, 3) which soil health tests are most appropriate for assessing soil nitrogen availability. Overall, the research is providing new data that farmers can use to make informed decisions around management with the goal of improving soil health and resilience to climate change.

Briefly describe how the broader public benefited from your project's activities.

Members of the broader public benefited from this work because it focuses on both adaptation and mitigation. The resuts of tihs study may help inform the design of new systems that reduce greenhouse gas emissions and help improve general environmental quality. In addition, non farmers including consumers interested in organic production attended a workshop on assessing soil health.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and Professional Development- This project resulted in the training of one staff scientist, one graduate student and two undergraduate students during the reporting period. Results have been disseminated through presentations at international meeting as well as regional workshops and producer trainings. In the next project reporting period data from the five-year replicated plot period will be prepared for publication with anticipated publication between 2023 and 2024.

Developing premier wheat cultivars for Idaho and Pacific Northwest using genomics-assisted technology

Project Director
Jianli Zhao
Organization
University of Idaho
Accession Number
1015790

AR-Developing premier wheat cultivars for Idaho and Pacific Northwest using genomics-assisted technology

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The long-term goal of the present project is to use genomics-assisted technology to develop premier wheat cultivars that have high grain yield, desirable end-use quality, and resistance to biotic and abiotic stresses.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The genetic manipulation of major yield components is an important approach to increase wheat grain yield. Phenotyping of these traits is cost-effective, time-consuming, and the output is also confounded by environmental conditions. Using molecular marker-assisted selection and traditional breeding methods, a new hard white spring wheat cultivar 'UI Gold' was released this year. This cultivar has high grain yield because of more spikelet and kernels as well as more productive tillers and excellent bread-baking quality because of desirable storage protein. This cultivar has potential to replace a high yielding check cultivar in the production system in 2024 to 2025. Additional two spring wheat lines have potential to release in 2023 or 2024.

Fusarium Head Blight is an emerged fungal disease reducing grain yield and end-use quality in Idaho wheat production due to the increase in acreages of corn for the increased dairy industry. Using molecular markers associated with a major gene *Fhb1* we developed one soft white spring wheat line 'IDO2101FHB' and another hard red spring wheat line 'IDO2103FHB'. In 2022, we introgressed another gene *Fhb7* and stacked it in the backgrounds of IDO2101FHB and IDO2103FHB to achieve the higher level of FHB resistance.

Falling number is an important quality trait in baking industry and trade markets. In 2021, we used CRISPr-CAS9 gene knockout experiment for a candidate gene associated with low falling number and obtained edited plants. In 2022, we characterized starch content and falling number in edited plants and hope to understand the gene function in 2023.

Dwarf and common bunt disease outbreaks are likely to increase due to the expansion of organic wheat production systems, changing climatic conditions, and the evolution of new pathogen races. Screening of major resistance genes is very difficult in field nursery and requiring a prolonged snow cover. Producing doubled haploid and using molecular marker-assisted selection will facilitate pyramiding multiple resistance genes to achieve high and durable resistance in cultivar development. In 2022, we evaluated 60 doubled haploid lines and selected two lines that have two genes stacked and excellent dwarf bunt resistance. The two lines have potential to release in 2025.

Briefly describe how your target audience benefited from your project's activities.

New cultivars released by this project, combining improved yield with biotic and abiotic resistances and top-notch end-use quality have been grown by wheat growers and used by end-users in Idaho, the PNW, and the US to maintain or increase their productivity and competitiveness in domestic and international markets. Growing such cultivars have increased in

the numbers of acres for UI released wheat cultivars that growers and industry can access and reduce the production costs for producers to use fungicides and insecticides. ‘UI Sparraw’ soft white winter wheat released in 2019 has high grain yield and immune resistance to dwarf bunt and tolerance to drought. ‘UI Gold’ hard white spring wheat released in 2022 has high grain yield and excellent bread-baking quality.

Briefly describe how the broader public benefited from your project's activities.

QTL, molecular markers, and new candidate genes identified have been used in the breeding programs worldwide, published in peer refereed journals, and presented at national and international meetings.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Information on cultivars and breeding lines have been distributed to growers through field day events, the wheat breeding project website, commodity schools, Idaho Grain Producer Association meetings and magazines, and publications in the Journal of Plant Registration and other journals. This project provided training to three Ph.D students on current breeding technologies and traditional breeding methods. One Ph.D student graduated this year and moved to private sector.

Hiring field technician has been very difficult in our breeding program and other breeding programs in the US because of lower salary offered compared to the private companies. Another reason is because my program is in the rural community. COVID pandemic also affected the hiring.

Closing Out (end date 06/07/2024)

Economics of Innovation and Supply Chain Design

Project Director

Liang Lu

Organization

University of Idaho

Accession Number

1015730

AR - Fiscal Year 2022 Results

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The goal of this project is to undertake that systematic analysis and to draw implications for agriculture and food policy to influence and complement those strategies so as to maximize efficiency and equity in food supply chains.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

I published four journal articles in the reporting period. This articles helped me make significant progress in the following goal stated in the non-technical summary:

This proposal identifies at least three sets of linkages among lead firms' (food industry and agribusiness) design of coordination strategies (among which, contracts) in their product or input supply chains in order to condition the incentives and capacity of farmers to technologically innovation.

Briefly describe how your target audience benefited from your project's activities.

Target audience benefited from my project activties through building better resillience of agricultural supply chains, which is an important task for sustainable agriculture.

Briefly describe how the broader public benefited from your project's activities.

Broader public benefited from my projects by better understanding of the costs of supply chain disruptions. For example, my project activities help explaining the COVID-19 pandemic impact throughout the food supply chain. When dining demand quickly switched from restaurants, hotels, and schools to cooking at home, surpluses and shortages arose: we witnessed potato shortage on the supermarket shelf and farmers' dumping potatoes at the same time. Similar food waste incidences are also reported for beef, milk, eggs, onion, cabbage, and other food inputs.

Exploring the Role of Microbial Communities in Soil and Ecosystem Processes

Project Director
Michael Strickland
Organization
University of Idaho
Accession Number
1016436

AR - Exploring the Role of Microbial Communities in Soil and Ecosystem Processes

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Soil and ecosystem biogeochemistry is in large part a product of microbial communities. Yet, how these communities respond to global and management change and in turn their impact on elemental cycles are not well understood. This project seeks to better understand how soil microbial communities are impacted by management change and in turn how this impacts carbon and nitrogen cycling.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Objective 1: We completed experiments associated with this objective and analyzed the resulting data. This research has been published in *Functional Ecology.*

Objective 2: Experiments associated with this project are mostly complete. Two manuscripts are in preparation and one manuscript was published in *Microbial Ecology.*

Objective 3: Experiments examining the interaction between climate change and antibiotic inputs are ongoing. Experiments examining differences in the response of land cover to antibiotic inputs is ongoing. Data examining the biogeography of the soil resistome are being analyzed and preparation of a manuscript is forthcoming. Preliminary results of this research have been reported at regional and national meetings. One manuscript is in preparation and one manuscript was published in *Soil Biology & Biochemistry.*

Objective 4: Data associated with the interactions between cover crops and tillage are being analyzed and a manuscript reporting these results are being drafted. Data examining cover crop diversity effects on soil carbon and nitrogen cycling, and soil microbial communities are being analyzed. Preliminary results of this research have been reported at regional and national meetings. One manuscript reporting the results of this research were published in *Soil and Tillage Research.*

Objective 5: We completed experiments associated with this objective and analyzed the resulting data. One manuscript reporting the results of this research were published in *Applied Soil Ecology.*

Briefly describe how your target audience benefited from your project's activities.

Results of these objectives have had the following benefits for the target audience:

1. We have demonstrated that the functional breadth of the soil microbial community is the primary microbial determinant of leaf litter decomposition. This can impact our estimates of the impact soil communities have on decomposition.

2. Volatile and dissolved organic carbon sources have distinct effects on microbial activity and these effects are mediated by soil moisture. This illustrates that volatile compounds can be the dominant source of carbon in dry soils.

3. We illustrate that the combination of increasing temperature and inputs of antibiotics disrupt microbial community composition and soil carbon cycling. Highlighting potential management considerations when utilizing antibiotics.

4. We developed a multivariate approach for the assessment of soil health. This may have potential application for farm-based decisions.

5. We illustrate that micronutrients, particularly calcium, can decrease the bioavailability of soil carbon. This may have applied use and illustrates the importance of micronutrients in soil function.

Briefly describe how the broader public benefited from your project's activities.

Overall, the results of this project have illustrated the diversity and importance of soil microbial communities. This research illustrates how management decisions impact soil communities and the ecosystem processed that they regulate.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

This project has provided training for 4 undergraduates, 6 graduate students, and 2 postdoctoral associates. The undergraduates have gained research experience related to both lab and field experiments. The graduate students and postdoctoral associate have gained experience in research project management, personnel management, and writing and presentation experience.

Site-specific, Adaptive Management for Sustainable Agricultural Performance

Project Director
Erin Brooks
Organization
University of Idaho
Accession Number
1015983

AR-Site-specific, Adaptive Management for Sustainable Agricultural Performance

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Agricultural producers in Idaho and throughout the inland Pacific Northwest continue to face challenges of managing degraded soils. Declining organic matter from excessive tillage is reducing water infiltration and retention; declining soil pH in North Idaho due to excessive synthetic fertilizer application is reducing nutrient cycling; and continued uniform application of fertilizer on poor ground continue to threaten the economic and environmental sustainability of Idaho agriculture.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Throughout the last year my research team collaborated with other research teams across the nation through the USDA-ARS LTAR (Long Term Agroecosystem Research) network to provide a synthesis of phosphorus budgets across the nation. Through this work and the continued data collection from artificial drain lines from a research farm near Moscow (Cook Agronomy Farm) we were able to demonstrate the challenges of legacy storages of phosphorus through agricultural systems. This research is helping to raise awareness of the water quality impacts of over-application and redistribution of phosphorus fertilizer in our landscapes. This research is also demonstrating particularly in North Idaho that growers can reduce P fertilizer in some landscape positions and variable rate phosphorus fertilizer strategies may be successful at increasing profit and minimizing long term accumulation and export of phosphorus to water bodies.

Our research team continued to use satellite imagery to identify persistent field scale crop response patterns in irrigated regions of Idaho. Over the last year we were able to develop an online tool that allows users to navigate to their fields and examine whether their fields demonstrate statistically significant cropping patters and the percentage of the field that is persistently unique.

Based on experimental data and modeling we have gained greater understanding of the benefits and challenges of cover cropping. Using a cropping model and long term simulations that producers in the crop-fallow transition zone of the Palouse can replace summer fallow with cover crop and avoid a yield penalty to the subsequent winter wheat crop through successful management of cover crop termination dates. In most years the cover crop can be allowed to grow into mid to late June.

Briefly describe how your target audience benefited from your project's activities.

We presented our research and summer field days and we continue to see greater interest in cover and forage cropping throughout the inland Northwest.

There were two large integrated climate-smart grants submitted during 2022. One of them was eventually selected for funding. Interestingly, one of the key benefits of putting the proposals together was open discussion and communication between producers, industry, and university research. We were able to present some of the online geospatial tools to a group of growers in the region and discuss benefits of on-farm experiments which generated strong interest in the technology.

We continue to have close relationships with USDA-ARS partners both at Pullman and Kimberly which has led to ongoing support for collaborative research including the support of multiple graduate students, a technician, and a post-doc.

Briefly describe how the broader public benefited from your project's activities.

Particularly through the development of the Climate Smart grants we have seen a growing interest in improve soil health and regenerative ag. Increased fertilizer costs are also resulting in greater interested in nutrient management technologies. We also see increased awareness and interested in climate-smart commodities that are produced from agricultural practices with zero or net storage of annual carbon. We have also be invited to participate in Cereal Schools across the state indicating strong state wide interest in our research.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Over the next year we will see much broader interactions with producers, the Soil and Water Conservation Districts, Tribal groups and other partners across the state of Idaho through the Climate Smart grant. This will be a great opportunity to increase adoption of nutrient management and cropping practices to increase overall nutrient use efficiency, profitability, soil health and carbon storage.

Economic Impacts of Plant Diseases and Other External Factors Affecting Production Agriculture

Project Director
Christopher McIntosh
Organization
University of Idaho
Accession Number
1012804

FR-Economic Impacts of Plant Diseases and Other External Factors Affecting Production Agriculture

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project addressed how Idaho crops are impacted by diseases, pests, and other pathogens. Analysis of the economic impacts ofthese, as well as the economics of control and biocontrol will be analyzed. Information regarding the production and economic risks posed by these pests, aswell as ways in which farmers and seed certification agencies can respond will be generated.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We were able to assess the value of seed potato certification. In addition, we were able to begin research to address other important plant diseases and pests.

Briefly describe how your target audience benefited from your project's activities.

Target audiences benefited from the project activities by gaining information as to the extent of economic damages resulting from plant disease pressure, and the value of seed certification.

Briefly describe how the broader public benefited from your project's activities.

The economic impact of plant diseases may not be obvious but it is felt throughout the economy of a state or region. When the agricultural industry is impacted negatively, so is the larger economy.

Critical Issue

Forest, Range, and other Natural Resources

Evolutionary History of the Genus Coloradia and the Putative Effects of Climate Change on the Spread of Pine Pest in Idaho's Coniferous Forests

Project Director
Christopher Hamilton
Organization
University of Idaho
Accession Number
1026158

Evolutionary History of the Genus Coloradia and the Putative Effects of Climate Change on the Spread of Pine Pest in Idaho's Coniferous Forests

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The long-term goal of this project, is to provide a means for identifying which populations of the Pandora pine moth (PPM), *Coloradia pandora*, represent the most significant risk for future outbreak, identify where these source populations are likely to expand their distribution into due to climate change (i.e., to mitigate large scale deforestation), identify genomic regions for potential targeted control strategies, and eventually predict future outbreaks – something especially important because PPM populations are expanding their distributions across the PNW coniferous forests.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

This project is generating novel scientific data that include the first population-scale study of Coloradia pandora (the Pandora Pine Moth, PPM), the first genomes of PPM, the first genomic comparison between two ecologically different populations of an outbreak pest, and the first attempt to identify the genomic basis of outbreaks in moths.
The outcomes of this research include the potential for new methods to be developed in surveying for outbreak potential in forest pests. These outcomes will likely lead to a better understanding of how to mitigate future damage to forest health and pine agroforestry in the Pacific Northwest. The outcomes of this research will be directly applicable to understanding where PPM is expanding its distribution and determining if emergent PPM populations pose a significant risk to novel pine forests. Outcomes of this research are going to deliver science-based knowledge and STEM educational programs to stakeholders, enabling them to make practical, informed decisions.
So far during the reporting period PD Hamilton has attempted to collect important Coloradia pandora specimens, from across their distribution (both outbreaking and non-outbreaking populations). We have collected samples from some new populations in WA, OR, and AZ, but have struggled to collect any new samples from non-outbreaking populations.
During the reporting period, PD Hamilton began sequencing three Coloradia pandora genomes. For now, these are only from outbreaking populations. Additionally, we have sequenced 76 samples from across the Coloradia genus for phylogenomic loci.
One critically important aspect of this project is the STEM outreach and education opportunities that take place to encourage and educate the next generation of caretakers of our tribal land. In order to broaden participation of Idaho's tribal students, PD Hamilton is using a genetics-based STEM outreach program to engage tribal K-12 students. This program uses a Lego "DNA sequencer" to teach kids about DNA, how DNA build genes, and how those genes produce the phenotypes we see. Called Nannoppolo' Lab (Chickasaw for 'monster'), children use four colors of LEGO blocks to "build" stretches of DNA. These genes are then "sequenced" by the sequencer - made of robotics and Arduino coding, and an output tells the student the characters that make up their monster (e.g. type of monster, number of eyes, number of legs, size, temperament, etc.). The students then draw and color their monster on an official sheet that they hang on their classroom wall and compare with other students. This type of STEM education has been identified by tribes as information they feel is important for the future of their tribes.
During the reporting period, the target audiences that were reached include K-12 students in the Couer d'Alene tribe (of Idaho), students from Owyhee HS (Idaho) AISES (The American Indian Science and Engineering Society), HOIST (Helping Orient Indian Students and Teachers into STEM) students visiting the University of Idaho for recruitment purposes, and the San Carlos Apache tribe (of Arizona).

Briefly describe how your target audience benefited from your project's activities.

One critically important aspect of this project is the STEM outreach and education opportunities that take place to encourage and educate the next generation of caretakers of our land. In order to broaden participation of Idaho's tribal students, PD Hamilton is using a genetics-based STEM outreach program to engage tribal K-12 students in tribal schools across Idaho. This program uses a Lego "DNA sequencer" to teach kids about DNA, how DNA build genes, and how those genes produce the phenotypes we see. Called Nannoppolo' Lab (Chickasaw for 'monster'), children use four colors of LEGO blocks to "build" stretches of DNA. These genes are then "sequenced" by the sequencer - made of robotics and Arduino coding, and an output tells the student the characters that make up their monster (e.g. type of monster, number of eyes, number of legs, size, temperament, etc.). The students then draw and color their monster on an official sheet that they hang on their classroom wall and compare with other students. This type of STEM education has been identified by tribes as information they feel is important for the future of their tribes.
During the reporting period, the target audiences that were reached include K-12 students in the Couer d'Alene tribe (of Idaho), students from Owyhee HS (Idaho) AISES (The American Indian Science and Engineering Society), HOIST (Helping Orient Indian Students and Teachers into STEM) students visiting the University of Idaho for recruitment purposes, and the San Carlos Apache tribe (of Arizona). In the classroom, students play with LEGOs to learn about DNA and genetics. This program (Nannoppolo' Lab) uses a "LEGO DNA sequencer" to teach the students about DNA, how DNA build genes, and how those genes produce the phenotypes we see.
PD Hamilton held STEM workshops with San Carlos Apache youth to show how Western Science and Traditional Ecological Knowledge (with Apache tribal elder - Louie Lorenzo) can work together to better understand our world. This work occurred on the San Carlos Apache reservation, Arizona and the Pinaleno Mountains (Mt Graham). During the summer 2022 field class, 28 students were engaged in the classroom using Nannoppolo’ Lab: LEGO-based STEM workshop to teach K-12 students about genomics (from genotype to phenotype), and 35 kids were taken to Mt Graham with Lorenzo. In the Fall of 2022, Nannoppolo’ Lab was again used to engage 6th grade classes (36 students) and 7th grade classes (47 students) at the San Carlos Middle School.

Briefly describe how the broader public benefited from your project's activities.

The methods developed herein will be transferrable for outbreak detection in other pests that also undergo population explosions and the identified genomic regions could be targets for future pest management strategies (i.e., pesticides, RNAi of transcription factors, or CRISPR/Cas9). Being able to predict these outbreaks in the future will allow stakeholders the ability to mitigate forestry losses.Aditionally, this project will provide opportunities to engage Idaho's tribal K-12 students in biology related STEM, with hopes of stimulating their future interest in STEM-related fields and that they will bring this knowledge back to their tribes.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The only major challenge during the last reporting period was that we were unable to collect specimens of Coloradia pandora from the non-outbreaking populations.

During the reporting period, PD Hamilton has begun training a PhD student on Coloradia genomics.

Sustainability of forests and rangelands and economic opportunity associated with natural resources

Project Director
NaveGhimire
Organization
University of Idaho
Accession Number
7000220

Family Forest Owners in Idaho Panhandle

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Family forests are critical to timber supply, water, wildlife and many other shared values. Since 1987, the average annual timber harvest from these forests in the Idaho Panhandle has been over 167 million board feet, valued at over $100 million milled. Since 1997, family forests have provided 28 percent of the timber harvest in ten northern counties of Idaho.

Family-forest owners usually have multiple goals for their property. To give family-forest owners a better working knowledge of forest ecology, silviculture, and related forest management techniques, we provide the Idaho Forest Stewardship program, in collaboration with the Idaho Department of Lands and others.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

This program is an annual series of workshops, field days and other educational activities designed to strengthen forest owners' ability to implement practices that improve forest health and growth. Forest owners can also choose from over 140 forestry Extension publications and videos on water quality, selective logging, and forest tax management. Finally, the University of Idaho Extension Forestry website offers a large archive of short forestry publications on a variety of topics and a calendar of upcoming forestry education opportunities.

Briefly describe how your target audience benefited from your project's activities.

Because of this program, family-forest owners can sustainably produce more wood and biomass and simultaneously improve forest health, water quality, wildlife habitat and other forest values.

In 2021-2022, 664 owners (with a total of 46,286 family-forest acres) attended UI Extension workshops in the Idaho Panhandle. In our survey, 80% of respondents indicated increased knowledge and reported their intentions to put their new skills into practice to improve forest management. For example, 435 forest owners indicated they will monitor for insect, disease, or animal damage issues; 320 stated they would favor tree species that resist insects & disease; 165 would reduce unwanted vegetation; and 108 would monitor/manage weeds or other non-native invasive species.

Briefly describe how the broader public benefited from your project's activities.

In 2016, the University of Idaho Policy Analysis Group surveyed 2,869 Idaho forest owners. Compared to other forest owners, those who sought assistance from UI Extension had taken significantly more management actions on their forests and planned to do more activities in the next five years. Forest owners who had completed an 18-hour, six session UI Extension program titled "The Forestry Shortcourse" were significantly more likely to have completed 12 different forest management practices (e.g. thinning, planting) than respondents who had not.

Participants in short courses were also likely to have a written forest management plan for their property (73% of these had a written forest management plan, compared to 25% of forest owners had not completed the program).

Complete results of that survey are available at uidaho.edu/cnr/policy-analysis-group.

The improved management practices family forest owners implement as a result of knowledge and skills gained in UI Extension programs will increase wood and biomass to fuel Idaho's economy, maintain water quality, reduce catastrophic fire risk, improve forest growth and health, and enhance biological diversity.

Critical Issue

Health and Wellness

Improving Saftey and Health of Wildland Firefighters Through Personal Protective Clothing

Project Director
Sonya Meyer
Organization
University of Idaho
Accession Number
7002181

AR - Improving Saftey and Health of Wildland Firefighters Through Personal Protective Clothing

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In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The project is designed to assess and improve the personal protective equipment, clothing, of wildland firefighters. The project aims to address the issues of fit, comfort and accessability of needed supplies while working on firelines.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Focus group interviews were conducted with 5 PNW regional crews. Interview questions combined nutrition needs/concerns and PPE concerns. The transcripts were passed on to the PPE researcher late fall 2022 and are currently being reviewed for trend analysis. This joint project data collection is a result of anticdotal comments previously heard on the need for additional features in PPE for quick snacks, thus tying the two projects together. Premliminary analysis confirms issues raised in previous conversations with wildland firefighters as well as fit and comfort concerns with PPE.

Briefly describe how your target audience benefited from your project's activities.

Benefits are still being determined.

Briefly describe how the broader public benefited from your project's activities.

Further analysis and continued work on projects goals and objectives is needed to determine broader public benefit.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Information from the focus group interviews will be shared with other members of the project who focus more on functional apparel design. The information will also be used in combination of other project members work to develop educational materials for interagency fire teams.

Toward Building A Metacognitive Scaffolding Framework to Facilitate Young Children's Science Competency Development

Project Director
Shiyi Chen
Organization
University of Idaho
Accession Number
1025895

AR- Toward Building A Metacognitive Scaffolding Framework to Facilitate Young Children's Science Competency Development

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Early science education is facing both empirical and practical challenges. Empirically, most research on metacognition's application in science education focuses on older students. In practice, science education is typically overlooked in early childhood classrooms, this is partially because teachers are underprepared (e.g., the lack of science teaching knowledge and pedagogy) for teaching science to children

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

So far, I completed Study 1*: Identify teachers' current practice and challenges in early science teaching by employing a qualitative grounded theory study (Goal1&3)* and Study 2: *Determine the contribution of EMS and TCR in early science competency development using a quantitative study employing a multilevel design (Goal 2&3). S*tudies 1 and 2 generated four research conference presentations and two manuscripts (in preparation). I also created an early childhood educators' professional development (PD) program based on the results of the two studies. This PD program aims to enhance early childhood teachers' science teaching efficacy and content knowledge as well as young children's basic science knowledge, cognitive skills, and learning motivation. This PD was launched in fall 2022, a total of 20 teachers and 136 children participated. The program duration is fall 2022-spring 2023.

I'm currently collecting Study 3*: Determine the effect of the teachers' professional development program using a triangulation mixed methods study that includes a quasi-experimental study and a case study (Goal 4).* The pretest data was collected in fall 2022, I will start post test data collection in April 2023.

Briefly describe how your target audience benefited from your project's activities.

Early childhood teachers in this program participated in an experiential PD that teaches them basic scientific facts about local produce (e.g., beets, carrots, micro greens) as well as inquiry teaching strategies. Teachers and children also received curriculum, activity materials, and produce from local small farms (as learning materials).

Briefly describe how the broader public benefited from your project's activities.

Once the post-test data are collected, we will revise the PD program and the curriculum based on the study results. The revised curriculum will be published on our website. The materials can be downloaded free of charge.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

- Post test data collection

- Data analysis

- Publications

[Biology, Ecology & Management of Emerging Disease Vectors]

Project Director
Shirley Luckhart
Organization
University of Idaho
Accession Number
1021560

Conceptualizing ABA for mosquito vector and virus transmission control

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Mosquitoes are perhaps the most important biotic agents of human disease. Within this group, the top three genera responsible for transmitting pathogens of human medical importance are Anopheles, Aedes, and Culex, with Culex quinquefasciatus (main vector of West Nile virus, WNV) and Aedes aegypti (main vector of dengue virus, DENV) ranked as 1st and 2nd in worldwide importance. Cx. quinquefasciatus is established in the US and Ae. aegypti is a highly invasive global mosquito vector that has likely become established in TX and FL, with additional foci of concern in CA. Controlling the pathogens that these species spread has been challenging as efforts have been based almost entirely on understanding of mosquito biology to limit contact with humans, with vector control as the current primary intervention to block transmission of these viruses. Control of theses vectors is hampered by increasing resistance to both adulticides and larvicides.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

A new collaboration was established with colleagues who are expert in mosquito ecology and mosquito-virus interactions to develop a new method for mosquito control and arbovirus transmission blocking. The concept is to extend findings by the Luckhart lab on abscisic acid (ABA) biology in Anopheles mosquito-malaria parasite interactions to novel interventions for Cx. quinquefasciatus and Ae. aegypti.

Briefly describe how your target audience benefited from your project's activities.

If successful, the scope of ABA effects on the basic biology and vector competence will be established for Cx. quinquefasciatus and Ae. aegypti. This knowledge will, therefore, provide important foundational knowledge for the potential use of ABA as a novel agent for mosquito control and virus transmission blocking strategies.

Briefly describe how the broader public benefited from your project's activities.

These two mosquito species are primary vectors of major viruses of public health importance and, therefore, new control methods for these mosquitoes and the viruses they carry could substantially reduce disease burden in the US and abroad.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

At this point, additional preliminary data are needed to support our larger studies, which have not been initiated. If the team is successful in moving to larger studies, this work will provide significant training and professional development for affiliated personnel. Results would be disseminated through scientific meetings and with stakeholders as appropriate to the goals of the outreach efforts.

Closing Out (end date 06/07/2024)

Nutritional, Circadian, and Sampling Factors Impacting the Human Milk, Maternal Fecal, and Infant Fecal Microbiomes

Project Director
Michelle McGuire
Organization
University of Idaho
Accession Number
1020084

AR - Maternal and infant microbiomes - understanding variation and impact on health

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Understanding factors impacting the milk and infant fecal microbiomes and their consequences for human health are complex, requiring big data, carefully conducted scientific studies, and difficult computational approaches. The use of multi-omics to tackle this problem is likely critical, as is the standardization of milk collection and analyis techniques.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

In 2022, we conducted research, published several papers, and gave multiple presentations to a variety of audiences that advanced the science in terms of understanding the milk and infant fecal microbiomes. These are listed here.

Research

We analyzed human milk samples collected from healthy women and those suffering from subclinical and clinical mastitis for a variety of components, including holistic proteins, lipids, metabolites, and microbes. We used state-of-the-science "multi-omics" techniques to complete these analyses (e.g., proteomics, lipidomics, metabolomics, metagenomics, etc.). We are currently analyzing these data to understand signatures of risk of and resilience to mastitis. We also characterized the microbiomes of fecal samples from breastfeeding mothers who did and did not have COVID-19 to determine whether illness altered this important parameter of health.

Publications

The following papers related to our project were written and/or published in 2022.

Smilowitz JT, Allen L, Dallas D, McManaman J, Raiten DJ, Rozga M, Sela DA, Seppo A, Williams JE, Young B, **McGuire MK**. (2023) Ecologies, synergies, and biological systems shaping human milk composition—a report from Breastmilk Ecology and the Genesis of Infant Nutrition (BEGIN) Working Group 2. Am J Clin Nutr, in press. This paper was written in 2022.

Couvillion SP, Mostoller KE, Williams JE, Pace RM, Stohel IL, Peterson HK, Nicolra CD, Nakayusa ES, Webb-Robertson B-JM, McGuire MA, **McGuire MK**, Metz TO. (2023) Interrogating the milk microbiome in the multi-omics era. Front Microbiol. 14:1105675. doi: 10.3389/fmicb.2023.1105675. This paper was written in 2022.

Pace RM, Pace CDW, Fehrenkamp BD, Price WJ, Lewis M, Williams JE, McGuire MA, **McGuire MK**. (2022) Sodium and potassium concentrations and somatic cell count of human milk produced in the first six weeks postpartum and their suitability as biomarkers of clinical and subclinical mastitis. Nutrients, 14, 4708. https://doi.org/10.3390/ nu14224708

Abstracts

King-Nakaoka E, Morse A, Pace R, Williams J, Meehan C, Martin M, Ley SH, Barbosa-Leiker, McGuire MA, **McGuire MK**. (2023) Frequency and duration of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) in feces of breastfed infants of mothers with and without confirmed COVID-19. Pesented at the Western Student and Resident Medical Research Forum. JCarmel, CA. January 2023.

Morse A, King-Nakaoka E, Pace R, Williams J, Meehan C, Martin M, Ley SH, Barbosa-Leiker C, McGuire MA, **McGuire MK**. (2023) Frequency and duration of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) in feces of breastfeeding mothers with and without confirmed COVID-19. Presented at the Western Student and Resident Medical Research Forum. January 2023.

Pham C, Williams JE, Holdswoth EA, McGuire MA, **McGuire MK**, Meehan CL, Gartstein MA. (2022) Associations between fecal microbiome diversity and temperament traits in young infants: The MIMBES Study. Presented at the Annual meeting of the International Society for Developmental Psychobiology. November 2022.

Pace R, Pace C, Williams J, McGuire MA, **McGuire MK.** (2022) Metagenomic characterization of the human milk microbiota at the species level in relationship to mastitis. Presented at the biennial meeting of the International Society for Research in Human Milk and Lactation. Panama City, Panama. October 2022.

Williams J, Murdoch B, Pace R, McGuire MA, **McGuire MK**, the INSPIRE Consortium. (2022) Maternal genetics is associated with variation in human milk microbiome composition: the INSPIRE Study. Presented at the biennial meeting of the International Society for Research in Human Milk and Lactation. Panama City, Panama. October 2022.

Holdworth EA, Williams JE, Pace RM, Hagen EH, Lane AA, Garstein M, McGuire MA, **McGuire MK**, Meehan CL. (2022) Breastfeeding frequency is associated with differential abundance of bacteria in human milk. Annual Meeting of the American Association of Biological Anthropologists, Denver CO. March 24-26, 2022.

Holdsworth EA, **McGuire MK**, Williams JE, Pace R, McGuire MA, Hagen E, Gartstein M, Meehan CL. (2022) Modeling the mother-infant nexus in the milk and infant fecal microbiomes. Presented at the annual meeting of the American Anthropological Association. Seattle, WA. November, 2022.

Presentations (*denotes speaker)

*Meehan CL, **McGuire MK**. (2022) Understanding and interpreting variation in human milk composition. Annual Meeting of the American Anthropological Association, Seattle WA. Nov. 2022.

*McGuire MK (2022) Hot topics in human milk research. Meeting of the International Milk Genomics Consortium, Davis, California, Oct. 2022.

***McGure MK** (2022) Milk collection for research on COVID-19 and breastfeeding, Meeting of the International Society for Research in Human Milk and Lactation. Panama City, Panama, Oct. 2022.

***McGuire MK**, *Meehan C. (2022) Human milk and breastfeeding: Scientific challenges, paradigm shifts, and unanswered questions. Washington State University “Pub Talk” series. Pullman, WA, September, 2022.

***McGuire MK** (2022) The human microbiome: a primer. Culinary Base Camp, University of Idaho, June 2022.

***McGuire MK** (2022) The human milk microbiome – What’s normal? Thriving brains and bodies: Nutrition from infancy to conception. Oregon Health and Science University Center for Global Child Health Research, Portland, Oregon. April, 2022.

***McGuire MK** (2022) The human milk microbiome – A brief review of a recent paradigm shift. Metabolomics Association of North America Microbiome Interest Group. Delivered virtually due to the SARS-CoV-2 pandemic. March, 2022.

***McGuire MK** (2022) Human milk: What do we know, and more importantly, what don’t we know? The Diane Anderson Neonatal Nutrition Conference, Texas Children’s Hospital. Delivered virtually due to the SARS-CoV-2 pandemic. February, 2022.

Briefly describe how your target audience benefited from your project's activities.

These activities (most of which targeted scientific audiences) will help inform scientists interested in understanding milk and fecal microbiomes about how samples should be collected and analzyed, and what the impact of variation might have on human health.

Briefly describe how the broader public benefited from your project's activities.

The broader public will benefit from this activity because it will help pave the wave to a better understanding of the human milk microbiome, which is likely an important colonizer of the infant gastrointestinal tract.

E. coli Probiotic Carrying a Conjugative Plasmid Engineered with CRISPR-Cas9 to Control Pathogens

Project Director
Carolyn Bohach
Organization
University of Idaho
Accession Number
1013175

E. coli Probiotic Carrying a Conjugative Plasmid Engineered with CRISPR-Cas9 to Control Pathogens

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The enterohemorrhagic E. coli (EHEC) are human pathogens carried as part of the normal and transient gastrointestinal flora of healty cattle.

Novel approaches to eliminate these bacteria from ruminants will increase the safety of our food supply.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

A bacterial conjugative plasmid was constructed using CRISPER with a guide RNA specific for genes ONLY found in pathogenic bacteria. This plasmid is similar to those normally carried by bacteria in the bovine gastrointestinal tract. the plasmids normally replicate and are normally passed from bacteria to bacteria. Our contruct, when passed between bacteria will kill only teh EHEC pathogens.

Briefly describe how your target audience benefited from your project's activities.

Cattlemen, dairymen, and everyone who consumes meat or dairy products.

The work also has applications for lamb/sheep industry and consumer.

Briefly describe how the broader public benefited from your project's activities.

The work explores a novel and potentially inexpensive way to improve the safety of the food supply against EHEC and Salmonella....and other Gram-negative foodborne pathogens.

Critical Issue

Horticulture and Small Farms

Sustainable use of land, plants, and food

Project Director
Naveen Ghimire

Organization
University of Idaho
Accession Number
7000221

Harvest Heroes Beginning Farming and Gardening Education

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

According to the US Census Bureau, an estimated 115,437 veterans live in Idaho. However, the Idaho veteran population is often an underserved community that faces issues of food insecurity and job security and is not always connected with available resources.

Our course participants of US military veterans and their families have either been interested in learning to grow food for their families in urban settings or looking for opportunities for agricultural entrepreneurship to raise crops and livestock for both home use and sale.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

To meet those needs, we provide a Harvest Heroes Beginning Farming and Gardening program. The program provides eight months of training and experiential education to US military veterans and their families interested in home and community food production and small-farm entrepreneurship. In the third year of the program, we enrolled 10 veterans in 2022.

Briefly describe how your target audience benefited from your project's activities.

Six of our original ten applicants completed the ten-month combined classroom and field components. They grew and harvested 1762.85 lbs. of produce at an approximate dollar value of $3,424.

Briefly describe how the broader public benefited from your project's activities.

The food, along with recipe ideas, was donated to the Boise Rescue Mission's Lighthouse shelter, community meals and neighborhood food-box distribution, and also the Caldwell WICAP food pantry.

By helping US military veterans and their families become self-sustainable and have greater access to fresh produce, there are potential cost savings on the system as a whole.

Critical Issue

Water

[Social-ecological resilience and water system robustness]

Project Director
Nav Ghimire
Organization
University of Idaho
Accession Number
7000219

Gooding Community Garden

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Many Gooding County community members lack access to fresh produce for diverse reasons, impacting their input of nutritive fresh vegetables and their overall nutrition and access to food. Urban and agricultural conservation practices that reduce water use and nutrient loss to leaching and runoff are lacking, and education about them is needed.

Many Gooding County citizens supplement their food needs through food banks, sub-kitchens, and other methods of accessing food. However, most of those food-donation hubs don't have access to fresh vegetables and need support from diverse organizations to operate. This need was especially evident during the COVID-19 pandemic, where volunteer organizations dealing with in-need people were stretched thin. Some citizens want to grow their own vegetables, but they don't have the space and sometimes knowledge to do so.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

To help citizens reduce water use, water contamination, and nutrient losses in urban and agricultural settings, we developed the Gooding Community Garden—a demonstration unit to increase understanding and adoption of such practices.

The Gooding Soil Conservation district and the University of Idaho Extension Gooding County obtained a second grant from the National Association of Conservation Districts for an additional $50,000. These funds covered a community garden manager, the cost of a greenhouse and its operation.

Briefly describe how your target audience benefited from your project's activities.

150 participants observed demonstration plots on cover crops, composting, water runoff capture and drainage, pollinator habitat, and vegetable gardening with water-saving techniques. This helped teach community members self-sufficiency, nutrition, water conservation, and maintaining water quality in their communities.

Ten people visiting and participating at the Gooding community garden have consulted our Extension office for low watering grasses, cover crops use, composting, and other water saving and nutrient retention/saving techniques.

The community garden distributed more than 4,000 lbs. of fresh produce to seven institutions (food banks, etc.) helping people meet their daily access to food. Recipients of the harvested and distributed produce increased their access to fresh vegetables.

Cost saved because of the garden is $4 per pound of produce donated. Since we donated 4000 lb. to about 200 people, we estimate about $16,000 in cost saved for our citizens.

Briefly describe how the broader public benefited from your project's activities.

Our community garden with demonstration plots on cover crops, composting, water runoff capture and drainage, pollinator habitat, and vegetable gardening with water-saving techniques help teach community members about self-sufficiency, nutrition, water conservation, and maintaining water quality in their communities.

Management and Policy Challenges in a Water-Scarce World

Project Director
Alexander Maas
Organization
University of Idaho
Accession Number
1021266

Evaluate and compare alternative water quantity and quality management strategies and institutions.Nothing Significant to Report

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In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The Elk River chemical spill in West Virginia resulted in the contamination of the local water supply with a chemical used in coal processing. The result was the possible contamination of drinking water for nearly 300,000 residents in the Charleston metropolitan area.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We conducted a hedonic valuation of properties in the area to estimate the damages from this spill. Hedonic valuation involves assessing the economic impact of environmental damage by analyzing changes in property values. Basically, we compare property values in the affected area before and after the incident. Regression techniques are used to isolate the effect of the spill on property values.

Briefly describe how your target audience benefited from your project's activities.

Quantifying the reduction in property values associated with the spill, we can estimate the economic damages incurred by the community. This approach helps assign a monetary value to the environmental harm caused by the chemical spill, aiding in legal and policy considerations for compensation and remediation efforts.

Briefly describe how the broader public benefited from your project's activities.

The public did not directly benefit from this project given our current legal framework. One week after the spill, roughly 25 lawsuits were brought against the company responsible, which subsequently filed for bankruptcy. Thus, the benefits of their production were privatized, but the costs of this spill were largely pushed onto the public. As such, the magnitude, temporal persistence, and spatial extent of these losses have significant implications for public welfare and policy. Hopefully this type of work can provide empirical bounds and raise public awareness around such issues, to ultimately create more equitable and fair policies/laws.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

N/A

Type	Projects / Programs
Projects / Programs without a Critical Issue	**0**

Not Provided