

**OWC**  
**OREGON WHEAT COMMISSION**

**FY 26-27 Research  
Proposals**

**Three Year Summary of Request/Funded\***  
*\*excludes endowments and undesignated dollars*

<b>Research Proposals</b>	<b>Funded 2024-25</b>	<b>Funded 2025-26</b>	<b>Requested 2026-27</b>
<b>Wheat</b>	665,349	699,689	752,086
<b>Barley</b>	35,000	1,500	0
<b>Tri-State</b>	78,668	80,250	81,250
<b>Total</b>	<b>779,017</b>	<b>781,439</b>	<b>833,336</b>



## OREGON WHEAT COMMISSION

### Research Summary

Research: Continuation Projects	Requested 2026-27
<b>Barroso</b> / Weed Management Research in Wheat Cropping Systems of Eastern Oregon	43,513
<b>Chen</b> / WSU - Improving Control of Wheat Stripe Rust	12,000
<b>Graebner</b> / Wheat and Barley Variety Testing in Oregon	175,400
<b>Graebner</b> / Breeding High Quality Hard Red Spring Wheat for Oregon	2,000
<b>Hagerty</b> / Utilizing Fungicides in the absence of Foliar disease for potential plant health	3,000
<b>Hagerty</b> / Disease notes and graduate student support	8,800
<b>Kiszonas</b> / Quality of varieties & pre-release lines: 'G&E' Study, Advancing Wheat	64,000
<b>Kiszonas</b> / One third Miag Mill	5,250
<b>Krause</b> / Developing Improved Winter Wheat Cultivars for Oregon	274,200
<b>Krause</b> / Gene Introgression and Trait Prediction for new and improved OSU wheat	69,000
<b>Ross &amp; Kongraksawech</b> / OSU Cereal Quality Laboratory	95,500
<b>Total</b>	<b>752,663</b>

Research: New Projects	Requested 2026-27
<b>Barroso</b> / Predicting Weed Emergence in Wheat Cropping Systems	6,647
<b>Berry</b> / Evaluating Indaziflam Carryover Risk	18,100
<b>Dung</b> / Characterizing Pathogens	9,912
<b>Hayes, Swackhamer and Dallas</b> / Elucidating human gut health benefits	24,717
<b>Powell</b> / Controlling Horsetail in wheat fallow in North Central Oregon	6,297
<b>Ribeiro</b> / Evaluating Herbicide Programs for Italian Ryegrass Control in Winter Wheat	15,000
<b>Total</b>	<b>80,673</b>

**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

Title: Developing Improved Winter Wheat Cultivars for Oregon

Investigator(s): Margaret Krause, Oregon State University - Corvallis

Cooperator(s): Andrew Ross, Oregon State University (OSU) - Corvallis, end-use quality evaluations; Ryan Graebner, OSU - Columbia Basin Agricultural Research Center (CBARC), field trial management assistances; Christina Hagerty, OSU - CBARC, disease resistance evaluations; Vishal Singh, OSU - remote, data analysis and interpretation

Funding History: 2025–26: \$257,899; 2024–25: \$245,913; 2023–24: \$217,080

Abstract: The development of new winter wheat cultivars that can address current and future needs of the wheat industry in Oregon and the Pacific Northwest (PNW) is essential to the profitability of Oregon wheat producers. Important market classes include soft white winter (SWW), hard red winter (HRW), and winter club wheat. To produce and release superior cultivars, the Oregon State University (OSU) wheat breeding program leverages a combination of conventional and emerging breeding techniques to improve productivity, biotic and abiotic stress resistance/tolerance, and end-use quality, and to incorporate competitive traits, e.g., herbicide tolerance. New genetic material harboring genes for these traits are crossed with elite OSU lines in an offseason greenhouse. The first through fourth generations are evaluated in the field to identify experimental lines with desired trait levels. The fifth through eighth generations are evaluated in yield trials in eastern and western Oregon for yield potential, agronomic adaptability, multiple disease resistance, milling/baking quality, and herbicide tolerance efficacy. By the ninth and tenth generations, elite lines are evaluated in breeding and extension trials in Oregon to identify potential cultivars. These lines are also entered into regional extension trials in Washington and Idaho for evaluation under broader climatic conditions and to assess marketability. Prior to release, the PNW Wheat Quality Council evaluates all potential cultivars to confirm end-use quality profiles. The overall goal of this project is to provide Oregon growers with improved wheat varieties to maximize profitability while minimizing risk. The current funding cycle would support the evaluation of material planted in the fall of 2025 as well as the sowing of trials in preparation for the 2027 crop. Finally, data collected in breeding trials will be leveraged to test emerging trait prediction and selection approaches to test their potential utility and benefit to the breeding program.

Objective(s):

*Objective 1:* To develop new SWW, HRW, and winter club wheat cultivars adapted to the high rainfall, low rainfall, and irrigated wheat-growing regions of eastern and western Oregon that have superior biotic and abiotic stress resistance/tolerance in minimize production risks and increase economic returns to growers. Measurable results: 1) Release varieties have confirmed resistance to most of Oregon’s relevant diseases; 2) Release varieties are broadly adapted and rank within the top ten highest-yielding entries at multiple locations of the Oregon State University Extension Variety Trials.

*Objective 2:* To increase demand and marketability of PWN wheat through the development of soft and hard winter wheat cultivars with superior end-use quality. Measurable results: 1) Released varieties rank “Most Desirable” or “Desirable” on Preferred Varieties List; 2) Entries to the Pacific Northwest Wheat Quality Council are reviewed favorable.

*Objective 3:* To identify and implement molecular genetics, genomics, phenomics, and biochemical approaches to select for disease resistance, adaptation, and end-use quality traits. Measurable results: Approaches that have been identified to improve breeding efficiency and output have been implemented in the breeding pipeline.

*Objective 4:* To develop SWW, HRW, and winter club cultivars with herbicide resistance for use by Oregon wheat producers to manage grassy weeds. Measurable results: Clearfield and CoAXium varieties are developed, released, and commercially available.

Procedures: ***Objective 1 – To develop new SWW, HRW, and winter club wheat cultivars adapted to high rainfall, low rainfall, and irrigated regions that have superior biotic/abiotic stress resistance/tolerance***

The first stage of the breeding program will involve the development of a winter greenhouse crossing program that produces progeny with unique genetic combinations. Released cultivars and advanced experimental lines from the OSU breeding program and other regional breeding programs that show superior agronomic performance and favorable molecular marker profiles will be used as parents for crossing. Parental lines from other regions may also be included if they are found to be donors of certain types of biotic/abiotic stress resistance. As an example, breeding lines from the Washington State University winter wheat breeding program were included in the 2024 crossing block. A new crossing strategy was implemented in 2024. For the 2025–2026 crossing block, the program leveraged genome-wide data to inform crossing for the first time in the program’s history.

The first through fourth generations will be evaluated in the field in Corvallis and Pendleton to identify and select lines with disease resistance, height, straw strength, and maturity. The material will likewise be evaluated at the molecular level to identify lines that carry genes for desired stress resistance/tolerance and end-use quality traits. The fifth and sixth generations will be evaluated in replicated preliminary yield trials in Corvallis, Moro, and Pendleton for yield, agronomic adaptability, disease resistance, and milling quality. The seventh and eighth generations will be evaluated at multiple locations throughout the state that vary in terms of rainfall environments and tillage regimes.

In addition to the core breeding sites at Hyslop (conventional), Hermiston (HAREC – conventional/irrigated), Moro (CBARC – no-till), and Pendleton (Ruggs Ranch – conventional), trials will be planted at several satellite test sites to evaluate the performance of breeding lines across a wide range of production conditions. Conventional test sites have been sown in Forest Banks/Cornelius, La Grande, and Milton-Freewater, while no-till trials have been sown at Lexington and Moro/Kaseberg for the 2026 season. The goal of this multi-location, multi-year

trialing program will be to identify breeding lines with yield stability and improved resistance to biotic and abiotic stresses. Elite lines from the ninth and tenth generations will be provided to Dr. Ryan Graebner of the OSU Cereal Extension program for evaluation in the Statewide Soft and Hard Winter Wheat extension nurseries.

Genetic resistance is often the most cost effective and environmental means of disease control. Disease screenings will begin the fifth and sixth generations in collaboration with Dr. Christina Hagerty. Dr. Hagerty will evaluate breeding lines for resistance to stripe rust *Fusarium crown rot* in inoculated and naturally infested fields in eastern western Oregon. Resistance to *Septoria* will be evaluated in trials grown in western Oregon. A field location near Irrigon in which consistently high levels of soil-borne wheat mosaic virus (sbWMV) occur will be used as a sbWMV resistance screening nursery. In addition to these collaborative efforts with the OSU cereal pathologists, breeding material will be sent to USDA-ARS Pathologist Dr. Xianming Chen for evaluation in stripe rust trials in Pullman, Washington.

**Objective 2** – Maintaining and improving wheat end-use quality parameters will be carried out concurrently with breeding for agronomic performance and biotic/abiotic stress resistance. Collaborators Dr. Andrew Ross and Teepakorn Kongraksawech will conduct in-house micro-analyses for rapid evaluation of material at early breeding stages as well as macro-testing to determine base product quality at intermediate stages. These include screenings for polyphenol oxidase (PPO, which causes dough discoloration), break flour yield, and sodium dodecyl sulfate-sedimentation volume (which indicates gluten strength and overall baking quality). Based on the results of these assays, Dr. Ross will make recommendations of elite breeding material to send for intensive milling and baking tests in collaboration with Dr. Alecia Kiszonas of the USDA-ARS Western Wheat Quality Laboratory.

Improvement of SWW will be the primary focus of the breeding program, accounting for approximately 75 percent of the program's effort. Improving SWW quality for cookie and cake production through the development of extra-soft, low PPO breeding lines will be a high priority. The other 25 percent of the breeding program efforts will be allocated to quality improvement HRW and winter club wheat lines for end-use markets. Breeding activities for HRW began in 2013, and the program is focused on bringing together yield potential, disease resistance, adaptation to Oregon growing conditions, and superior bread-baking quality in candidate breeding lines for release. The breeding program initiated winter club wheat breeding in 2016, and breeding activities are currently being led by program Faculty Research Assistant Mark Larson. Selection of club wheat lines is based on agronomic performance at eastern Oregon testing locations. Molecular markers for club wheat-specific glutenin profiles are leveraged to increase breeding efficiency.

**Objective 3** – While the OSU breeding program has successfully leveraged diagnostic markers for several disease resistance and end-use quality genes, extensive research in wheat and other crops has shown that “genomic selection”, which utilizes far greater numbers of genome-wide markers, is more effective than the use of diagnostic markers when the traits of interest are controlled by many genes. Since many of the most agronomically and economically important traits are genetically controlled in this way, there is a high likelihood that genomic selection will increase the rate of genetic improvement in the OSU wheat breeding program. To date, the utility of genomic selection has not been evaluated within the context of the OSU wheat breeding program. In 2024, genome-wide data were generated for OSU wheat breeding material for the first time by the USDA-ARS Western Regional Small Grains Genotyping Laboratory. Additional genome-wide data were generated in 2025. These data will be combined with agronomic data to test the accuracy of genomic selection models for several traits, including but not limited to grain yield, test weight, disease resistance, and end-use quality. If these models are found to be predictive, the program will begin to initiate a genomic selection pipeline that will enable the

recycling of superior breeding lines back into the crossing program to serve as parents approximately three to four years earlier than they otherwise would be.

“Phenomic selection” is an additional trait prediction technique that utilizes near-infrared spectroscopy (NIRS) instead of genomic markers as predictors. Phenomic selection has the potential to be much cheaper than genomic selection, enabling its usage at earlier breeding stages when the number of breeding lines in the program is extremely large. Like genomic selection, phenomic selection has not yet been evaluated for its potential utility within the OSU wheat breeding program. During the 2024 and 2025 seasons, a subset of breeding trials was harvested using a Harvest Master H3 GrainGage. This device collected raw NIRS data on the samples as the grain passed through the combine. In collaboration with Dr. Andrew Ross, NIRS data on the same grain samples will be collected using a benchtop diode array. These samples will then be sent to the USDA-ARS Western Wheat Quality Laboratory for milling and bake testing. Once complete, this dataset can be used to evaluate phenomic selection approaches for their potential application within the OSU wheat breeding program. A major priority will be placed on the evaluation of prediction models for end-use quality, as this would open up the possibility of selecting for quality traits at early generation stages of the breeding program.

*Objective 4* – A large number of advanced and elite Clearfield or CoAXium herbicide-resistant lines from the SWW, HRW, and club wheat market classes will be evaluated in the field for agronomic performance and herbicide resistance. Many lines have shown good resistance to stripe rust, high yield potential, and acceptable to desirable end-use quality. Newer breeding lines currently in efficacy testing show a wide range of height, heading dates, and disease resistance, providing an array of potential breeding lines for adaptation to different wheat production zones in Oregon. Efficacy testing will be conducted at four locations in Oregon in accordance with the requirements for the release of herbicide-resistant lines.

Timelines:

Below is a general timeline of activities performed for the four objectives:

*Summer 2026:* Maturity measurements (e.g., plant height, lodging). Harvest of all field trials. Processing of harvest samples. Grain quality measurement (e.g., protein, test weight). Trial preparation and seed packaging for planting. Dissemination of results at extension field days.

*Fall 2026:* Planting of all field trials at all testing locations.

*Winter 2026–2027:* Crossing parental lines in the greenhouse to develop new breeding progeny. Tissue sampling and genotyping for diagnostic and genome-wide markers. Milling and baking quality testing. Testing genomic and phenomic prediction models. Industry meetings with growers and collaborators.

*Spring 2027:* Disease resistance and some agronomic measurements. Testing site field management. Spraying herbicide tolerance efficacy trials.

Justification:

Winter wheat is the major cereal crop grown in Oregon and represents a substantial component of the agricultural economy of the state. Previous investments in wheat breeding have provided considerable economic returns to Oregon growers through the development, deployment, and production of high-yielding, disease-resistant varieties that are adapted to the state’s varied growing conditions and show superior end-use quality. An additional benefit of the proposed activities is that OSU varieties and breeding stocks are available for use by other breeding

programs in the region as parents. This has the potential to improve the overall agronomic performance, disease resistance, and end-use quality of the wheat grown in PNW. Wheat diseases, management practices, production limitations, and market needs are ever-changing, and there is therefore a need for an ongoing commitment to variety development to ensure stability and economic viability of the wheat industry in Oregon. In order to reach this goal, it is likewise important for the OSU breeding program to continuously evaluate emerging breeding technologies that have the potential to enhance the efficiency of the breeding pipeline, identify the most promising breeding lines, and shorten variety development and release timelines.

Budget:

Salaries and Fringe		
Faculty Research Assistants (0.32: Larson, Heesacker; 0.7100: Hansen)		\$115,005
Hourly student workers		\$70,000
Operating		
Supplies		\$6,000
Land and greenhouse charges		\$34,200
Fuel and vehicle maintenance		\$11,500
Equipment		\$7,500
Travel (domestic and in-state)		<u>\$30,000</u>
Total		\$274,200

Matching funds of \$111,169 include 1.0 FTE for Dr. Margaret Krause for 9 months, 0.68 FTE for Mark Larson and Adam Heesacker, and 0.23 FTE for Faculty Research Assistant Nathalia Moretti. The royalties estimate is \$90,000.

Relation to Other Research:

This research is related to Dr. Krause’s current U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA) Agriculture and Food Research Initiative (AFRI) Coordinated Agricultural Project grant “Leveraging high-throughput genotyping and phenotyping technologies to accelerate wheat improvement.” Dr. Krause is a co-PI and is receiving a \$346,661 subaward from University of California–Davis out of the total project budget of \$15million for five years. The project is currently in year five, which will end on 31 December 2026. The funds are currently being used to support the graduate studies and dissertation research of Ph.D. student Dalton Jones. Dalton’s projects involve evaluating genomic selection, phenomic selection, and drone-based imaging systems for improving breeding efficiency.

This research is also related to Dr. Krause’s current Foundation for Food & Agriculture Research (FFAR) New Innovator in Food & Agriculture Research Award “Big data to improve and sustain wheat end-use quality in the face of increasingly variable climate scenarios.” Dr. Krause is the lead PI and is receiving \$322,128 for three years. The project is currently in year two. The funds are being used to support Postdoctoral Scholar Dr. Vishal Singh’s research on the impacts of weather conditions on end-use quality in wheat.

**CURRENT AND PENDING SUPPORT**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>

<b>Current:</b>					
J. Dubcovsky & 37 other key personnel	USDA-NIFA-AFRI	\$15million, subaward \$346,661	01/01/2022–12/31/2026	5	CAP for Innovation in Genomic Technology to Accelerate Breeding: “Leveraging high-throughput genotyping and phenotyping technologies to accelerate wheat improvement”
M. Krause	FFAR New Innovator Award in Food & Agriculture Research Award	\$322,128	01/01/2024–12/31/2026	5	Big data to improve and sustain wheat end-use quality in the face of increasingly variable climate scenarios
J.E. Rutkoski, M. Krause	USDA-NIFA-AFRI	\$799,998 subaward \$262,193	06/01/2023–05/31/2026	5	PARTNERSHIP: Phenomic assisted genomic selection to accelerate grain yield improvement in small grains
M. Krause	Oregon Wheat Commission	\$257,899	07/01/2025–06/30/2026	30	Developing improved winter wheat cultivars for Oregon
M. Krause	Oregon Wheat Commission	\$56,194	07/01/2025–06/30/2026	5	Gene introgression and trait prediction for developing new and improved Oregon State University wheat cultivars
M. Krause	Oregon Wheat Commission	\$1,000	07/01/2025–06/30/2026	4	Bringing ‘Successor’ spring feed barley to Oregon
M. Krause	American Malting Barley Association	\$60,000	07/01/2025–06/30/2026	4	Optimizing disease resistance, low temperature tolerance, and water sensitivity via accelerated development of two-row winter and facultative malting barley varieties
M. Krause	USDA-ARS-NACA BSR/BPI	\$58,206	07/01/2025–06/30/2026	4	Barley stripe rust, scald, and BYDV resistance in wild and cultivated barley
M. Krause	USWBSI	\$89,435	07/01/2025–06/30/2026	4	Germplasm acceleration for FHB resistance breeding in barley
M. Krause	USDA-ARS-NACA SGGI/TTKSK	\$206,169	11/01/2025–10/31/2026	4	Northwest-adapted barleys for resistance to stem rust (UG99)
K. Vining & 13 other key personnel	Oregon State University College of Agricultural Sciences Hatch	\$40,000 subaward \$3,300	05/07/2024–09/30/2029	1	Improving plant productivity and resilience in a changing climate
<b>Pending:</b>					
M. Krause ( <i>this proposal</i> )	Oregon Wheat Commission	\$274,200	07/01/20256–06/30/2027	30	Developing improved winter wheat cultivars for Oregon
M. Krause	Oregon Wheat Commission	\$69,000	07/01/20256–06/30/2027	5	Gene and value-added trait introgression for developing new and improved Oregon State University wheat cultivars
M. Krause	USWBSI	\$92,000	05/01/2026-04/30/2027	4	Producing FHB-resistant doubled haploids in barley
M. Krause, C. Hagerty, M. Reynolds	USDA-NIFA-AFRI	\$800,000	09/01/2026-08/31/2029	4	PARTNERSHIP: Genomics- and physiology-informed wheat cultivar mixtures to maximize yield and manage risk due to biotic and abiotic stress
G. Vargas Gutierrez, P. Busby, J. LeBoldus, C. Still, M. Krause	USDA-NIFA-AFRI	\$649,977	05/01/2026-04/30/2029	2	The KCS switch: a functional genetics approach to regulating water use efficiency in poplar

K. Frels, M.I. Ibba, K. Campbell, D. Rose, A. Carter, J. Anderson, M. Krause, E. Olson, N. DeWitt, X. Zhang	USDA-NIFA-AFRI	\$799,645 subaward \$18,001	06/01/2026- 05/31/2029	2	PARTNERSHIP: Bread for health: developing arabinoxylan-enriched wheat for improved dietary fiber intake in the US diet
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**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

**Title:** Gene and Value-Added Trait Introgression for Developing New and Improved Oregon State University Wheat Cultivars

**Investigator(s):** Margaret Krause, Oregon State University - Corvallis

**Cooperator(s):** Andrew Ross, Oregon State University (OSU) - Corvallis, end-use quality evaluations; Ryan Graebner, OSU - Columbia Basin Agricultural Research Center (CBARC), field trial management assistances; Christina Hagerty, OSU - CBARC, disease resistance evaluations; Vishal Singh, OSU - remote, data analysis and interpretation

**Funding History:** 2025–26: \$56,194; 2024–25: \$65,517; 2023–24: \$62,080

**Abstract:** Introducing genes into Oregon State University (OSU) wheat germplasm for herbicide tolerance, biotic / abiotic resistance and end-use quality can be challenging depending on the source of the gene(s). Using cultivars or breeding lines that are not adapted to Oregon growing conditions or are in a different market class of wheat as the source of the desired genes results in linkage drag where undesirable genes/traits are also transferred with the desired gene. To speed the transfer or introgression of the desired traits/genes molecular markers can be used to select lines carrying the desired genes each generation to ensure the gene is maintained in the intermediate and advanced generation breeding lines. The proposed research continues the process of transferring genes for disease resistance to barley yellow dwarf virus (Bydv2), soilborne wheat mosaic virus (sbm1), and Fusarium head blight resistance (Fhb1)); herbicide resistance to Beyond (Clearfield) and Aggressor (CoAxiom) herbicides; and end-use quality traits such as low polyphenol oxidase (PPO) reaction. Molecular techniques will also be applied to assist Oregon wheat growers with confirmation of herbicide-resistant varieties when questions arise after planting. Finally, emerging genomic and phenomic selection breeding techniques will be evaluated for their utility to select for traits of interests, with a special emphasis on end-use quality characteristics.

**Objective(s):**

*Objective 1:* Develop wheat breeding lines of soft white winter (SWW), hard red winter (HRW), and club winter wheat carrying genes for improved disease resistance and low polyphenol oxidase (PPO) reaction. Disease resistance genes being screened include: stripe rust (Yr5 and Yr15), strawbreaker foot rot (Pch1 and Pch2), soilborne wheat mosaic virus (Sbm1), barley yellow dwarf virus (bdv2), and Fusarium head blight resistance (Fhb1).

*Objective 2:* Transfer genes for CoAXium herbicide resistance into SWW, HRW, and club winter wheat; to screen HRW and SWW CoAXium lines in the field in eight locations for herbicide efficacy, disease resistance, and agronomic performance.

*Objective 3:* Assist Oregon wheat growers with variety confirmation (herbicide resistance) using molecular techniques when questions arise post-planting.

*Objective 4:* Evaluate genomic and phenomic selection approaches to predict and select for end-use quality characteristics.

Procedures:

*Objective 1* – Breeding lines from other land grant universities are being used as parents for crossing in order to transfer resistance to barley yellow dwarf virus (BYDV), soilborne wheat mosaic virus (sbWMV) and Fusarium head blight (FHB) into OSU SWW, HRW and winter club cultivars and advanced breeding lines. Breeding lines carrying resistance genes (Bydv2, Wmv1 and Fhb1) for these diseases are now in advanced seventh-generation yield trials. Molecular screening is being performed to identify lines carrying these genes to ensure that the resistance genes are maintained within the breeding program. Lines that are likewise found to have superior agronomic performance and end-use quality will be recycled as parents within the crossing program.

PPO activity causes darkening and discoloration of dough made for wheat flour and is generally considered to be an undesired characteristic by the baking industry. To meet the needs of the baking industry, crosses were made to transfer a ‘null’ PPO gene from a Montana State University breeding line into OSU hard white winter (HWW) wheat breeding material with the goal of the development and release of low PPO wheat varieties. The OSU HWW lines carrying the null PPO gene were used as parents to transfer the null PPO gene into SWW and HRW cultivars and advanced breeding lines. SWW and HRW intermediate to advanced generation lines with low PPO are now under evaluation in the field for agronomic performance.

*Objective 2* – CoAXium herbicide resistance is a relatively new type of herbicide resistance in wheat that provides resistance to a grassy weed herbicide that has little to no soil residual. HRW breeding lines from Colorado State University carrying the CoAXium herbicide resistance were received at OSU in October 2017. A two-year project was initiated in the winter of 2018 to rapidly transfer the herbicide resistance genes into all the market classes of wheat currently being developed at OSU. Utilizing molecular markers, SWW, HRW, and winter club breeding lines carrying the two resistance genes for Aggressor herbicide have been developed. Efficacy trials of HRW and SWW CoAXium lines were sown at four testing sites and will be evaluated to identify superior breeding lines for herbicide resistance, agronomic performance, and disease resistance. Breeding lines that are selected will undergo screening with molecular markers to ensure that they contain both CoAXium resistance genes for a minimum of 95 percent of the plants tested.

*Objective 3* – Periodically, Oregon wheat growers have approached the OSU wheat genetics program with questions concerning which variety they intend to plant or if they planted the correct variety. When possible, the OSU wheat genetics program will utilize molecular markers to confirm the presence or absence of herbicide-resistant genes and/or identify the variety. Support staff Hilary Gunn will perform the genotyping protocols.

*Objective 4* – While the OSU breeding and genetics programs have successfully leveraged diagnostic markers for various disease resistance and end-use quality genes over several years, extensive research in wheat and other crops has shown that “genomic selection”, which utilizes far greater numbers of genome-wide markers, is more effective than the use of diagnostic markers when the traits of interest are controlled by many genes. Since many of the most agronomically and economically important traits are genetically controlled in this way, there is a high likelihood that genomic selection will increase the rate of genetic improvement in the OSU

wheat breeding program. To date, the utility of genomic selection has not been evaluated within the context of the OSU wheat breeding program. In 2024, genome-wide data were generated for OSU wheat breeding material for the first time by the USDA-ARS Western Regional Small Grains Genotyping Laboratory. Additional genome-wide data was generated in 2025 and will be combined with data acquired in 2026. These data will be combined with agronomic data that is already routinely collected within the breeding program to test the accuracy of genomic selection models for several traits, including but not limited to grain yield, test weight, disease resistance, and end-use quality. If these models are found to be predictive, the OSU wheat genetics program will begin to develop a data analysis pipeline for genomic selection that will enable the recycling of superior breeding lines back into the crossing program to serve as parents approximately three to four years earlier than they otherwise would be. The ability to analyze trait observations and genomic data in a timely fashion to develop predictions and inform parental selection is critical given the short time interval between field harvest and planting of selected parents in the greenhouse for crossing.

“Phenomic selection” is an additional trait prediction technique that utilizes near-infrared spectroscopy (NIRS) instead of genomic markers as predictors. Phenomic selection has the potential to be much cheaper than genomic selection, enabling its usage at earlier breeding stages when the number of breeding lines in the program is extremely large. Like genomic selection, phenomic selection has not yet been evaluated for its potential utility within the OSU wheat breeding program. During the 2024 and 2025 seasons, a subset of breeding trials was harvested using a Harvest Master H3 GrainGage. This device collected raw NIRS data on the samples as the grain passed through the combine. In collaboration with Dr. Andrew Ross, NIRS data on the same grain samples will be collected using a benchtop diode array. These samples will then be sent to the USDA-ARS Western Wheat Quality Laboratory for milling and bake testing. Once complete, this dataset can be used to evaluate phenomic selection approaches for their potential application within the OSU wheat breeding program. A major priority will be placed on the evaluation of prediction models for end-use quality, as this would open up the possibility of selecting for quality traits at early generation stages of the breeding program. Additional models that combine both NIRS and genomic data will be evaluated to determine whether the integration of both data types can improve trait predictions. Ph.D. student Dalton Jones will carry out the data analyses.

#### Timelines:

Below is a general timeline of activities performed for the four objectives:

*Objective 1* – Breeding lines carrying resistance genes for BYDV, sbWMV, and FHB in the intermediate generations will be identified using molecular markers to ensure the disease resistance genes are maintained through the breeding process.

Initial HWW crosses to the low PPO breeding lines were made in the greenhouse during the winter and spring of 2017. Additional crosses of SWW and HRW breeding lines to the low PPO breeding lines were done in the greenhouse during the winter and spring of 2018. Subsequent backcrosses, three-way, and four-way crosses were made in the winter and spring of 2019. SWW advanced lines with low PPO are currently being evaluated in the field for agronomic performance. PPO reaction evaluation is being done on all intermediate generation breeding lines by Dr. Andrew Ross of the OSU Cereal Chemistry Laboratory. Low PPO SWW lines identified by the OSU Cereal Chemistry Laboratory will be used as parents to transfer the low PPO trait into the OSU breeding pool.

*Objective 2* – Initial crosses to the herbicide resistant donor lines were done in the greenhouse in the winter and spring of 2018. Soft white spring wheat and spring club wheat crosses were made

to allow for more rapid introgression into a soft white and club genetic background. Two generations of backcrosses were then done on lines identified by molecular markers as carrying the herbicide resistance genes in the summer and fall of 2018. Restoration of the winter habit was initiated in the summer of 2019.

For transfer into HRW, a backcrossing program utilizing molecular marker screening in the greenhouse was used. The second generation of backcrosses (BC<sub>2</sub>) were produced in the winter and spring of 2019. The BC<sub>2</sub> lines carrying the herbicide resistance genes were self-pollinated and/or backcrossed for a third time in summer 2019. Resulting BC<sub>2</sub>S<sub>1</sub> plants with the herbicide resistance genes were grown to maturity in the greenhouse, and seed from these plants were planted in the field in the late fall and early winter of 2019–2020.

For transfer into specific SWW lines, a more traditional backcross/self-pollinating approach is being used due to the number of genes that need to be restored. After each generation of self-pollinating, plants with the herbicide resistance genes will be selected using molecular markers and used as parents for backcrossing. Initial backcrossing for these groups was done in the spring of 2019. Initial gene transfer work was completed in winter of 2021. Agronomic evaluation on the first CoAXium breeding lines is underway, and herbicide efficacy trials are being conducted at four locations. Together with last year's efficacy data, the trials harvested during the 2026 field season should meet or exceed the requirement of eight site-years of efficacy data for the release of a CoAXium variety.

*Objective 3* – Depending on the timing of the request and the type of tissue being provided (seed or leaf), DNA extraction and screening will require three to four weeks if molecular marker profiles can be used to answer the grower's question.

*Objective 4* – Additional leaf tissue sampling, genotyping, end-use quality testing, NIRS data collection will be conducted during the winter of 2026–2027 to generate the second year of training data. The first year of training data are currently (i.e., winter of 2025–2026) being collected. Using the two years of data, prediction development will take place during the fall of 2026. If promising results are obtained, these approaches may be leveraged to inform crossing decisions during the winter of 2027.

#### Justification:

To utilize genes for herbicide resistance, disease resistance and end-use quality from non-adapted genetic backgrounds, it is necessary to first transfer the genes into genetic material that is adapted to the Pacific Northwest. Through incorporation of these genes, the cultivars developed by the OSU breeding program will provide Oregon producers with varieties that have improved agronomic performance, disease resistance, and end-use quality characteristics that will provide a competitive edge to Oregon wheat in the world market. Herbicide tolerant varieties will provide Oregon wheat growers with a potential management solution to control grassy weeds. Finally, genomic and phenomic selection have the potential to enhance the efficiency of the breeding pipeline, identify the most promising breeding lines, and shorten variety development and release timelines.

#### Budget:

##### Salaries and Fringe:

Laboratory Technician (0.50: Gunn)	\$60,921.00
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##### Equipment:

Annual service contract for PCR machine maintenance	\$3,287.00
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Supplies and Materials:

Genotyping reagents and consumables \$4,792.00

Total \$69,000.00

Matching funds from OSU estimated at \$10,000 will cover 0.10 FTE for Laboratory Technician Hilary Gunn. The remaining 0.4 of Hilary’s FTE is covered by the hemp breeding project. Some objectives can leverage an estimated \$35,000 from Dr. Krause’s current competitive grants funds when activities overlap.

Relation to Other Research:

This research is related to Dr. Krause’s current U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA) Agriculture and Food Research Initiative (AFRI) Coordinated Agricultural Project grant “Leveraging high-throughput genotyping and phenotyping technologies to accelerate wheat improvement.” Dr. Krause is a co-PI and is receiving a \$346,661 subaward from University of California–Davis out of the total project budget of \$15million for five years. The project is currently in year five, which will end on 31 December 2026. The funds are currently being used to support the graduate studies and dissertation research of Ph.D. student Dalton Jones. Dalton’s projects involve evaluating genomic selection, phenomic selection, and drone-based imaging systems for improving breeding efficiency.

This research is also related to Dr. Krause’s current Foundation for Food & Agriculture Research (FFAR) New Innovator in Food & Agriculture Research Award “Big data to improve and sustain wheat end-use quality in the face of increasingly variable climate scenarios.” Dr. Krause is the lead PI and is receiving \$322,128 for three years. The project is currently in year two. The funds are being used to support Postdoctoral Scholar Dr. Vishal Singh’s research on the impacts of weather conditions on end-use quality in wheat.

**CURRENT AND PENDING SUPPORT**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>
<b>Current:</b>					
J. Dubcovsky & 37 other key personnel	USDA-NIFA-AFRI	\$15million, subaward \$346,661	01/01/2022–12/31/2026	5	CAP for Innovation in Genomic Technology to Accelerate Breeding: “Leveraging high-throughput genotyping and phenotyping technologies to accelerate wheat improvement”
M. Krause	FFAR New Innovator Award in Food & Agriculture Research Award	\$322,128	01/01/2024–12/31/2026	5	Big data to improve and sustain wheat end-use quality in the face of increasingly variable climate scenarios
J.E. Rutkoski, M. Krause	USDA-NIFA-AFRI	\$799,998 subaward \$262,193	06/01/2023–05/31/2026	5	PARTNERSHIP: Phenomic assisted genomic selection to accelerate grain yield improvement in small grains
M. Krause	Oregon Wheat Commission	\$257,899	07/01/2025–06/30/2026	30	Developing improved winter wheat cultivars for Oregon

M. Krause	Oregon Wheat Commission	\$56,194	07/01/2025–06/30/2026	5	Gene introgression and trait prediction for developing new and improved Oregon State University wheat cultivars
M. Krause	Oregon Wheat Commission	\$1,000	07/01/2025–06/30/2026	4	Bringing ‘Successor’ spring feed barley to Oregon
M. Krause	American Malting Barley Association	\$60,000	07/01/2025–06/30/2026	4	Optimizing disease resistance, low temperature tolerance, and water sensitivity via accelerated development of two-row winter and facultative malting barley varieties
M. Krause	USDA-ARS-NACA BSR/BPI	\$58,206	07/01/2025–06/30/2026	4	Barley stripe rust, scald, and BYDV resistance in wild and cultivated barley
M. Krause	USWBSI	\$89,435	07/01/2025–06/30/2026	4	Germplasm acceleration for FHB resistance breeding in barley
M. Krause	USDA-ARS-NACA SGGI/TTKSK	\$206,169	11/01/2025–10/31/2026	4	Northwest-adapted barleys for resistance to stem rust (UG99)
K. Vining & 13 other key personnel	Oregon State University College of Agricultural Sciences Hatch	\$40,000 subaward \$3,300	05/07/2024–09/30/2029	1	Improving plant productivity and resilience in a changing climate
<b>Pending:</b>					
M. Krause ( <i>this proposal</i> )	Oregon Wheat Commission	\$69,000	07/01/20256–06/30/2027	5	Gene and value-added trait introgression for developing new and improved Oregon State University wheat cultivars
M. Krause	Oregon Wheat Commission	\$274,200	07/01/20256–06/30/2027	30	Developing improved winter wheat cultivars for Oregon
M. Krause	USWBSI	\$92,000	05/01/2026-04/30/2027	4	Producing FHB-resistant doubled haploids in barley
M. Krause, C. Hagerty, M. Reynolds	USDA-NIFA-AFRI	\$800,000	09/01/2026-08/31/2029	4	PARTNERSHIP: Genomics- and physiology-informed wheat cultivar mixtures to maximize yield and manage risk due to biotic and abiotic stress
G. Vargas Gutierrez, P. Busby, J. LeBoldus, C. Still, M. Krause	USDA-NIFA-AFRI	\$649,977	05/01/2026-04/30/2029	2	The KCS switch: a functional genetics approach to regulating water use efficiency in poplar
K. Frels, M.I. Ibba, K. Campbell, D. Rose, A. Carter, J. Anderson, M. Krause, E. Olson, N. DeWitt, X. Zhang	USDA-NIFA-AFRI	\$799,645 subaward \$18,001	06/01/2026-05/31/2029	2	PARTNERSHIP: Bread for health: developing arabinoxylan-enriched wheat for improved dietary fiber intake in the US diet

**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

**Title:** *Elucidating human gut health benefits of Oregon-grown whole grain wheat*

**Investigator(s):** Anna Hayes (PI), Clay Swackhamer (co-PI), David Dallas (co-PI) – all at Oregon State University (OSU), Corvallis campus

**Cooperator(s):** Margaret Krause (OSU, Corvallis): wheat breeding  
Andrew Ross (OSU, Corvallis): wheat processing and incorporation into a model food system (crackers) for testing

**Funding History:** No previous OWC support or requests for OWC support.

**Abstract:**

As interest in whole grain foods continues to rise among consumers, largely stemming from the widening recognition of the benefits of dietary fiber, there is an expanding opportunity to characterize and promote the health-enhancing properties of Oregon-grown wheat. We seek to explore the human gut health benefits of Oregon-grown whole grain wheat by determining how different forms of wheat impact human gut microbial composition and metabolite production. *This project aims to generate foundational data that could help improve the marketability of Oregon wheat while also advancing our scientific understanding of how whole grain-based products impact the gut microbiome* through two primary objectives: 1) to determine the effects of different forms of wheat flour from the Oregon-based variety Gale on the human gut microbial community, and 2) to determine the effects of the same Gale wheat flours on human gut metabolites (short-chain fatty acids, SCFAs) produced during fermentation in a model of the human gut. Gale wheat samples will be milled and prepared into either whole wheat flour, refined wheat flour, or reconstituted whole wheat flour and then incorporated into standardized cracker models, which will then be subjected to simulated ('in vitro') gastrointestinal digestion. The resulting samples will undergo a 24-hour in vitro fermentation using human fecal inoculum, and samples for microbial and metabolite characterizations will be collected across 7 timepoints. Sequencing will be used to determine the microbial community compositions, and gas chromatography will be used to measure SCFAs at each timepoint. We expect that the results from this work will enable us to identify specific microbial taxa and metabolite profiles that are differentially altered by Oregon-grown wheat forms. We anticipate that these findings will reveal gut health-promoting properties of whole grain wheat, *thereby benefiting Oregon wheat producers through increased product value and consumer appeal.*

## **Objectives:**

The global whole grain foods market is estimated to grow from USD 45 billion in 2025 to USD 75 billion by 2033, largely due to increasing consumer interest in foods that support digestive health and long-term wellness (Data Bridge Market Research). The composition of the gut microbiome and production of gut metabolites have been shown to play key roles in both gut health and overall health – from inflammation, to metabolism, to cognitive processes (Dalile et al., 2019; Sanna et al., 2019; Hays et al., 2024). Consumption of dietary fibers, such as those found in whole grain wheat, is a promising opportunity to favorably modulate the gut microbial community and, as a result, gut metabolites (Cantu-Jungles et al., 2021). Therefore, we aim to reveal the potential human gut health benefits of Oregon-grown whole grain wheat by determining how different forms of wheat impact human gut microbial composition and metabolite production. We will achieve this through two objectives:

Objective 1: Determine the effects of different forms of wheat flour (whole wheat flour, refined wheat flour, reconstituted whole wheat flour) from one Oregon-based variety (Gale) on the human gut microbial community. To achieve this, we will use a simulated (‘in vitro’) model of the human gut microbiome, which will allow us to identify specific bacteria that increase or decrease in relative abundance during a 24-hour fermentation in the presence of different wheat forms. Sequencing will be performed to determine gut microbial community composition.

Objective 2: Determine the effects of different wheat forms (whole wheat flour, refined wheat flour, reconstituted whole wheat flour) from one Oregon-based variety (Gale) on human gut metabolites produced during fermentation in a model of the human gut. During the same experiment as in Objective 1, fermentation digesta samples will be collected from each wheat form treatment and analyzed for levels of short-chain fatty acids (i.e., butyrate, propionate, acetate) using a gas chromatography system.

## **Procedures:**

Samples of Gale wheat will be obtained in collaboration with the breeding program of Dr. Margaret Krause at OSU. These samples will be processed into a composite through milling with or without decortication in collaboration with Dr. Andrew Ross at OSU to produce samples of **1) whole grain wheat flour, 2) refined wheat flour, and 3) a reconstituted whole grain wheat flour** containing bran and refined wheat flour combined in the same ratio as that found in whole grain wheat flour to evaluate the intactness of the inherent structure. Comparing intact vs. reconstituted whole wheat flours is of particular interest because of the existing regulatory option to label reconstituted flours as ‘whole grain’ as long as they contain all anatomical components (i.e., endosperm, germ, and bran) in the same relative proportions as an intact kernel (U.S. Food and Drug Administration 21 CFR 137.200; Whole Grains Council). These samples will then be incorporated as the flour component into cracker products with the help of Dr. Ross to constitute the samples for evaluation of effects on the gut microbiome.

The cracker samples (containing either whole grain wheat, refined wheat, or reconstituted wheat) will then be subjected to simulated gastrointestinal digestion to mimic the breakdown and absorption of nutrients that happens in the mouth, stomach, and small intestine of humans,

resulting in samples that will more closely resemble the contents of gastrointestinal digestion that are present in the human large intestine, where the largest portion of gut microbes reside in the human body. Following these digestion steps, the samples will then undergo in vitro fermentation with human fecal samples, which represent the gut microbial community of actual humans. These in vitro fecal fermentations will be performed in an anaerobic chamber, which replicates the oxygen-depleted environment of the human large intestine, and will involve exposing fecal samples from healthy adult humans to the experimental testing samples (cracker samples that have been digested). This exposure will continue for 24 hours – with collection timepoints of 0 (baseline), 30 minutes, 60 minutes, 2 hours, 6 hours, 12 hours, and 24 hours – to allow examination of time-dependent changes in both gut microbes and metabolites. Following this experiment, sequencing will be performed on samples collected from each of the 7 timepoints to characterize the microbial communities and how they changed over time to achieve *Objective 1*. These analyses will be performed according to well-established methods (Cantu-Jungles et al., 2018; Cantu-Jungles et al., 2021; Igwe et al., 2025). To achieve *Objective 2*, short-chain fatty acids (SCFAs; acetate, propionate, butyrate) will be quantified in samples collected from each of the 7 timepoints through gas chromatography according to established procedures (Cantu-Jungles et al., 2018; Cantu-Jungles et al., 2021; Igwe et al., 2025).

### **Timelines:**

- July 2026: Obtain wheat grain (Gale variety) from Dr. Krause.
- August-September 2026: Process wheat grain into the different forms to be tested with assistance from Dr. Ross and prepare cracker samples.
- September-October 2026: Conduct in vitro fecal fermentation experiments.
- November-December 2026: Perform sequencing to examine gut microbial communities from fermentation samples; quantify short-chain fatty acids (gut microbial metabolites) from fermentation samples.
- January-February 2027: Analyze sequencing and metabolite data.
- March-June 2027: Write report and manuscript from experimental results obtained.
- June 2027: File final report.

### **Justification:**

With the global market for whole grain foods projected to rise from USD 45 billion in 2025 to USD 75 billion by 2033 (Data Bridge Market Research), consumer demand for these products continues to grow. Much of this momentum is driven by the expanding evidence that whole grain foods support gut function and promote overall health. Together, these trends create a timely opportunity to better understand how *whole grain wheat products from Oregon* influence gut health, advancing both their market potential and their health value.

Whole grain foods contain higher amounts of dietary fiber than their refined grain counterparts. This dietary fiber remains indigestible within the gastrointestinal tract and thus travels to the large intestine to serve as a substrate for microbes within the gut. Gut microbial communities have been found to be drastically altered by different foods/diets, especially by the types and amounts of dietary fiber consumed. Certain gut microbial communities ('gut microbiomes') and even specific microbial taxa have been associated with positive effects on health, which is likely

mediated at least in part by the metabolites produced by these bacteria in the gut.

*Characterization of the gut microbial effects of Oregon-grown wheat varieties could provide **unrealized potential in increased market gains** for consumer sales as well as improved health outcomes for consumers.*

We expect that this work will benefit Oregon's wheat producers by identifying the gut health-promoting properties of Oregon wheat, *which we anticipate will incentivize the consumption of wheat-based food products and increase marketability in Oregon and beyond.* In the longer term, our experimental pipeline could be used to connect wheat breeding practices with impacts on the gut microbiome. This could allow wheat breeders to select for specific fermentable dietary fiber components, leading to varieties that give Oregon wheat producers decisive market advantages in a marketplace where consumers increasingly value the health promoting properties of foods.

**Budget:** \$24,717 requested from the OWC.

### **Relation to Other Research:**

PI Hayes' research program is investigating the impacts of the physicochemical characteristics of foods on gut-brain health using both in vitro and in vivo models. Her research group also investigates the impact of foods on metabolism and cognitive function in rodent models. Depending on the results from the proposed project, future research could involve investigating the impacts of Oregon-grown wheat forms on the brain using rodent models, which could provide mechanistic evidence for how wheat-based foods may have benefits beyond the gut microbiome (beyond gut health). Future work could involve more detailed characterization of the dietary fiber structural profiles in both whole grain and refined Oregon-grown grain wheat / wheat products. Co-PI Dallas' research program has expertise on digestion of food components using both in vitro and in vivo models and their impacts on health. Co-PI Swackhamer has expertise in studying the gut microbiome, specifically by employing in vitro fecal fermentations to examine the effects of dietary fibers on the gut microbial community.

### **References:**

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## **BUDGET**

### Salary:

Faculty – \$8,118; 2.08% FTE (0.25 month) each for PI Hayes, co-PI Swackhamer (Research Associate), and co-PI Dallas

Graduate Student – No support requested

Other students – \$2,973; Support for one undergraduate student conducting 179 hours of research is requested (\$16.65/hour)

Other Labor (specify type) – No support requested

OPE for all categories – \$3,726; OPE for PI, co-PIs, and undergraduate student researcher

Equipment: No support requested

Travel: No support requested

Domestic (in state) – No support requested

Domestic (out of state) – No support requested

Foreign (conferences, etc) – No support requested

Supplies and Materials:

\$4,900 – Supplies, reagents, and materials for grain processing & preparation and in vitro fecal fermentation

\$5,000 – 16s rRNA microbiome sequencing costs

**Total amount requested: \$24,717**

*Matching funds: \$19,948; this includes 3 months' salary for a postdoctoral scholar with OPE*

**CURRENT AND PENDING SUPPORT – HAYES (PI)**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>
<b>Current:</b>					
Hayes, A. (PI)	Global Hemp Innovation Center	\$50,053	10/2025-09/2026	0%	Impact of hemp seed on Western diet-induced cognitive impairments in aging rats
Hayes, A. (PI)	Collins Medical Trust	\$39,944	01/2026-12/2027	0%	Impacts of endogenous vs. exogenous advanced glycation end-products on gut-brain health
<b>Pending:</b>					
Hayes, A. (PD), Cerrato D.C. (co-PI), Sangokunle, O. (co-PI)	USDA-NIFA AFRI-Standard Grant	\$649,935	08/2026-07/2029	7%	Advanced glycation end-product-induced disruptions in the gut microbiota and cognitive health: Mitigation through Muscadine grape consumption
Hayes, A. (PI)	OSU Agricultural Research Foundation	\$15,000	02/15/2026-02/14/2027	0%	Extraction and purification of L-fucose from Oregon-based brown seaweed for human health

**CURRENT AND PENDING SUPPORT – SWACKHAMER (PI)**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>
<b>Current:</b>					
<b>Pending:</b>					
Swackhamer, C (PD), Dallas D.C. (co-PI), Ma L. (co-PI), Schumacher, T. (co-PE)	Dairy Management, INC Product Research	\$100,000	07/2026-07/2028	7% FTE in year 1, 17% FTE in year 2, 9% FTE in year 3	Decision support for optimal cheddar ripening using nondestructive ultrasonic testing and AI modeling

**CURRENT AND PENDING SUPPORT – DALLAS (PI)**

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
<b>CURRENT</b>					
Dallas, DC (PI)	National Institutes of Health (NIH) R01 1R01HD106140- 01	\$2,480,757	9/1/2021- 6/30/2026	10% (1.2 calendar months)	Can high pressure processing (HPP) and ultraviolet-C irradiation (UV-C) treatment preserve donor HUMAN milk bioactive protein structure and function better than Holder pasteurization?
Dallas, DC (PI)	NIH 1 R01 HD097367-01A1	\$2,777,779	8/20/2022- 07/31/2027	37.4% (1.49 academic, 3 summer months)	Effects of human milk handling practices on peptide release and bioactivity in the preterm infant intestine.
Scottoline, BP (PI), Dallas, DC (PI), Andres, S (co-I), Bohe, G (co-I)	NIH 1 R01 HD109193-01A1	\$531,981	6/1/2024- 5/31/2026	0.75% (0.01 academic, 1.5 summer months)	Defining bioactivities of peptides released from human milk proteins in the preterm infant intestine
<b>PENDING</b>					
Dallas (PI), Wazed (co- PI), Jump (co-I), Traber (co- I), and Waite- Cusic (co-I)	USDA NIFA	\$650,000	09/01/2026- 08/31/2029	2% (12 calendar months)	Optimized UV-C Processing Better Preserves Bioactive Proteins in Bovine Skim Milk Compared with Thermal Processing While Maintaining Vitamins, Lipids and Sensory Properties
Liang (PI), Dallas (co- PI)	USDA NIFA	\$650,000	09/01/2026- 08/30/2030	2% (12 calendar months)	Do dairy foods modify gut motility and constipation in elderly adults: determine their

					impacts and identify the underlying mechanisms of action
Dallas, DC (PI), Scottoline, B (co-PI), Jerome, M (co-I), Bohe, G (co-I), Jump, D (co-I)	NIH R01	\$3,723,066	04/01/2026-03/31/2031	8.3% (9 academic months), 15% (3 summer months)	Pancreatic enzyme supplementation to enhance nutrient digestion, absorption and growth in preterm infants

**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

Title: **Oregon State University Cereal Quality Laboratory**

Investigator(s): **Dr. Andrew S. Ross, Dr. Teepakorn Kongraksawech:** Crop & Soil Science, Oregon State University (OSU)

Cooperator(s): **Drs. Margaret Krause, Ryan Graebner, Christina Hagerty** Crop & Soil Science Department, OSU; **Drs. Alecia Kiszonas, Camille Steber, Alison Thompson,** USDA, Pullman WA; **Drs Jayne Bock and Andrew Mense,** The Wheat Marketing Center, Portland OR, and **Sarah Windes** University of Idaho Wheat Quality Lab.

Funding History:

2023-24	\$80,000
2024-25	\$80,000
2025-26	\$82,000
<b>Request 2026-27</b>	<b>\$95,500</b>

**Abstract:**

The Oregon State University (OSU) cereal quality program seeks funds to provide laboratory testing in support of cereal variety and germplasm development. It is our view that the processing performance (functionality) of Oregon-grown cereal grain needs to meet or exceed customer expectations for the grain to remain market-competitive. Consequently, identifying genotypes with class-appropriate functionality is central to the variety development process. Our core activity is testing soft white wheat functionality for the wheat breeding program. We also test grain of other market classes and provide on-site support for other OSU efforts aimed at improving grain functionality. We assess grain characteristics, milling, flour, dough, and batter performance, and end-product quality. This lab focuses on early generation screening and strives to report as much actionable data as possible before the coming planting season begins. Activities include support of Dr. Krause's initiatives for high-throughput assessments of functionality, ongoing analyses of amylase-affected samples, investigations of AI-based automation of functionality assessments, and matching of field-based spectral analyses with grain and flour functionality. We also interpret, summarize, and report to the breeder the functionality data created by the Western Wheat Quality Laboratory (WWQL). Grain samples are supplied by the programs we serve. These are grown at multiple locations across the state and cover the key agroclimatic zones for grain production.

**Objectives:**

Improve or maintain the processing and other functional properties of new cereal varieties being developed by OSU through the following actions...

- 1) Creating and interpreting cereal quality data for OSU cereal breeding programs, and for the cereal extension and genetics programs as needed, for the purpose of identifying superior genotypes or crop management strategies.
- 2) Reviewing existing quality testing methods with the aim of improving them and creating and implementing new laboratory methods as appropriate.

3) Maintaining communication with research partners and the wheat industry through appropriate travel.

**Procedures:**

1) *Create and interpret cereal quality data...* The OSU Cereal Quality Lab applies appropriate methods for assessment of grain functionality. Screening of F<sub>4</sub> and F<sub>5</sub> wheat breeding nurseries has highest priority and as much actionable data as possible is reported to the breeder prior to planting in fall. Additional comprehensive testing on selected breeding nurseries e.g., F<sub>6</sub> through F<sub>8</sub> nurseries is conducted in the late fall and winter as requested by the breeder. Decisions on which nurseries to test are made in collaboration with the breeder. As resources allow, we also create quality data for the cereal extension and genetics programs as part of our core activities. This includes phenotypic validation of gene introgression and gene editing projects, support for club and hard spring wheat breeding efforts, and support for studies examining the effects of crop management on quality.

2) *Review and improve existing quality testing methods...* We constantly assess the validity and usefulness of methods, and we amend current methods or create new ones as necessary. In this cycle we propose to continue to support Dr. Krause's initiatives for genomic and spectroscopy-based assessments of quality at early generations. We plan to continue validating the new test, developed collaboratively by the Wheat Marketing Center and the OSU Cereal Quality lab, for the screening of breeding lines for Japanese Sponge cake potential. We will continue working with USDA cooperators on development and validation of new methods for separating late-maturity amylase from preharvest sprouted and continue to investigate AI-based platforms for automation of some quality assessments.

3) *Maintain communication with research partners...* We anticipate traveling to and contributing to, for example, to Cereals and Grains Association meetings, the PNW Wheat Quality Council meeting, as well as visiting the WWQL and other cooperating cereal quality labs.

**Timelines:**

Fast-track screening of early generation lines completed by end of Fall 2026. Screening of other soft and hard nurseries and extension trials completed by end of Spring 2027. Processing and analyses of current harvest WWQL data by June of 2027 year depending on timeliness of data availability. Other projects require ongoing work with completions spread throughout the grant year. A progress report to the Oregon Wheat Commission (OWC) will be available in March 2027 or earlier as required by the Commission.

**Justification:**

Wheat is one of Oregon's most valuable agricultural crops. New varieties offer better agronomic performance, stronger resistance to diseases and environmental stresses, and improved or more consistent end-use quality. Together, these traits...

- increase economic returns and enhance crop quality for growers by boosting yields and reducing both field and market risk and

- ensure reliable supplies of high-quality wheat and wheat flour for food producers and high-quality wheat foods for consumers.

Our program contributes to maintaining and expanding market demand by verifying that candidate varieties meet grain-quality expectations and, when possible, exceed published quality targets. We assert that on-site quality screening provides meaningful value to Oregon's grain growers. Our team interprets test results in the context of our understanding of both customer needs and quality traits and how these needs and quality traits interact. Increasing our understanding of how grain composition, processing, and end-product quality interact

strengthens our ability to influence grain composition through genetics, breeding, and crop management. This knowledge enables us to make targeted improvements that enhance industrial performance and, ultimately, market competitiveness of Oregon wheat.

**Budget:**

Salary:

Faculty*	30,000
Other students	10,000
OPE for all categories*	18,000

Equipment: 10,000

Travel:

Domestic (in state)	1,500
Domestic (out of state)	6,000
Foreign (conferences, etc)	

Supplies and Materials: 20,000

**Total: 95,500**

\*OSU may further reduce support for Dr. Kongraksawech's position from 68% of total salary and benefits during CY2026. We have budgeted for the current salary split (68% state, 32% grant) as we have not been told if or when this might occur nor what the new split might be. We also budgeted for additional student labor to advance projects mostly within Objective 2.

**Relation to Other Research:**

OSU cereal quality work is also conducted in collaboration with OSU faculty in Crops, Soils, Extension, and Plant Pathology throughout the state. OSU's cereal quality program is designed to support and complement OWC-funded and other research of Drs. Krause, Graebner, Hagerty, Kiszonas, among others. Collaboration with USDA low FN project continues as does validation of the new method for Japanese sponge cake potential. In collaboration with the Wheat Marketing Center and US Wheat we plan to expand this work into other cake types. Other collaborations include germplasm development, genetics research, and methods development, at OSU and throughout the tri-state region and the nation. All efforts are targeted at improving outcomes for Oregon grain farmers by strengthening the market competitiveness of Oregon wheats and other cereal grains, seeking avenues to reduce risk and improve crop value for farmers, and by making the breeding process more efficient and more effective by examining and validating new screening tools. This effort includes projects funded from other sources,

## CURRENT AND PENDING SUPPORT

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
<b>Current:</b> Ross, Kongraksawech	Oregon Wheat Commission	82,000	7/25 - 6/26	25	Oregon State University – Cereal Quality Laboratory
Meints, Ross, et al.	USDA-NIFA- OREI	~3,500,000	7/23 - 6/27	10	Extension of Organic Naked Multi-use Barley
<b>Pending:</b> Ross, Kongraksawech	Oregon Wheat Commission	95,500	7/25 - 6/26	25	Oregon State University – Cereal Quality Laboratory THIS PROPOSAL

**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

Title: Quality of varieties & pre-release lines: G&E Study, Advancing Wheat Quality in Oregon

Investigator(s): Alecia M. Kiszonas, USDA-ARS, Pullman, WA.

Cooperator(s): Drs. Margaret Krause, Andrew Ross, Teepakorn Kongraksawech.

Prof Ross and Krause provide samples; Prof. Ross is consulted annually at the PNW WQC with other regional cereal chemists to establish new entries on the Preferred Variety pamphlet.

Funding History: 2025/2026: \$63,000 across both projects now combined.  
2024/2025: \$61,418 across both projects now combined.  
2023/2024: \$61,418 across both projects now combined.

Amount requested: \$64,000

Abstract: The goal of this project is twofold. Part 1 (G&E): obtain robust, statistically-valid comparisons of the quality of new varieties and advanced breeding lines, pre-release, from public and private breeding programs; and build a database of quality data across crop years and environments, and Part 2 (Breeding Lines): accelerate the development of new wheat varieties with superior quality by processing a greater number of OSU breeding samples in shorter amount of time and with more extensive assays that would otherwise be possible. Samples are obtained from the OSU extension testing/elite breeding line nursery plots, and are provided by Dr. Ross and Dr. Krause. Complete and extensive milling, baking and flour quality analyses are conducted. We have used these results to support the “*Preferred Wheat Varieties*” pamphlet identifying the relative quality (advantages or short-comings) of public and private varieties and advanced lines. Similarly, quality data on an environment-by-environment basis are generally lacking, especially for a wider array of commercial varieties. Historically, mid-generation breeding samples have received testing priority at the WWQL; in-depth analysis of commercial varieties was not possible. We now have a system of testing that includes both commercial varieties and the most advanced elite experimental breeding lines in ‘head-to-head’ comparisons. This on-going study has identified varieties with exceptionally good quality (e.g. Bobtail) and others that were considered to be inferior. The breeding samples are sent by the OSU wheat breeding team

and all analyses are completed by mid-summer. This OWC support provides additional technician time and supplements the USDA-ARS permanent funding and technicians. **This program conveys a clear message to our customers that ‘quality’ is a high priority in the PNW.**

Objective(s):

Part 1 (G&E): Obtain robust, statistically-valid comparisons of the quality of new varieties and pre-release lines, including those from both private and public breeding programs.

Part 2 (Breeding Lines): Accelerate the development of new wheat varieties with superior quality and grain yield by processing a greater number of OSU breeding samples in a shorter amount of time and with more extensive analysis than would otherwise be possible.

Procedures:

Part 1 (G&E): Grain samples are obtained from the extension testing/elite breeding line nursery plots, and are provided by Dr. Ross and Dr. Krause. Complete and extensive milling, baking and flour quality analyses are conducted following AACC International Approved Methods. Soft white common samples receive standard milling and cookie bake tests. Hard winter wheat samples receive standard milling and pan bread, and hard whites additionally receive Asian noodle and color evaluations. Quality data are analyzed using paired “t-tests,” and “t-scores” are used to rank the overall quality of varieties. (For a description of the samples, see budget).

Part 2 (Breeding Lines): Capacity of testing breeder samples is limited primarily by personnel. OWC funding specifically adds technical help during the peak post-harvest winter season; this assistance supplements the major portion of testing capacity provided by direct USDA federal support. Complete and extensive milling, baking and flour quality analyses are conducted following AACC International Approved Methods and others deemed appropriate (for example, Flour Swelling Volume).

Timelines:

Part 1 (G&E): Samples are received soon after harvest each fall and into early winter; work commences immediately. Nurseries are generally completed by late February. The new *Preferred Wheat Varieties* pamphlet usually is published in March.

Part 2 (Breeding Lines): Samples are received anytime from soon after harvest through the winter season. This past year, samples arrived around the end of the year. Work commences immediately but in a prioritized fashion. All sample analyses are completed

before early summer (June 30 is our target). As each breeding nursery is completed, data are e-mailed to Dr. Ross and Dr. Krause.

Justification:

Historically, the PNW has produced approximately 300 million bushels of wheat with a value of \$1 billion per year. Increasing the relative value of our wheat compared to that of Australia and Canada improves our export competitiveness. Also, improving yield in the PNW by as little as 1/10th of 1% would mean an extra \$1 million in crop value. New varieties that carry pathogen resistance also generally reduce the need for costly management inputs such as fungicides. 'Clearfield' has provided a valuable management tool for weed control. There are many reasons why we need new wheat varieties, but regardless of the reason, they all require extensive quality evaluation before release.

Identifying the relative quality (advantages or short-comings) of public and private varieties and advanced breeding lines requires multi-location robust, statistically-valid comparisons. Similarly, quality data on an environment-by-environment basis are generally lacking, especially for a wider array of commercial varieties. Historically, breeding samples have received testing priority; in-depth analysis of commercial/released varieties was not possible. We now have a system of testing where nurseries combine both commercial varieties and the most advanced elite experimental breeding lines. This on-going program has identified varieties with exceptionally good quality (e.g. Bobtail) and others that were considered to be inferior. Generally after 3 years, testing is discontinued on those varieties to save money.

Budget:

Funding amount requested: \$64,000.

The majority of quality testing for OSU breeding lines comes from direct Federal funding to the USDA WWQL. This proposal funds partial-year technical and hourly employees. The budget also includes a modest (~\$600 for lab supplies).

Relation to Other Research:

Part 1 (G&E): This program is an extension of our standard collaborative testing for the OSU breeding program. Further, this program connects 'G&E' studies in Washington and North Idaho, thereby facilitating a region-wide *Preferred Wheat Varieties* pamphlet.

Part 2 (Breeding Lines): This assistance enhances our base level of milling and baking analyses provided by USDA. The WGC provides a similar amount of funding to enhance testing of WSU breeding lines.

## BUDGET

### **Part 1 (G&E):**

Budget for 2026 Harvest:

SWW: 38 varieties x 5 locations for each = 185 samples @ \$240/sample = \$44,400

Hard Winter: 28 varieties x 5 locations = 140 samples @ \$240/sample = \$33,600

Supplies = \$2,000

Total program cost: \$80,000

The WWQL is requesting that the OWC split the cost of this program 50:50, consequently we are requesting **\$40,000** for one-half the sample analysis cost.

Equipment: none

Travel: none

Supplies and Materials: ~\$2000. The costs of reagents such as sucrose and ingredients such as Crisco and eggs have increased dramatically causing a need for a slight increase in supply costs.

### **Part 2 (Breeding Lines):**

Salary: Seasonal full time technician (1), part time hourly employees: **\$24,000**.

Equipment: none

Travel: none

Supplies and Materials: ~\$600 (est.)

**Request for FY2026/27: \$64,000**

**CURRENT & PENDING SUPPORT**

**Name: Dr. Alecia M. Kiszonas**

**Instructions:**

**Who completes this template:** Each project director/principal investigator (PD/PI) and other senior personnel that the Request for Applications (RFA) specifies

**How this template is completed:**

- Record information for active and pending projects, including this proposal.
- All current efforts to which PD/PI(s) and other senior personnel have committed a portion of their time must be listed, whether or not salary for the person involved is included in the budgets of the various projects.
- Provide analogous information for all proposed work which is being considered by, or which will be submitted in the near future to, other possible sponsors, including other USDA programs.
- For concurrent projects, the percentage of time committed must not exceed 100%.

Note: Concurrent submission of a proposal to other organizations will not prejudice its review by CSREES.

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
	<b>Active:</b>				
Kiszonas, A.M.	Washington Grain Commission	\$24,000	7/01/25 to 6/30/26	1	Supplemental Support for Assessing the Quality of Washington Wheat Breeding Samples
Kiszonas, A.M.	Washington Grain Commission	\$84,430	7/01/25 to 6/30/26	2	Quality of Varieties and Pre-Release Line
Kiszonas, A.M.	Washington Grain Commission	\$60,908	7/01/25 to 6/30/26	2	Breeder Quality Trials
Kiszonas, A.M.	Oregon Wheat Commission	\$68,250	7/01/25 to 6/30/26	2	Supplemental Support for Assessing the Quality of Oregon Wheat Breeding Samples Genotype & Environment Study
Kiszonas, A.M.	Idaho Wheat Commission	\$19,000	7/01/25 to 6/30/26	1	Genotype & Environment Study and PNW-WQC Milling and Sampling
Kiszonas, A.M.	Mondelez Trust	\$37,308	1/1/24 to 12/31/29	1	Mondelez Soft White Wheat Quality
McGee, R., Kiszonas, A.M., Daba, S., Chen, C., and Finnie, S.M.	USDA-ARS Pulse Crop Health Initiative	\$155,500	7/01/25 to 9/30/26	1	Functional Properties and Nutritional Quality of Pea Starch and Protein as Affected by Genetic and Environmental Variables
Warburton, M., Coyne, C., Sankaran, S., Ferreira, S., Finnie, S., and Kiszonas, A.M.	USDA-ARS Pulse Crop Health Initiative	\$26,000	7/01/25 to 9/30/26	1	ChickpeaAI: Deployment of Machine Learning to Develop Resilient Chickpea with Improved Nutritional, Functional and Yield Profiles
Murphy, K., Pumphrey, M., Carter, A., Brueggeman, R.,	Washington Research Foundation / WGC	\$10,000,000 Total \$870,825 Individually	2025-2030	1	Optimizing Human Health and Nutrition from Soil to Society

## Current and Pending Support

Hauvermale, A., McGee, R., LaHue, G., LaHue, D., Singh, S., Ganjyal, G., Monsivais, P., Carbonero, F., Kiszonas, A., Main, D., Garland- Campbell, K.					
	<b>Pending:</b>				
Kiszonas, A.M.	Idaho Wheat Commission	\$19,650	7/01/26 to 6/30/27	1	Genotype & Environment Study and PNW-WQC Milling and Sampling
Kiszonas, A.M.	Washington Grain Commission	\$24,700	7/01/26 to 6/30/27	2	Supplemental Support for Assessing the Quality of Washington Wheat Breeding Samples
Kiszonas, A.M.	Washington Grain Commission	\$86,118	7/01/26 to 6/30/27	2	Quality of Varieties and Pre-Release Line
Kiszonas, A.M.	Washington Grain Commission	\$63,000	7/01/26 to 6/30/27	2	Breeder Quality Trials
Kiszonas, A.M.	Oregon Wheat Commission	\$69,250	7/01/26 to 6/30/27	2	Supplemental Support for Assessing the Quality of Oregon Wheat Breeding Samples Genotype & Environment Study

**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

Title: One-third the cost of the Miag pilot flour milling of the Pacific Northwest Wheat Quality Council samples.

Investigator(s): Alecia M. Kiszonas, USDA-ARS, Pullman, WA.

Cooperator(s): Drs. Margaret Krause and Andrew Ross, Oregon State University, and regional wheat breeders who submit samples to the PNW Wheat Quality Council.

Funding History: 2025/2026: \$5,250. 2024/2025: \$5,250. 2023/2024: \$5,250. 2022/2023: \$5,250. 2021/2022: \$5,250. Amount requested: \$5,250 (no increase).

Abstract: The goal of this project is to conduct large-scale flour milling of the PNW Wheat Quality Council breeder samples and checks on the WWQL's Miag Pilot Flour Mill. Flour samples are distributed to industry collaborators and the merits of individual samples and the broader needs of end-users are discussed and defined. These discussions have a major impact on how we test breeder samples and what our quality targets are. The budget covers only the cost of labor to prepare and mill the samples, and is split 3-ways among the Tri-State Wheat Commissions.

Objective(s): Conduct large-scale flour milling of the PNW Wheat Quality Council breeder samples on the WWQL's Miag Mill. Flour samples are distributed to industry collaborators and the merits of individual samples and the broader needs of end-users are discussed. These discussions have a major impact on the testing of breeder samples and quality targets.

Procedures: Approximately 120-160 lb. of each experimental breeding line or check sample is cleaned, tempered and then milled on our Miag pilot flour mill. Individual flour streams (n=10) are evaluated for flour yield and ash content, and "straight-grade" flours are blended for distribution to collaborators. The budget covers only the cost of labor to prepare and mill the samples, and is split 3-ways among the Tri-State Wheat Commissions.

Timelines: Samples are received soon after harvest each fall; work commences immediately so that flours can be distributed by the first week of November. The PNW Wheat Quality Council meets in late January/early February depending on when the NAWG and PAG meetings are held.

Justification: The PNW Wheat Quality Council was first convened in 1995 with the backing and encouragement of the Tri-State Wheat Commissions. It has been an excellent program and has yielded immeasurable benefits. The USDA ARS WWQL underwrites the majority of the cost through appropriated Federal funds. WWQL personnel plan and organize the entire meeting. To assist in the process, the Tri-State Wheat Commissions each contribute one-third the cost of labor to prepare and mill the samples.

Budget: Total cost is dependent on the number of samples milled and analyzed, based on labor and benefits cost. We have held funding constant since 2015. We are requesting \$5,250 (1/3) per Tri-State Commission (no increase).

Relation to Other Research: The PNW WQC provides direct feedback from end-users and helps guide, via the discussions and analyses, the testing program and priorities for experimental breeding lines.

## **BUDGET**

Salary: **\$5,250 (no increase)**

Equipment: none

Travel: none

Supplies and Materials: none

**CURRENT & PENDING SUPPORT**

**Name: Dr. Alecia M. Kiszonas**

**Instructions:**

**Who completes this template:** Each project director/principal investigator (PD/PI) and other senior personnel that the Request for Applications (RFA) specifies

**How this template is completed:**

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Note: Concurrent submission of a proposal to other organizations will not prejudice its review by CSREES.

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Kiszonas, A.M.	Idaho Wheat Commission	\$19,000	7/01/25 to 6/30/26	1	Genotype & Environment Study and PNW-WQC Milling and Sampling
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Murphy, K., Pumphrey, M., Carter, A., Brueggeman, R.,	Washington Research Foundation / WGC	\$10,000,000 Total \$870,825 Individually	2025-2030	1	Optimizing Human Health and Nutrition from Soil to Society

## Current and Pending Support

Hauvermale, A., McGee, R., LaHue, G., LaHue, D., Singh, S., Ganjyal, G., Monsivais, P., Carbonero, F., Kiszonas, A., Main, D., Garland- Campbell, K.					
	<b>Pending:</b>				
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Kiszonas, A.M.	Washington Grain Commission	\$24,700	7/01/26 to 6/30/27	2	Supplemental Support for Assessing the Quality of Washington Wheat Breeding Samples
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Kiszonas, A.M.	Washington Grain Commission	\$63,000	7/01/26 to 6/30/27	2	Breeder Quality Trials
Kiszonas, A.M.	Oregon Wheat Commission	\$69,250	7/01/26 to 6/30/27	2	Supplemental Support for Assessing the Quality of Oregon Wheat Breeding Samples Genotype & Environment Study

**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

**Title:** Improving Control of Wheat Stripe Rust

**Investigator(s):** Xianming Chen, USDA-ARS and WSU, Pullman, WA

**Cooperator(s):** Christina Hagerty, OSU, Pendleton, collect and send stripe rust samples.  
Margaret Krause, OSU, Corvallis, plant stripe rust monitoring nurseries at Corvallis, collect and send stripe rust samples, and send breeding lines for screening stripe rust resistant varieties.  
Ruijun Qin, OSU, Hermiston, plant stripe rust monitoring nurseries at Hermiston, collect and send stripe rust samples.

**Funding History:** 2023-24 requested and funded: \$12,000; 2024-25 requested and funded: \$12,000; and 2025-26 requested and funded: \$12,000

**Abstract:**

Stripe rust is one of the most destructive diseases in the Pacific Northwest (PNW) and can damage wheat crops of approximately 800,000 acres in Oregon. The disease occurs every year and can cause yield losses of 42% on susceptible varieties and 8% on commercially grown varieties on average in PNW. The goal of our on-going project is to reduce rust damage to minimum on a yearly basis and continually improve control of stripe rust. The objectives of the project are to: 1) improve the understanding of stripe rust disease epidemiology and the pathogen population; 2) improve stripe rust resistance in wheat varieties; and 3) improve the integrated management of stripe rust. Although the objectives are the same, every year we will work with new rust populations and work with new wheat lines from breeding programs. To achieve these objectives, we will make disease forecasts using our prediction models, conduct field surveys for monitoring rust development, and provide recommendations for implementing proper control measures based on disease pressure and resistance levels of wheat varieties, identifying virulent races of the pathogen and studying the pathogen populations, screening breeding lines for stripe rust resistance. In addition to the germplasm screening, we will provide breeding programs with information on pathogen races, resistant wheat stocks, effective genes, and useful markers for developing better varieties. We will test new fungicides and commercially grown varieties for rust resistance and fungicide response and provide essential information to growers for making managerial decisions. We will conduct research for identifying and developing wheat germplasm with effective resistance, identifying genes, and developing molecular markers for improving efficiency of breeding wheat varieties with adequate and durable resistance. Growing more rust resistant wheat varieties will reduce the use of fungicides, which will reduce production cost, increase profit, and protect the environment.

**Objectives:**

- 1) Improve the understanding of stripe rust disease epidemiology and the pathogen population

- 2) Improve stripe rust resistance in wheat varieties
- 3) Improve the integrated management of stripe rust

### **Procedures:**

1) For improving the understanding of stripe rust disease epidemiology and the pathogen population (Objective 1), we will conduct field surveys for monitoring rust occurrence, spreading, and development; and collect and receive stripe rust samples and identify races of the wheat stripe rust pathogen using the set of wheat differentials established in our program. We will determine race frequencies, distributions, changes, and potential impact of new races on resistant germplasm, commercially grown varieties, and breeding lines, and select a set of races for evaluating wheat germplasm and breeding lines. We will use the race data to guide breeding programs for choosing effective resistance genes and to guide disease management. In addition, we will use simple sequencing repeat (SSR) and Kompetitive allele specific PCR (KASP) markers developed in our program to characterize the pathogen populations and identify changes relevant to rust control.

2) For improving stripe rust resistance in wheat varieties (Objective 2), we will evaluate wheat lines from Oregon breeding programs and other public and private breeding programs, as well as the regional uniform nurseries and variety trials, for resistance to stripe rust and provide data to breeding programs for developing and releasing new varieties with adequate and durable resistance. The resistance evaluation of wheat nurseries will be conducted in fields at five locations in Washington under natural rust infection or inoculation with local races if needed. In addition to the field tests in Washington and Oregon, the nurseries of wheat elite breeding lines and varieties currently grown in the Pacific Northwest will also be evaluated in the greenhouse with selected races of the stripe rust pathogen in both seedling and adult-plant stages under different temperature profiles to identify different types of resistance. The stripe rust reaction data of elite breeding lines and currently grown varieties will be provided to breeders for releasing new varieties and to growers for selecting stripe rust resistant varieties to grow. To identify new resistance sources and genes, we will conduct molecular mapping studies on wheat crosses made in our program. New germplasm lines will be developed from the progenies of the crosses.

3) For improving the integrated management of stripe rust (Objective 3), we will test new chemicals, together with registered fungicides, for their efficacy of controlling stripe rust in the field under natural stripe rust infection, or inoculation with local races if needed, for both winter and spring wheat crops using completely randomized design experiments with four replications. Stripe rust severity will be recorded four to five times during the rust season, and grain test weight and yield will be measured for each plot at harvest. Effectiveness, dosage, duration, and timing of fungicide application will be assessed. The data of efficacy for new fungicides will be provided to individual companies for registration of new fungicides. Similarly, major commercially grown varieties will be tested in randomized split-block design experiments with four replications under natural or artificial infection of stripe rust with and without fungicide application to determine yield loss by stripe rust and yield increase by fungicide application for individual varieties. The data of these experiments will be used to guide disease control based on individual varieties. We will forecast stripe rust using our prediction models and disease

monitoring data and provide recommendations for implementing proper control measures. We will make great efforts to reduce unnecessary fungicide applications to maximize growers' profit. This will be achieved by providing growers with the level of resistance/susceptibility of individual varieties in Seed-Buying Guide based on our evaluation in multiple field locations and greenhouse tests, as well as the fungicide control data for individual varieties.

### **Timelines:**

This is a long-term and on-going project. Specified experiments will be conducted and service will be provided on a yearly basis. The project can be reported and evaluated on a yearly basis. For a wheat crop season, winter wheat nurseries are planted in September to October and harvested in late July to early August, and spring wheat nurseries are planted in March to April and harvested in late August to early September. Stripe rust data are collected in April to July and provided to breeders and growers in August to October, depending upon different nurseries. Greenhouse experiments for identification of stripe rust races and evaluation of wheat germplasm for resistance are conducted all year long, and the data will be provided to collaborators when tests are completed. Stripe rust forecasts based on our prediction models are issued in January and March and throughout the crop season based on field surveys and weather conditions. Field surveys are conducted in November, February to July, and updates together with recommendations are made after each time of field survey. Annual reports of the project to Oregon Wheat Commission can be made at request.

### **Justification:**

Stripe rust is one of the most damaging diseases in the PNW. In Oregon, all approximately 800,000 acres of winter wheat can be affected by stripe rust. The disease occurs every year and has the potential to cause yield losses of 42% on susceptible varieties in the PNW on average. Although most wheat varieties currently grown in the PNW have some levels of resistance, which can reduce the potential yield loss to 8% on average, but 8% grain yield is more than 5 million bushels and worth more than 30 million dollars for Oregon alone. Commercially grown susceptible wheat varieties often suffer more than 20% yield loss. For example, winter wheat variety 'UI Magic CL+' had 36% yield loss in 2020 under natural infection; 44% in 2022 and 21% in 2023 under artificial inoculation; and 40% yield loss in 2024 under natural infection in our field experiment near Pullman. Fungicides can be used to further reduce yield losses, but using fungicides adds multi-million-dollar cost for production and is not feasible for areas under special environmental protection or fields for organic wheat production. Moreover, the stripe rust pathogen population never stops changing, and changes in new races and race frequencies can make resistant varieties become susceptible or reduce the levels of resistance. Continual efforts are needed to monitor the pathogen population and races, to evaluate breeding materials for releasing new varieties with adequate resistance, to test varieties with current stripe rust races and populations, and to improve the integrated management strategy for control of the disease using most current and accurate information about variety resistance, disease epidemics, and fungicide efficacies. Our goal is to reduce stripe rust damage to minimum on a yearly basis. Meanwhile, we will conduct research for obtaining new knowledge, resources, and methods to improve control of stripe rust. This project will support Oregon wheat breeding programs to develop new varieties with adequate resistance; produce data of stripe rust resistance and

fungicide responses of currently grown and newly released wheat varieties for growers to know which varieties need and which varieties do not need fungicide application under different levels of stripe rust epidemic, reducing unnecessary fungicide application. We will obtain new knowledge of stripe rust races and distribution for developing new management strategies, identify effective resistance genes, develop molecular markers and new germplasm for breeding programs to use for more efficiently developing new varieties with adequate, durable resistance to stripe rust. Growing resistant varieties and appropriate use of fungicides will prevent multi-million-dollar losses caused by stripe rust to the Oregon wheat industry on a yearly basis. In the long run, the project will gradually improve control of stripe rust by reducing fungicide application and therefore help Oregon wheat growers reduce stripe rust risk, reduce production cost, and maximize profit, as well as protect the environment.

The stripe rust project needs to be conducted every year as the pathogen always changes virulence and its frequency, the disease pattern and pressure are different due to variety and weather changes, and new breeding lines need to be evaluated every year. Field data of multiple year and multiple locations plus greenhouse data with multiple races are required for reliable rust data for releasing new varieties with adequate and durable resistance. Without diligently monitoring stripe rust and properly managing the disease on a yearly basis, the problem can become worse. Similarly, without vigorously testing breeding lines and commercially grown varieties every year, susceptible varieties could go into production and growers might need to use more chemicals, which could reduce a lot of profit.

#### **Budget:**

A total of \$12,000 including \$10,000 for wages and benefits of temporary workers (mainly part-time students), \$600 for a student or research associate to go to Mount Vernon, WA twice for planting and collecting rust data, and \$1,400 for partially covering supplies and greenhouse/field space charges.

#### **Relation to Other Research:**

Our program is the only one in the United States to focus on control of stripe rust by conducting basic and applied research on stripe rusts of wheat and barley. We evaluate germplasm and breeding lines for supporting cereal breeding programs in the United States, especially in the PNW, to develop stripe rust resistant varieties; identify races of the stripe rust pathogens; identify and map resistance genes, develop new stripe rust resistant germplasm; and develop integrated disease management strategies including resistant varieties and fungicides. Our major funding is from USDA-ARS, and we also get funding from Washington Grain Commission and Idaho Wheat Commission. The support from Oregon Wheat Commission shows the importance of stripe rust in the state and the region, which leverages the major funding from USDA-ARS and ensures a similar level of support from Idaho Wheat Commission and a high level of support from Washington Grain Commission. We collaborate with wheat breeding, extension, and pathology programs in the PNW and other regions of the U.S., especially the programs of Drs. Christina Hagerty, Margaret Krause, and Ruijun Qin in Oregon.

## BUDGET

Salary: \$10,000  
     Faculty  
     Graduate Student  
     Other students  
     Other Labor (Time-slip undergraduate students including benefits): \$10,000  
     OPE for all categories  
 Equipment: 0  
 Travel: \$600  
     Domestic (in state): \$600  
     Domestic (out of state)  
     Foreign (conferences, etc)  
 Supplies and Materials: \$1,400  
**Total: \$12,000**

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### CURRENT AND PENDING SUPPORT

NAME	SUPPORTING AGENCY	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
Current: Chen, XM, PI	USDA-ARS (In-House) CWU: 2090-22000-020-00D	Budget info available from Area Office	3/2022-2/2027	50	Enhancing Control of Stripe Rusts of Cereal Crops
Chen, XM, PI	Washington Grain Commission	125,444	7/2025-6/2026	10	Enhancing Wheat and Barley Rust Management
Chen, XM, PI	Idaho Wheat Commission	12,000	7/2025-6/2026	5	Control of Wheat Stripe Rust
Chen, XM, PI	Oregon Wheat Commission	12,000	7/2025-6/2026	5	Improving Control of Wheat Stripe Rust
Chen, XM, Contractor	Bill & Melinda Gates Foundation	59,404	10/2020-10/2026	5	New Sources of Genetic Disease Resistance through Host-Pathogen Mapping
Pending: Chen, XM, PI	This proposal	12,000	7/2026-6/2027	5	Improving Control of Wheat Stripe Rust
Chen, XM, PI	Washington Grain Commission	115,203	7/2026-6/2027	10	Enhancing Wheat and Barley Rust Management
Chen, XM, PI	Idaho Wheat Commission	12,000	7/2026-6/2027	5	Control of Wheat Stripe Rust
Chen, XM, Co-PI	USDA-NIFA-AFRI	650,000	9/2026-9/2029	5	AI-Enabled Scalable Capacity Enhancement to Reduce Wheat Yield Losses to Stripe Rust



**Christina H. Hagerty, PhD**

**Columbia Basin Agricultural Research Center**

Oregon Wheat Faculty Scholar

Oregon State University

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Adams, Oregon, 97810

541-990 -9673

[agsci-labs.oregonstate.edu/cerealpathology](http://agsci-labs.oregonstate.edu/cerealpathology)

January 23, 2026

Dr. Xianming Chen  
USDA-ARS  
Wheat Health, Genetics, and Quality Research Unit  
2072 Johnson Hall  
Washington State University  
Pullman, WA 99164-6430

Dear Xianming:

This letter is to state my willingness for on-going collaboration with you on your Oregon Wheat Commission project "Improving Control of Wheat Stripe Rust", specifically on monitoring stripe rust populations and implementing control strategies. When stripe rust occurs, we will collect samples from our experimental fields and commercial fields in eastern Oregon and send them to you for race identification and share findings from field surveys. We will collaborate on delivering rust updates and recommendations to Oregon growers for implementing proper measures to prevent rust damage.

Sincerely,

A handwritten signature in black ink, appearing to read "CHAGERTY".

Christina H. Hagerty



**Department of Crop and Soil Science**  
Oregon State University  
109 Crop Science Building  
Corvallis, Oregon 97331

**P:** 541-737-6709  
margaret.krause@oregonstate.edu

30 January 2026

Dr. Xianming Chen USDA-ARS Wheat Health, Genetics, and Quality Research Unit 2072 Johnson Hall Washington State University Pullman, WA 99164-6430

Dear Xianming:

This letter is to indicate my desire for on-going collaboration with you on your Oregon Wheat Commission project titled "Improving Control of Wheat Stripe Rust", specifically the collaborative development of superior wheat cultivars through control of rusts of cereal crops. As leader of the wheat breeding program at Oregon State University, I appreciate working with you to obtain your assessment and interpretation of the rust reactions on Oregon breeding lines. Our collaborative efforts are crucial to the identification of superior breeding lines and the successful release of high-yielding cultivars with sufficient stripe rust resistance. I particularly appreciate the quickness and thoroughness of your evaluations.

In recent years, our collaboration with you has become even more important. In the past, we relied on additional stripe rust resistance data provided by Dr. Chris Mundt to inform variety release decisions. Following Dr. Mundt's retirement, and with the uncertainty around Dr. Eric Nazareno's continuation of these efforts, it is likely that collaborating with your program will be the only way for us to confirm stripe rust resistance of our breeding lines in the field. Relatedly, while we can sometimes rate stripe rust resistance opportunistically when the disease is present in our fields, we appreciate that your program is able to conduct inoculated trials, which generate critical data on stripe rust resistance even in years with low disease pressure.

My program will continue sending our breeding lines to your program for evaluation of stripe rust resistance at multiple locations in Washington. Data on rust reaction of wheat cultivars has been valuable for stakeholders as they decide which cultivars to plant in areas of different disease organisms and environments. A fully equipped breeding program with laboratory and other requisite facilities including equipment and field locations are available for this collaboration. In addition, we will collect stripe rust samples from western Oregon and send them to you for race identification. Thank you for your willingness to continue this collaboration.

Sincerely yours,

A handwritten signature in cursive script that reads "Margaret Krause".

Dr. Margaret Krause  
Assistant Professor  
W.E. Kronstad Endowed Chair of Wheat Research  
Oregon State University

January 23, 2026

Dr. Xianming Chen  
USDA-ARS  
Wheat Health, Genetics, and Quality Research Unit  
2072 Johnson Hall  
Washington State University  
Pullman, WA 99164-6430

Dear Xianming:

This letter is to state my willingness for on-going collaboration with you on your Oregon Wheat Commission project "Improving Control of Wheat Stripe Rust", specifically on monitoring stripe rust populations and implementing control strategies. As stripe rust is more severe in fields under irrigation than fields under dryland agriculture and Hermiston is an important location for monitoring stripe rust in eastern Pacific Northwest, we will continue planting your rust monitoring nurseries at the Hermiston station. We will monitor wheat fields in other locations for stripe rust. When stripe rust occurs, we will collect samples from our experimental fields and commercial fields in eastern Oregon and send them to you for race identification and share findings from field surveys. We will collaborate on delivering rust updates and recommendations to Oregon growers for implementing proper measures to prevent rust damage.

Best wishes,



Dr. Ruijun (Ray) Qin  
Associate Professor & Extension Agronomist  
Hermiston Agricultural Research & Extension Center  
Oregon State University  
2121 South 1st Street  
Hermiston OR. 97838  
Tel: (541) 567 8321 ex 134  
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**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

**Title:** Weed Management Research in Wheat Cropping Systems of Eastern Oregon (Year 2)

**Investigators:** Judit Barroso, Associate Professor in Weed Science, OSU-CBARC

**Cooperators:** Pete Berry (OSU-campus), Victor Ribeiro (OSU-campus), Vhuthu Ndou (OSU-CBARC), Noemi Codina (OSU-CBARC), colleagues from OSU-Extension, and growers from northeastern Oregon.

<b>Funding History:</b> 2023-2024:	\$59,855
2024-2025:	\$57,939
2025-2026:	\$44,825
2026-2027:*(requested)	\$43,513

**Abstract**

Effective weed management is one of the critical components of successful wheat production systems. The goal of this project is to help wheat growers improve weed management in their production through three particular objectives: 1) Study the use of pyroxasulfone (pre-emergence herbicide) in relation to application timing, soil moisture/precipitation, amount of residue present, and seeding depth. Pre-emergence herbicides are a very useful tool to control Group 2 herbicide-resistant weeds and delay the development of new cases of resistance to post-emergence herbicides. Learning which factors impact pyroxasulfone efficacy the most will help to optimize its applications; 2) Study the effects of some settings of spot sprayers. This objective aims to reduce herbicide inputs while maximizing savings in chemical products, fuel, and growers' time. Spot sprayers, such as Weed-IT, require some operator decision-making during application that can significantly impact treatment outcomes. Evaluating the effect of key equipment settings will help growers optimize applications and reduce application frequency. Precision sprayers enable a reduction in the treated area and overall cost per acre; Consequently, a wider range of herbicides (with different modes of action) may become economically feasible, allowing growers to adopt more integrated weed management strategies and delay or prevent the development of herbicide resistance; and 3) Study new cases of herbicide-resistant weeds and provide alternative solutions.

**Objectives:**

The proposed objectives of this research project are:

- 1) Maximize the use of pre-emergence herbicides based on timing of application, soil moisture, residue management, and seeding depth.
- 2) Optimization of post-harvest precision applications with Weed-IT systems.
- 3) Evaluate new cases of herbicide-resistant weeds and study alternative solutions.
- 4) Communicate results to wheat growers, crop advisors, industry reps, and other stakeholders.

## Procedures:

- 1) Maximize the use of pre-emergence herbicides based on timing of application, soil moisture, residue management, and seeding depth. We propose to conduct this study in two locations, Pendleton and Moro, OR where we have weather stations to record rainfall. In summer, we will select two fallow fields that will be seeded with winter wheat in the fall. We will put several soil moisture sensors per trial to study how precipitation translates into soil moisture according to different residue treatments. The residue treatments we are planning are Chemical fallow (no-till) and Minimum tillage with a pass of TurboMax to incorporate the residue. Soil moisture sensors will be put shallow (in the first inch of soil) and deeper (around 2 inches) for better soil moisture tracking. The experiments will have a split-split-plot randomized block design with four replications. Plot size will be 10 by 30 ft. The main treatment will be the two residue managements, the subplots will be the two different seeding depths, and the sub-subplots will be the different pyroxasulfone application times (preplant, preemergence, early postemergence, and untreated check). Downy brome seeds will be sprinkled in the trial areas in July to secure a uniform infestation and simulate a natural seed shedding that happens around that time. The residue management will be conducted before the downy brome seeds have been sprinkled. Herbicide efficacy will be evaluated by counting the weed plants three and six weeks after the herbicide application and in early spring using four sampling frames (0.5 m x 0.5 m) per plot. A visual evaluation of weed control per plot will also be conducted at the same time. Crop yield will be measured at harvest with a plot combine. Data will be subjected to mixed model analyses with site, residue management, seeding depth, and application timing as fixed factors and replication as a random factor. Where significant differences are found, we will follow with Tukey tests to determine differences among groups at the 5% level.
- 2) Optimization of post-harvest precision applications with Weed-IT systems. Weed-IT sensors have different sensitivity levels that provide different outputs. Low sensitivity level prioritizes herbicide savings, while high sensitivity prioritizes not missing weeds. We plan to study the herbicide/volume used with the two extreme sensitivities (lowest and highest) and their efficacies in controlling the weed infestation. We propose to establish the trial in two locations, one at CBARC's research farm in Adams, OR and the other in a grower's field in Morrow County. The experiment will be a randomized complete block design with four replications. The treatments included in each replication will be uniform herbicide application (our control), precision herbicide application using Weed-IT at low sensitivity, and precision herbicide application using Weed-IT at high sensitivity. The trials will be established in freshly harvested fields to conduct weed control post-harvest. The plot size will be 100 ft long by 20 ft wide. To estimate treatment efficacy, a minimum of 10 plants per species and plot will be marked with plastic labels using a different color per species right before herbicide application. Three and six weeks after treatment, we will count the marked plants that are still alive per plot. Efficacy will be provided as percentage of control based on the difference between live plants present at application time and at evaluation times for the three different treatments. To prevent herbicide resistance, we will spray an herbicide tank-mix of two different modes of action that are active on the weeds present. We anticipate that the tank-mix could be of glyphosate at 32 fl oz/ac and Huskie (bromoxynil + pyrasulfotole) at 14 fl oz/ac, if the predominant weed species were, for example, prickly lettuce, Russian thistle and/or marestail. Visual evaluations of weed control will also be conducted at three and six weeks

after treatment. Data will be analyzed with mixed models with the site and treatment type as fixed factors and replication as a random factor. Where significant differences are found, we will follow with Tukey tests to determine differences among groups at the 5% level.

- 3) Evaluate new cases of herbicide-resistant weeds and study alternative solutions. Growers are having problems controlling weeds in wheat cropping systems, most of the time due to herbicide resistance. My plan for this objective is to provide continuous service to Oregon growers, crop advisors, and other stakeholders who contact me with problems to control a particular weed species or multiple species. The first step will be to collect seeds of the weed species suspected of being herbicide-resistant. The second step will be to spray the weed/s with the labelled rate (1X) of the herbicide that is supposed to control the weed at seedling stage, and that the grower is having problems with, and with twice (2X) the labelled rate. If we confirm the resistance, the third step will be to study alternative herbicides to try to provide solutions. Currently, the species we are working with for this objective are horseweed (marestail), hairy fleabane, and prickly lettuce.
- 4) Communicate results to wheat growers, crop advisors, industry representatives, and other stakeholders. Results from the above objectives will be communicated in-person, virtually, or in hybrid set-ups. Events where the information will be communicated include grower meetings, field days, and/or regional conferences. Other media, such as scientific and extension publications, OSU websites, Weeders of the West blog, Oregon Wheat Magazine, or the CBARC Newsletter, will be used to share the information as well.

#### **Timelines:**

*Objective 1.* The trials will be established in July 2026. Weed evaluations will be conducted in the fall of 2026 and spring of 2027. Crop yield will be evaluated in summer 2027. The results report should be ready by fall 2028.

*Objective 2.* The trials will be established in July 2026. Weed evaluations will be conducted in summer and early fall 2026. Data analysis and results writing will be conducted in winter 2026-2027. The results report should be ready by spring 2027.

*Objective 3.* Weed seeds will be collected in summer. Screening of the populations will be conducted during fall, winter, and spring. Data analysis and results writing will be conducted in spring. The result report should be ready by the end of spring - early summer 2027.

*Objective 4.* This objective will be conducted all year round. The different extension activities will be indicated in the project report.

#### **Justification:**

Objective 1. The use of pre-emergence herbicides is recommended to delay the development of resistance to post-emergence herbicides and/or help control weeds that may already be resistant to some of the post-emergence herbicides, such as Group 2 herbicides like Osprey, PowerFlex, Outrider, Olympus, or Beyond (Ribeiro et al., 2024). However, the effect of pyroxasulfone (pre-emergence herbicide which trade names are Zidua® or Anthem® Flex (this last one contains carfentrazone as well)) seems inconsistent in controlling certain grass weeds, and a better understanding of the important factors that might be affecting its efficacy is needed to optimize

its use in the region. From this objective, growers will have information about which of the herbicide application timing possibilities included in the pyroxasulfone label (pre-plant, post-plant pre-emergence, or early post-emergence) can provide greater control efficacy and protect crop yield the most based on year precipitation (soil moisture conditions), residue management, and crop seeding depth. This objective will also inform about the efficacy of pyroxasulfone pre-emergence herbicide to control downy brome and other grass weeds in minimum tillage and no-till.

Objectives 2. Growers in the region that have sprayers with optical sensors to apply herbicide site-specifically, such as Weed-IT, say that they have to go through their fields more often than when they broadcast herbicides. The knowledge gained with this objective will help understand how to set up the equipment more efficiently based on the weed species present and the size of those plants. In addition to helping growers who already have a precision sprayer, this objective will help to increase the adoption of this technology in the region if our results show that the savings from using this technology will pay off quickly for its purchase. This objective will help to reduce herbicide inputs in the wheat cropping systems of Oregon and make them more sustainable.

Objective 3. The proposed objective will help to identify potential new cases of herbicide-resistant weeds in the region and look for alternatives. Many weed seeds are dispersed by the wind, so if a resistance problem exists in one of these species, it will spread very quickly in the region. The sooner we can help growers confirm resistance problems, the lower the risk of spreading the resistance to others. The proposed work will benefit growers with the resistance problem but will also help others to prevent acquiring it. Results from this objective are essential to provide information from eastern Oregon to the website <https://www.pnwhri.org/resources>.

Objective 4. Last, but not least, the support of OWC for this project is vital to disseminating unbiased knowledge to those involved in wheat production and to ensuring that the information reaches the end user.

**Budget:**

Summary table indicating the funding requested to accomplish the proposed objectives.

Categories	Dollars (\$)	Justification
<u>Salaries:</u>		
Postdoc (22%)	13,691	To pay for 10% of Postdoc salary
Senior FRA (5%)	3,665	To pay for 5% of technician's salary
Summer labor	6,204	To support 2.4 months of a summer student at \$15/h x 8h/day x 22 days/month = \$2,640/month
OPE (Postdoc; 12.7%)	1,739	
OPE (Senior FRA; 71%)	2,602	
OPE (summer student; 10%)	620	
<u>Travel:</u>		
Domestic (in-state)	2,500	To travel to communicate results, visit grower's fields, attend extension activities, etc.

<u>University Fees:</u>		
Land fee	2,400	To rent field space (4 ac) at CBARC at \$600/ac
Farm equipment fee	1,900	To use the station tractor, drill, trailer and commercial sprayer
CBARC Labor Services	992	Farm manager 16 hours at \$62/h
<u>Supplies and materials:</u>		
Supplies, materials, and equipment	5,000	To buy herbicides, adjuvants, seeds, fertilizers, portable weather station, nozzles, flags, and other miscellaneous.
Publications	2,200	To pay for an open access manuscript in a scientific journal and PNW extension publication.
<b>Total</b>	<b>43,513</b>	

Matching funds are the salary percentage (including OPE) of the people needed to accomplish the objectives: Barroso (0.20 FTE - \$30,000) and Gourlie (0.40 FTE- \$50,136). Total = \$80,136.

**Relation to Other Research:**

This proposal will leverage funds received by the OWC in the previous year, along with support from the PNW herbicide resistance initiative.

**References:**

Ribeiro V., Mallory-Smith C.A., Brunharo C.A.C.G., and Barroso J. 2024. Downy brome (*Bromus tectorum*) management and herbicide resistance in dryland wheat production across northeastern Oregon. *Weed Science* 72, 5: 638–45. DOI:10.1017/wsc.2024.52

**CURRENT AND PENDING SUPPORT**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>
Current: <b>J. Barroso</b>	Oregon Wheat Commission (OWC)	\$44,825	7/1/2025-6/30/2026	15%	Weed Management Research in Wheat Cropping Systems of Eastern Oregon
<b>J. Barroso</b> (Project Leader), P. Berry	USDA-ARS	\$420,000	09/01/2022-08/31/2027	25%	PNW Herbicide Resistance Initiative
F. J. Calderon (Project Leader), S. Machado, <b>J. Barroso</b> , P. Ramirez-Cisterna.	USDA-ARS	\$260,454	9/15/2021-9/14/2026	10%	Soil Health and Crop Productivity in Pacific Northwest Dryland Wheat Production Systems.
D. Wooster (Project Leader), S. Machado, R. Qin, S. DeBano, <b>J. Barroso</b>	USDA-NIFA	\$7,000	12/10/2022-09/30/2027	1%	Optimizing Ground and Surface Water Resources for Agricultural Production, Drinking Water Quality and Ecosystem Health in the Umatilla Basin, OR Phase II
Pending: <b>J. Barroso</b> (This project)	OWC	\$43,513	7/1/2026-6/30/2027	15%	Weed Management Research in Wheat Cropping Systems of Eastern Oregon (Year 2)
<b>J. Barroso</b>	OWC	\$6,647	7/1/2026-6/30/2027	5%	Predicting Weed Emergence in Wheat Cropping Systems

**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

**Title:** Predicting Weed Emergence in Wheat Cropping Systems

**Investigators:** Judit Barroso, Associate Professor in Weed Science, OSU-CBARC

**Cooperators:** Pete Berry (OSU-campus), Victor Ribeiro (OSU-campus), Vhuthu Ndou (OSU-CBARC), Noemi Codina (OSU-CBARC).

**Funding History:**

2023-2024:	\$59,855
2024-2025:	\$57,939
2025-2026:	\$44,825
2026-2027:*(requested)	\$6,647 (\$50,160)

**Abstract**

Accurate prediction of weed emergence is essential for improving the timing and efficiency of weed management practices. This project aims to study the emergence of important weeds in wheat cropping systems of northeastern Oregon with the ultimate goal of being able to predict weed emergence based on environmental variables such as soil moisture and air temperature. By linking emergence dynamics with weather and field conditions, we seek to identify the conditions when a species may start to germinate and when the emergence peak or peaks might occur to optimize the timing of control operations. Weed emergence prediction will enable more targeted interventions, reduce herbicide use and operational costs, and support integrated weed management strategies that enhance long-term sustainability in cropping systems.

**Objective:**

Study the emergence of important weeds in wheat cropping systems of northeastern Oregon

**Procedures:**

In August, at CBARC, we will establish a complete randomized block design with four repetitions and two treatments per repetition. The treatments will be fallow and winter wheat crop. The plot size will be 10 by 30 ft. Three permanent frames will be placed per plot of 0.5 x 0.5 m. Total sampling units: 2 treatments x 4 reps x 3 frames = 24 frames. Evaluations will start in September, and emergence will be counted weekly for the first two months. When emergence slows, the evaluations will be conducted biweekly until we no longer observe more emergences because of the cold weather. When temperatures in late winter start to warm up, we will resume the biweekly evaluations. In each sampling date, we will count all emerged seedlings by species and remove them or immediately spray an effective, no-residual postemergence herbicide. At the end of the season, the proportional emergence of seedlings observed will be modeled using a hydrothermal and thermal seed germination model in R (version 2024.04.1).

**Timelines:**

July - August 2026: Determine the area of the trial and establish the soil moisture sensors.  
 Sept - October 2026: Evaluate weed emergence weekly.  
 Nov - May 2027: Evaluate weed emergence biweekly.  
 June – July 2027: Fit the models to the data.  
 September 2027: Write the project report.

**Justification:**

Understanding weed emergence is critical for growers because emergence timing determines when weeds are most vulnerable to control and when management actions are most effective. Accurate knowledge of emergence patterns allows growers to better time herbicide applications and other control measures, increasing control efficacy while reducing unnecessary applications, fuel use, and labor. Ultimately, studying weed emergence will enable weed emergence predictions that will help growers achieve more reliable weed control, delay the development of herbicide resistance, and improve the long-term sustainability and profitability of their production systems.

**Budget:**

Summary table indicating the funding requested to accomplish the proposed objective.

Categories	Dollars (\$)	Justification
<u>Salaries:</u>		
Postdoc (8%)	4,979	To pay 8% of Postdoc salary
OPE (Postdoc 12.7%)	632	
<u>University Fees:</u>		
Land fee	600	To rent field space (1 ac) at CBARC for \$600/ac
<u>Supplies and materials:</u>		
Supplies, materials, and equipment	436	To buy one soil moisture sensor and other miscellaneous items.
<b>Total</b>	<b>6,647</b>	

Matching funds are the salary percentage (including OPE) of the people needed to accomplish the objectives: Barroso (0.05 FTE - \$7,500) and Gourlie (0.05 FTE- \$6,267). Total = \$13,767.

**Relation to Other Research:**

This proposal will provide preliminary data to facilitate expansion of this research through funding from the PNW herbicide resistance initiative.

Implementation of this proposal is contingent upon funding of the proposal titled “Weed Management Research in Wheat Cropping Systems of Eastern Oregon (Year 2)”.

**CURRENT AND PENDING SUPPORT**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>
Current: <b>J. Barroso</b>	Oregon Wheat Commission (OWC)	\$44,825	7/1/2025-6/30/2026	15%	Weed Management Research in Wheat Cropping Systems of Eastern Oregon
<b>J. Barroso</b> (Project Leader), P. Berry	USDA-ARS	\$420,000	09/01/2022-08/31/2027	25%	PNW Herbicide Resistance Initiative
F. J. Calderon (Project Leader), S. Machado, <b>J. Barroso</b> , P. Ramirez-Cisterna.	USDA-ARS	\$260,454	9/15/2021-9/14/2026	10%	Soil Health and Crop Productivity in Pacific Northwest Dryland Wheat Production Systems.
D. Wooster (Project Leader), S. Machado, R. Qin, S. DeBano, <b>J. Barroso</b>	USDA-NIFA	\$7,000	12/10/2022-09/30/2027	1%	Optimizing Ground and Surface Water Resources for Agricultural Production, Drinking Water Quality and Ecosystem Health in the Umatilla Basin, OR Phase II
Pending: <b>J. Barroso</b>	OWC	\$43,513	7/1/2026-6/30/2027	15%	Weed Management Research in Wheat Cropping Systems of Eastern Oregon (Year 2)
<b>J. Barroso</b> (This project)	OWC	\$6,647	7/1/2026-6/30/2027	5%	Predicting Weed Emergence in Wheat Cropping Systems

**Research Proposal Format**  
**Research Proposal for the Agricultural Research Foundation**  
**Oregon Wheat Commission**

Title: Evaluating Indaziflam Carryover Risk in Winter Wheat Following Spot-Spray Applications for Annual Grass Control

Investigator(s): Dr. Pete Berry – PI, Julio Peres – Graduate Student – Berry Lab

Cooperator(s): Drs Victor Ribeiro and Judit Barroso, Corvallis and Pendleton, OR. Both will be contributing to design and data analysis.

Funding History: 2023-2024 - \$29,887  
Requesting - \$18,100

**Abstract:**

Herbicide-resistant winter annual grasses continue to be one of the most significant production constraints in Pacific Northwest wheat–fallow systems. Resistance to commonly used Group 1 and Group 2 herbicides has reduced the effectiveness of broadcast programs, increased production costs, and limited long-term management options. Precision agriculture technologies, such as spot-spray systems, offer new opportunities to improve weed control, however, their integration into wheat systems has lagged behind others crops due to challenges in weed identification within crop canopies – grassy weeds in a grass crop. Weed-identification models for wheat are advancing, and proactive research is needed to ensure growers are prepared to adopt these technologies as they become commercially available.

This project evaluates the integration of spot-applied indaziflam (Group 29) into winter wheat production systems, positioning Oregon wheat growers ahead of the adoption curve. Indaziflam provides long-lasting residual control of winter annual grasses and has no documented cases of resistance, making it a valuable addition to resistance-management programs. By selectively spot applying indaziflam to where emerged weeds are, growers can increase weed control of winter annual grasses during fallow and into subsequent wheat crops where known weeds were present previously. However, crop phytotoxicity needs to be assessed to determine potential yield impacts with a long-lasting residual herbicide.

Field experiments will be conducted at the Hyslop Farm and the Columbia Basin Agricultural Research Center (CBARC) using CoAXium® winter wheat. A Weed-it spot-spray system will be programmed to randomly spot apply indaziflam to varying proportions of the field area during the wheat production cycle. Crop response and grain yield will be measured, followed by evaluation of residual phytotoxicity after a fallow year and replanting to wheat. In parallel, the accuracy of the Ecorobotix ARA green-on-green system for detecting weeds in wheat will be assessed to establish baseline performance under Oregon conditions.

Results will provide growers with data-driven guidance on integrating spot spraying and residual herbicides into wheat–fallow systems, supporting sustainable, resistance-conscious weed management as precision spraying technologies become increasingly available.

## **OBJECTIVES:**

**Objective 1:** Determine the effect of spot sprayed indaziflam on winter wheat stand, biomass, and grain yield when 0, 5, 10, 15, 25, 30 and 100 percent of the field area is treated during the previous production cycle.

**Objective 2:** The Ecorobotix ARA spot-sprayer system has not yet been evaluated in U.S. wheat production, leaving a key gap in understanding its performance in these systems. Assessing its current detection model—especially for winter annual grasses—will provide the first indication of how well the technology functions under local conditions and what improvements may be needed moving forward.

## **PROCEDURES:**

### **Objective 1:**

#### **Site Establishment and Experimental Design**

Field experiments will be conducted at two contrasting Oregon wheat production environments: the Hyslop Research Farm and the Columbia Basin Agricultural Research Center. CoAXium® winter wheat will be planted following standard regional agronomic practices using a randomized complete block design with four replications. Fields will be planted during the Fall of 2025 – spot and broadcast sprayed in the early spring of 2026 with yield data taken during that summer. The field will be left fallow during the 2026-2027 growing season but weed populations quantified to assess residual benefits. Fall 2027 plots will be planted and crop phytotoxicity assessed throughout the growing season (including yield). A replicated study will be planted during the fall of 2026 with the same treatments and seasonal assessments.

#### **Spot-Spray Treatments**

A Weed-it optical spot-spray system will be programmed to apply indaziflam during spring 2026 at a labeled rate (6.5 fl oz/acre), with treatments representing 0, 5, 10, 15, 25, 30, and 100% of plots. Randomized polygons (shapefiles) within each plot corresponding the percent coverage (0 – 30) will be uploaded into the sprayer using the ISOBUS connection through the John Deere RTK 7000 series system. Based on the geolocation of the sprayer and polygons, nozzles will activate as the system drives over those pre-determined locations. Aggressor (quizalofop) programs will be applied uniformly across all treatments for in-season weed control. Glyphosate will be broadcast sprayed over fallow fields and prior to fall plantings.

#### **Crop and Weed Assessments**

During the production year (year 1), wheat stand density, aboveground biomass, weed density and crop injury will be assessed from aerial imagery. Plots will be harvested at maturity to quantify grain yield and to determine any impact of indaziflam applications during the POST application.

#### **Fallow-Year and Replant Evaluation**

Following harvest, fields will remain fallow for one year but imaged to assess weed populations relative to the untreated check. In fall 2027, CoAXium® wheat will be replanted to assess residual indaziflam phytotoxicity. The same assessment will occur in a replicated study planted during the fall of 2026.

## **Objective 2:**

### **Site Establishment and Experimental Design**

Field experiments will be conducted at Hyslop Research Farm. CoAXium® winter wheat will be planted following standard regional agronomic practices using a randomized complete block design with four replications. Fields will be planted during the Fall of 2026 and spot sprayed during the fall after emergence (early season small winter annual weedy grass identification) and during the early spring of 2026 for larger winter annual weedy grasses.

The Ecorobotix ARA green-on-green spot sprayer will be operated across wheat plots at the Hyslop research farm to assess weed detection accuracy, focusing on winter annual grasses. Detection accuracy will be quantified by comparing system activations to ground-truth weed observations. Aggressor (quizalofop) will be spot sprayed in order to identify sprayed grasses in POST application imagery. Percent control relative to weed size will be quantified to determine model accuracy.

### **Timeline**

#### **Objective 1:**

- |                                |   |
|--------------------------------|---|
| <b>Fall 2025</b>               | <ul style="list-style-type: none"><li>• Establish CoAXium® winter wheat at CBARC and Hyslop research locations</li></ul>  |
| <b>Spring 2026</b>             | <ul style="list-style-type: none"><li>• Spot application of indaziflam treatments using Weed-it system</li><li>• Broadcast application of Aggressor for standard weed management</li></ul>  |
| <b>Summer 2026</b>             | <ul style="list-style-type: none"><li>• Grain harvest</li><li>• Yield and grain quality assessments</li></ul>   |
| <b>Fall 2026 – Summer 2027</b> | <ul style="list-style-type: none"><li>• Fallow period following wheat harvest</li><li>• Site maintenance at both locations</li><li>• Assessment of weed control and volunteer wheat response in plots previously receiving indaziflam</li></ul> |
| <b>Fall 2026</b>               | <ul style="list-style-type: none"><li>• Establishment of replicated phytotoxicity assessment plots at CBARC and Hyslop</li></ul>  |
| <b>Spring 2027</b>             | <ul style="list-style-type: none"><li>• Indaziflam applications to replicated phytotoxicity plots</li></ul>   |
| <b>Summer 2027</b>             | <ul style="list-style-type: none"><li>• Crop response evaluations and harvest of replicated plots</li></ul>   |
| <b>Fall 2027 – Summer 2028</b> | <ul style="list-style-type: none"><li>• Replanting to CoAXium® winter wheat following fallow</li><li>• Evaluation of crop stand, phytotoxicity, and grain yield</li><li>• Data analysis and interpretation</li></ul>                            |
| <b>Fall 2028</b>               | <ul style="list-style-type: none"><li>• Final wheat planting for extended indaziflam carryover assessment</li></ul>   |

#### **Objective 2:**

- |                    |   |
|--------------------|---|
| <b>Fall 2026</b>   | <ul style="list-style-type: none"><li>• Establish wheat at Hyslop research farm.</li><li>• Assess Ecorobotix model of weed identification in smaller crop/weeds</li></ul> |
| <b>Spring 2027</b> | <ul style="list-style-type: none"><li>• Assess Ecorobotix model of weed identification in larger crop/weeds</li></ul>   |

## **Justification and Expected Benefits**

Herbicide-resistant winter annual grasses are increasingly limiting effective weed control in Oregon wheat–fallow systems, creating an urgent need for new, durable management approaches. At the same time, precision spot-spray technologies and weed-identification models for wheat are rapidly advancing toward commercial availability, yet there is limited field-based information to guide their responsible integration into cereal production systems. This proposal is justified by the need to proactively evaluate spot-applied indaziflam within winter wheat to understand crop response, yield impacts, and residual effects across production cycles, while establishing baseline performance of emerging spot-spray platforms under Oregon conditions. Generating this information now positions growers, industry, and researchers ahead of adoption, reduces uncertainty associated with new technologies, and supports the development of resilient, long-term weed management strategies for wheat production in the Pacific Northwest.

### **Benefits to Growers**

This research directly addresses herbicide-resistant winter annual grasses by integrating a new mode of action into wheat–fallow systems through spot spraying. Applying indaziflam only where weeds occur reduces total herbicide inputs, lowers costs, and preserves the effectiveness of existing Group 1 and Group 2 chemistries. Importantly, this work prepares growers for the imminent availability of wheat weed-identification models, enabling rapid adoption once commercially released.

### **Benefits to Industry**

This project provides early, field-scale data that supports both herbicide and precision-application industries as wheat weed-identification technologies advance toward commercialization. For herbicide manufacturers, the study documents the performance and crop safety of spot-applied indaziflam in winter wheat systems, focusing on residual effects following fallow, generating data critical for stewardship guidance and resistance-management strategies.

For precision-sprayer developers, this research offers foundational validation of spot-spray systems in wheat, a major cropping system that has historically limited green-on-green model development, helping guide algorithm refinement, sensor calibration, and application logic for winter annual grass detection. The wheat and grain industry benefits from improved risk management as herbicide resistance expands, with precision integration supporting yield stability, reduced chemical inputs, and long-term system viability. By proactively evaluating these tools ahead of full commercial deployment, this project reduces uncertainty for industry investment, accelerates technology readiness, and positions Oregon as a leader in precision weed management for cereal production systems.

### **Benefits to Society**

This research supports long-term food security and agricultural resilience by improving the stability and sustainability of winter wheat production systems threatened by herbicide-resistant winter annual grasses. By proactively evaluating emerging precision weed-management technologies in wheat before widespread commercialization, the project ensures that future adoption is informed by agronomic performance, crop safety, and system-level understanding, reducing the risk of misapplication or unintended impacts. The work also contributes to workforce development by training researchers and practitioners in advanced sensing, precision application, and data-driven agronomy—skills increasingly critical to modern agriculture. Ultimately, strengthening weed management in wheat–fallow systems helps sustain farm profitability, supports rural economies, and reinforces the reliability of wheat production systems that are central to regional and global food supplies.

Salary:

Faculty

Graduate Student: \$8,000

Other students

Other Labor (specify type): FRAs Andy Branka and Jennifer Gourlie - \$2,500

OPE for all categories: \$1,725

Equipment:

Travel: \$1,600

Domestic (in state): \$1,600 (Four trips to CBARC from Corvallis)

Domestic (out of state)

Foreign (conferences, etc)

Supplies and Materials:

Land Rental

CBARC - \$ 850

HYSLOP - \$1,150

DASH Monitor System - \$1,000 (Berry lab covering additional \$8000 for sensor)

TerraSolid Software - \$1,000 (Berry lab covering additional \$2500 annual cost)

**CURRENT AND PENDING SUPPORT**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>
Current:					
Weed identification model in Grasses grown for seed	Oregon Grass Seed Commission	\$28,085	7/1/25 – 12/1/2026	5%	Using Aerial imagery and AI to develop weed identification in Tall Fescue
Mapping herbicide resistance in the PNW	Pacific Northwest Herbicide Resistance Initiative	\$124,000	7/1/2023 – 12/1/2028	5%	Mapping Herbicide Resistance in the PNW

Pending:					
Precision fertilization in grasses grown for seed	Oregon Grass seed Commission	\$14,500	7/1/2026 – 12/1/2027	5%	Evaluating Precision Fertilizer Placement to Improve Tall Fescue Establishment and Reduce Weed Competition
Assessing Precision Planting and Spot Carbon Placement to Improve Weed Management in Grass Seed Crop	Oregon Grass seed Commission	\$8,640	7/1/2026 – 12/1/2027	5%	Assessing Precision Planting and Spot Carbon Placement to Improve Weed Management in Grass Seed Crops
Spot Spraying Technology in Grasses grown for Seed	Oregon Grass Seed Commission	\$8,750	7/1/2026 – 12/1/2027	5%	Assessing the Transferability of Ecorobotix Tall Fescue and Kentucky Bluegrass Weed Identification Models to Perennial Ryegrass and Fine Fescue
Spot Spraying Technology in Clover Grown for Seed	Oregon Clover Commission	\$10,000	7/1/2026-12/1/2027	5%	Assessment of the Ecorobotix ARA system for AI-Driven Weed Detection and Targeted Herbicide Application in Clover Grown for Seed
Spot spraying residuals in mint grown for oil	Oregon Mint Commission	\$14,500	3/1/2026 – 8/1/2027	5%	Optimizing Late-Season Zidua Application in Mint Using Spot-Spray Technology for Extended Weed Control
Assessing seed destruct technology in dryland wheat production	USDA -AFRI	\$600,000	9/1/2026 – 7/31/2030	10%	Assessing Impact Mill Efficacy to Help Address Herbicide Resistance Management in the PNW

**Title:** Wheat and Barley Variety Testing in Oregon

**Investigator:** Ryan Graebner, Assistant Professor of Practice, Columbia Basin Agricultural Research Center, OSU, Adams

**Cooperators:** Margaret Krause, Crop and Soil Science Department, OSU, Corvallis

Andrew Ross, Crop and Soil Science Department, OSU, Corvallis

Chris Mundt, Botany and Plant Pathology Department, OSU, Corvallis

Brian Charlton, Klamath Basin Research and Extension Center, OSU, Klamath Falls

Everaldo McLennon, Klamath Basin Research and Extension Center, OSU, Klamath Falls

**Funding History:**

2023 – 2024 - \$167,800
2024 – 2025 - \$170,400
2025 – 2026 - \$173,400
2026 – 2027 - <b>\$175,400</b>

**Abstract:** The Oregon statewide variety testing program provides growers with performance information on commonly grown and newly released wheat and barley varieties from public and private breeding programs. Wheat varieties are split into four categories for evaluation (Oregon Soft Winter Extension Yield Trial or OWEYT; Hard Winter Extension Yield Trial or HWEYT; Oregon Soft Spring Yield Trial or OSSYT; and Oregon Hard Spring Yield Trials or OHSYT). Barley varieties are evaluated in the Oregon Spring Barley Variety Trial (OSBVT). In 2026-27, the variety testing program is proposing seventeen winter wheat, seven spring wheat, and six spring barley locations in Oregon, eastern Washington, and Northern California. The Klamath Falls and Tulelake trials are conducted in collaboration with the Klamath Basin Research and Extension Center (KBREC) and the Intermountain Research and Extension Center (IREC), while the Walla Walla and Eureka trials are conducted in collaboration with the Washington State University variety testing program and Northwest Grain Growers. Trial locations are chosen to provide relevant variety performance data for all major Oregon wheat and barley growing regions. Trial results are reported through email alerts, web publications, grower meeting, crop tours, and field days.

**Objective:**

- 1) Evaluate the performance of commonly grown varieties, new varieties, and variety candidates across Oregon. Provide growers with up-to-date information on variety performance, adaptation, and disease resistance.

**Procedure:** Commonly grown varieties, new varieties, and variety candidates from the PNW wheat breeding programs are evaluated in the OSU statewide variety trials. Wheat varieties are split into categories based on wheat class and winter/spring type. In 2026-27, the variety testing program is proposing seventeen soft winter, ten hard winter, seven spring wheat, and six spring barley locations in Oregon, Eastern Washington, and Northern California (Table 1). These sites are chosen to represent a diverse array of production conditions - from very low rainfall to full irrigation, shallow to deep soils, and low residue to high residue management practices. Exact location of the trials may vary each year, depending on field availability. The Klamath Falls and Tulelake trials are conducted in collaboration with the Klamath Basin Research and Extension Center (KBREC) and the Intermountain Research and Extension Center (IREC). Several of the OSU variety trial locations are co-located with OSU wheat breeding trials and Dr. Chris Mundt's disease screening nurseries to best utilize our personnel, equipment, and monetary resources to achieve the goals of each program.

Wheat varieties are split into four categories for evaluation (Oregon Soft Winter Elite Yield Trial or OWEYT; Hard Winter Elite Yield Trial or HWEYT; Oregon Soft Spring Elite Yield Trial or OSSYT; and Oregon Hard Spring Elite Yield Trials or OHSYT). Barley varieties are evaluated in the Oregon Spring Barley Variety Trial (OSBVT) and the Oregon Winter Barley Variety Trial (OWBVT). There are 50-60 entries in the OWEYT, 15-30 entries in the HWEYT, 15-25 entries in the OSSYT, 15-25 entries in the OHSYT, and 15-25 entries in the OSBVT. Trials will be grown in three-replicate or four-replicate alpha lattice designs.

Yield, protein, test weight, and height are measured for every plot in the program, while disease severities and heading dates are collected at a subset of locations. Data from the OWEYT, HWEYT, OSSYT, OHSYT, and OSBVT are collected, analyzed, and made available to growers soon after harvest. Data is summarized and distributed via web, email, newsletters, print media, and various extension outlets. The OWEYT and HWEYT also provide grain samples to evaluate stability and consistency of end-use quality traits by the OSU Wheat Quality Improvement Program and ARS Western Wheat Quality Lab.

In the 2024 growing season, we began attempting to evaluate effects varieties may have on the yield of following crops. This will be done by planting a single spring wheat variety over the footprint of a previous year's variety trial, then harvesting the spring wheat to determine whether the initial variety affected the following crop's yield.

Variety trials will be treated with a fungicide if needed to ensure the grain yield and agronomic results are representative of the surrounding region.

**Table 1.** Proposed variety trial locations and trials.

<b>Location</b>	<b>Trials</b>
Athena	OSSYT, OSHYT, OSBVT
Condon	OWEYT, HWEYT
Dufur	OWEYT
Helix	OWEYT, HWEYT
Hermiston	OWEYT, HWEYT
Kent	OWEYT, OSSYT, OHSYT, OSBVT
Klamath Falls	OWEYT, HWEYT, OSSYT, OHSYT, OSBVT
La Grande	OWEYT, HWEYT, OSSYT, OHSYT, OSBVT
Lexington	OWEYT, HWEYT
Madras	OWEYT
Moro- CBARC	OWEYT
Moro- Kaseberg	OWEYT, HWEYT
Ione	OSSYT, OHSYT, OSBVT
North Willamette Valley	OWEYT, OSSYT, OHSYT
Ontario	OWEYT
Pendleton- CBARC	OWEYT, HWEYT, OSSYT, OHSYT, OSBVT
South Willamette Valley	OWEYT
Tulelake, CA (collaborative)	OWEYT, HWEYT
Milton Freewater	OWEYT, HWEYT

**Timeline:** Plots will be established starting in September (winter trials) and February (spring trials) and will be managed to reflect local growing conditions. Trials will be evaluated in-season for diseases and pests. At maturity, plots will be harvested using a small plot combine. Grain yield will be determined using an on-combine weigh system, and samples will be analyzed for test weight and protein using a FOSS NIR. Results from these trials will be as each location is harvested (typically results are released two weeks after harvest, but longer delays may occur near the end of the season). Results will be reported through email alerts, web publications, grower meetings, and extension publications when applicable. Preliminary results may also be

presented at regional and national meetings. Yearly progress reports will be presented to the Oregon Wheat Commission.

**Justification:** Variety selection is one of the most important agronomic decisions a grower makes. Selecting an appropriate variety minimizes the risk from crop diseases and stresses while maximizing yield potential. The OSU statewide variety trials provide growers and industry with the fundamental data on the performance, adaptation, disease resistance, and quality of commonly grown and new varieties required for variety selection and quality recommendations.

Trials at the Klamath Basin Research & Extension Center are presented as a separate item in the budget, as these trails are planted, maintained, and harvested directly by KBREC personnel. This differs from most other locations in Oregon due to the distance from Pendleton and because planting and harvest schedules often conflict which with other sites. Trials in the Klamath Basin provide a valuable addition to other trial locations due to the basin’s unique growing conditions and its distance from other variety trials in the state. Trial results will be collated with results from the Intermountain Research & Extension Center and disseminated as a Klamath Basin summary to stakeholders.

**Budget:** Funds are requested for labor, travel, services, supplies, minor equipment, and land rent.

**Salaries**

**FRA 1**

0.25 FTE	15,000
0.25 FTE OPE Share for FRA	10,000

**FRA 2**

1.0 FTE	58,000
1.0 FTE OPE Share for FRA	37,000

**Student Labor (2 Students)**

Student OPE (10%)	14,000
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**Other Expenses**

Services (NIR Expenses)	3,000
Supplies (Flags, Labels, Fertilizer, Office Supplies)	3,000
Minor Equipment & Repairs	5,000
Land Rent	6,000
Miscellaneous Expenses	2,000

**Klamath Basin Cooperation**

7,500

**Travel**

Domestic In/Out-of-State (Including Vehicle Maintenance)	13,500
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**TOTAL REQUEST**

175,400

**Relation to Other Research:** This project will complement current research efforts and be conducted through collaboration with the OSU Wheat Breeding Program, the OSU Cereal Quality Program, Dr. Chris Mundt's plant pathology program, the Western Wheat Quality Laboratory, Oregon's agricultural experiment stations, and local extension faculty.

**CURRENT AND PENDING SUPPORT**

NAME	SUPPORTING AGENCY	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
Current:	USDA-ARS	\$8,000	7/1/26 – 6/30/27	3%	Resilient Dryland Farming Alliance
Pending:					

**Title:** Breeding High Quality Hard Red Spring Wheat for Oregon

**Investigator:** Ryan Graebner, Assistant Professor of Practice, Columbia Basin Agricultural Research Center, OSU, Adams

**Cooperators:** Margaret Krause, Crop and Soil Science Department, OSU, Corvallis

Andrew Ross, Crop and Soil Science Department, OSU, Corvallis

**Funding History:** 2024 – 2025 - \$2,000  
2025 – 2026 - \$2,000  
2026 – 2027 - **\$2,000**

**Abstract:** This project aims to breed hard red spring wheat varieties that are adapted to dryland and irrigated growing conditions in Oregon. We are attempting a “small but agile approach” to spring wheat breeding, where we leverage our small size (rarely more than 200 plots in the field) to advance through generations and release promising experimental lines quickly. We have received tremendous support for this work from the WSU spring wheat breeding program and the UC-Davis wheat breeding program through germplasm sharing, and from the Western Small Grains Genotyping Lab and the Western Wheat Quality Lab through genotyping and end-use quality analysis.

**Objective:**

- 1) Develop hard red spring wheat varieties that are locally adapted to Oregon’s growing conditions.

**Procedure:** Spring wheat is currently being developed on a three-year cycle. Below is a summary of the types of activities we conduct in each year of the cycle (all steps are sequential unless otherwise noted).

*Year 1 (Advance Generations in Greenhouse, Screen Segregating Families in the Field):*

- Grow segregating F2:3 families in the greenhouse.
- Grow segregating F2:4 families in 3-4 field sites.
- Select experimental lines from F2:4 families with favorable agronomic characteristics.

*Year 2 (Increase Seed in Greenhouse, Screen Fixed Lines in the Field):*

- Increase experimental lines from F4 heads in greenhouse.
- Evaluate experimental lines in 3-4 field locations, selecting the most promising for crossing and further testing.

*Year 3 (Advanced Field Testing and Crossing for the Next Generation):*

- Make crosses and grow resulting F1 plants (this may overlap with the following step).

- Grow segregating F2 families in the field.
- Evaluate 9-16 experimental lines in replicated multi-environment trials.
- Select 1-3 experimental lines for entry into statewide variety trials and 4-8 crosses to develop the next generation.

The first generation of this effort is complete and resulted in two experimental line submissions to the OSU and WSU statewide variety trials in 2024, but neither were released. This proposal will fund Year 1 of the third generation. In this funding cycle, 60-80 segregating F2:4 families will be developed and tested in 3-4 locations (Table 1). F4 heads will be selected from families with favorable agronomic, disease, and quality traits to develop fixed experimental lines to evaluate over the following two years.

**Table 1.** Likely locations for spring wheat breeding trials in the 2027 growing season.

Location	Type
Athena	Irrigated
La Grande	Irrigated
Ione	Dryland
Pendleton	Dryland

**Timeline:** Following the 2026 harvest, we will select 4-6 experimental lines to be parents for the third generation. That fall, we will use F2 heads derived from crosses between these lines to develop 60-80 segregating F2:4 families. Segregating families will be evaluated in the field in spring 2027.

**Justification:** According to the 2012, 2017, and 2022 Oregon Agricultural Censuses, Oregon produces approximately 5 million bushels of spring wheat per year, worth \$30-40 million. We expect that approximately one third of this (\$10-13 million) is hard red spring wheat. Because Oregon receives little attention from outside breeding programs, we believe that an Oregon-focused breeding program could improve hard red spring wheat yields by 2% compared to varieties bred for regions outside the state (2 bu/acre in a 50 bu/acre crop, or 4 bu/acre in a 100 bushel crop). This would result in a \$200,000-270,000 annual value to Oregon Growers. We expect it will take 3-7 years to release a competitive variety from this work.

**Budget:** Funds are requested for supplies, minor equipment, land rent, and quality testing.

<b>Greenhouse, Field, and Genotyping Supplies</b>	500
<b>Quality Testing</b>	1,500
	<hr/>
<b>TOTAL REQUEST</b>	<b>2,000</b>

**Relation to Other Research:** Field research plots will be co-located with existing variety testing plots, which will eliminate travel and set-up time needed to manage these trials. We don't anticipate that this project would significantly interfere with our core variety testing work. We typically limit our spring wheat breeding field footprint to ~200 plots, which is not significant compared to our ~5,500 variety testing plots.

### CURRENT AND PENDING SUPPORT

NAME	SUPPORTING AGENCY	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
Current:	USDA-ARS	\$8,000	7/1/26 – 6/30/27	3%	Resilient Dryland Farming Alliance

**Research Proposal Format**  
**Research Proposal for the Agricultural Research Foundation**  
**Oregon Wheat Commission**

Title: Utilizing fungicides in the absence of foliar disease for potential plant health (third year in the field)

Investigator(s): Christina H. Hagerty – CBARC Pendleton

Cooperator(s): Grayson Namdar, FRA, CBARC Pendleton, field work assistance and data curation

Funding History: 2023-24  
\$25k Seed care evaluation  
2024-25  
\$25k Seed care evaluation  
\$5k Fungicide evaluation for plant health effects  
2025-2026  
\$30k Disease notes and grad student support  
\$10k Fungicide evaluation for plant health effects

Amount requested: \$3k

**Abstract:**

Fungicide applications in crops such as soybeans in the Midwest have demonstrated yield benefits even in the absence of foliar disease. Some fungicides exhibit activity within plant stomata, influencing gas exchange and potentially improving water use efficiency — an essential factor for maximizing dryland winter wheat yield. While this phenomenon has been explored in other cropping systems, no replicated, unbiased research has been conducted in the dryland Pacific Northwest (PNW) to assess the impact of fungicide applications on wheat in the absence of disease pressure.

This study aims to evaluate the effects of fungicide applications on dryland winter wheat yield, grain protein content, and test weight under low disease pressure. We will apply combinations of Group 3, Group 7, and Group 11 fungicides, alongside untreated controls to stripe rust-tolerant wheat varieties. These trials will run in parallel with stripe rust-susceptible treatments to enable comparative analysis.

Objective(s): Evaluate the effects of fungicide applications on dryland winter wheat yield, grain protein content, and test weight under low disease pressure. Determine if results from the 2024 and 2025 field season are repeatable in 2026.

Procedures: 5ft x 50ft plots of stripe rust tolerant cultivar, LCS Hydra AX, will be sprayed with Group 3, Group 7, and Group 11 fungicides at CBARC-Pendleton. Evaluate for area under the disease progress curve (if applicable). Evaluate yield, protein, and test weight at harvest. trial will run in parallel with stripe rust-susceptible treatments to enable comparative analysis.

Timelines: Third year of fungicide application and disease evaluation will occur in spring 2026 with yield, protein, and test weight collected in summer 2026. Final report and manuscript for peer review will be prepared in winter 2026 and submitted to *PhytoFrontiers*.

Justification: This research will generate practical, science-based recommendations to help growers determine whether fungicide applications in stripe rust-resistant wheat or low-disease years are economically and agronomically justified, ultimately contributing to more efficient and sustainable wheat production in the dryland PNW. We feel this research has potential to be high impact and therefore we want to submit this research to a higher tier open-source journal which may require running the study for a third year. Three years of replicated work will also increase my confidence in disseminating this work to growers.

Budget:

\$1500 – Salary support for Christina Hagerty

\$1500 – salary support for Grayson Namdar

3k total

Relation to Other Research: A third year is necessary to confirm our results and generate a high tier peer-reviewed publication. This work supports our goal to provide practical, applied, and grower-driven research to stakeholders of Oregon Wheat.

Signature Page: List title of proposal and requested funding level and provide signature blocks for principal investigator(s), department head(s), the Agricultural Exp. Station (Extension Service if a pure extension education proposal) and the OSU Research Office.

Formatting: Your proposal must include all of the categories listed here, in the order listed. Use Times New Roman font at 12-pitch with a margin of at least one-inch on all sides. **Proposals must not exceed five pages** (signature and current/pending pages are not included in count). Save your proposal as a PDF. Send an electronic copy to [tsimpson@oregonwheat.org](mailto:tsimpson@oregonwheat.org). and upload your PDF into the ARF web form for the OWC - <http://agresearchfoundation.oregonstate.edu/webform/oregon-wheat-commission-proposalreport>

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NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
ACTIVE					
Hagerty	Agriculture Research Foundation	15,000	2025-2027	5	Combining cultivar mixtures and fungicides to improve management of stripe rust in  wheat
Hagerty	USDA-ARS/58-2090-4- 012	267,300	2024-2027	10	Identification and Control of Soilborne Pathogens of Wheat and Barley
Hagerty, Berry, Krause, Graebner	USDA-ARS/ 58-2074-3- 006	429,239.25	2024-2027	35	Resilient dryland farming alliance
Hagerty, Lutcher, Berry	Oregon Wheat Commission	25,000	2024-2025	10	Seed Care
Busby, Mundt, Myers, Hagerty	NSF/2319568	1,685,440	2023-2028	10	URoL:ASC: Microbiome- mediated plant genetic resistance for enhanced agricultural sustainability
Moore and Hagerty	NRCS	250,000	2022-2025	5	Evaluating lime application strategies to recently acidified dryland wheat production fields in Eastern Oregon
Hagerty	Current industry support: Syngenta, FMC, Albaugh, Valent	112,474	2022-2025	15	Product evaluations
Hagerty	Oregon Wheat Commission	5000	2024-2025	10	Plant health effects of fungicides
PENDING					
Krause, Reynolds, Hagerty,	USDA NIFA AFRI	800,000	2026-2028	20	PARTNERSHIP: Genomics- and physiology-informed wheat cultivar mixtures to maximize yield and manage risk due to biotic and abiotic stress

**Research Proposal Format**  
**Research Proposal for the Agricultural Research Foundation**  
**Oregon Wheat Commission**

Title: Graduate student support

Investigator(s): Christina H. Hagerty, CBARC-Pendleton

Cooperator(s): Rachael Plunkett (PhD Student), CBARC-Pendleton

Funding History:

2023-24

\$25k Seed care evaluation

2024-25

\$25k Seed care evaluation

\$5k Fungicide evaluation for plant health effects

2025-2026

\$30k Disease notes and grad student support

\$10k Fungicide evaluation for plant health effects

Amount requested: \$8,800

**Abstract:** This proposal supports the graduate training of Rachael Plunkett through a highly cost-effective integration with the Resilient Dryland Farming Alliance (RDFA) research platform. While the RDFA Non-Assistance Cooperative Agreement cannot be used to support tuition, targeted funding for graduate tuition will enable a unique training and research opportunity that directly enhances RDFA project outcomes.

As a full-time Oregon State University employee, Rachael Plunkett qualifies for the OSU employee tuition benefit, reducing annual tuition costs from \$56,363 to \$8,800. This substantial cost savings allows for efficient use of funds while supporting advanced doctoral training. Her PhD research is tightly aligned with RDFA objectives and will add new, complementary disease-management components that strengthen the project's scientific scope and applied impact.

Through this integration, Rachael will contribute directly to RDFA disease management efforts while receiving rigorous training as a next-generation cereal pathologist. This approach maximizes return on investment by simultaneously advancing RDFA research goals and building workforce capacity critical to the future of dryland cereal production systems.

**Objective(s):** Support graduate tuition for Rachael Plunkett in order to increase Resilient Dryland Farming Alliance (RDFA) research outputs, leverage existing RDFA investments, and train the next generation of cereal pathologists. Rachael Plunkett's reduced tuition rate reflects her status as a full-time Oregon State University employee in Dr. Francisco Calderón's laboratory at OSU's Columbia Basin Agricultural Research Center (CBARC). Her PhD research focuses on evaluating the impacts of cover crops on nematode populations within dryland cereal systems, with an anticipated dissertation defense in 2028.

Rachael has demonstrated exceptional initiative and commitment to professional development. In the past year, she independently applied for and received three graduate student travel awards and self-funded her travel to the American Phytopathological Society annual meeting, with RDFA support limited to conference registration fees.

**Research Objectives:**

1. Characterize nematode community ecology in RDFA cover-crop trials at CBARC and Starvation Farm.
2. Evaluate whether cover crops reduce yield-limiting nematode populations in subsequent cash crops.
3. Identify cover crop species that support or suppress nematode reproduction.

Procedures: Rachael Plunkett will generate new data through the Resilient Dryland Farming Alliance (RDFA) by characterizing the community ecology of nematode populations in RDFA field trials at the Columbia Basin Agricultural Research Center (CBARC) and Starvation Farm. This work will include systematic sampling and analysis of nematode communities associated with cover crop treatments and subsequent cash crops.

Additional research objectives will leverage existing RDFA datasets, allowing for efficient integration of historical data with newly generated observations. This approach maximizes use of prior investments, reduces redundancy in data collection, and enables a greater volume of analyses, publications, and outreach deliverables to be produced on an accelerated timeline.

Timelines: This is the third year of Rachael Plunkett's graduate program with the anticipated defense date of 2028.

**Justification:**

Funding Rachael Plunkett's graduate studies leverages ongoing research and RDFA data. By reducing tuition expenses from \$56,363 to \$8,800 annually, this approach enables high-impact research without excessive financial burden, fostering the next generation of cereal pathologists. In the current funding climate, it is critical to continue advising graduate students. Overall, Rachael's involvement in the RDFA has improved our science communication efforts.

Budget: \$8,800 support for Rachael Plunkett

Relation to Other Research: Rachael Plunkett's PhD thesis provides a direct grower benefit by determining how cover crops impact nematode populations in the following winter wheat cash crop.

Signature Page: List title of proposal and requested funding level and provide signature blocks for principal investigator(s), department head(s), the Agricultural Exp. Station (Extension Service if a pure extension education proposal) and the OSU Research Office.

Formatting:

Your proposal must include all of the categories listed here, in the order listed. Use Times New Roman font at 12-pitch with a margin of at least one-inch on all sides. **Proposals must not exceed five pages** (signature and current/pending pages are not included in count). Save your proposal as a PDF. Send an electronic copy to [tsimpson@oregonwheat.org](mailto:tsimpson@oregonwheat.org). and upload your PDF into the ARF web form for the OWC - <http://agresearchfoundation.oregonstate.edu/webform/oregon-wheat-commission-proposalreport>

## SAMPLE BUDGET

Salary:

Faculty  
 Graduate Student: \$8,800  
 Other students  
 Other Labor (specify type)  
 OPE for all categories

Equipment:

Travel:

Domestic (in state)  
 Domestic (out of state)  
 Foreign (conferences, etc)

Supplies and Materials:

\*\*\*\*\*

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
ACTIVE					
Hagerty	Agriculture Research Foundation	15,000	2025-2027	5	Combining cultivar mixtures and fungicides to improve management of stripe rust in  wheat
Hagerty	USDA-ARS/58-2090-4- 012	267,300	2024-2027	10	Identification and Control of Soilborne Pathogens of Wheat and Barley
Hagerty, Berry, Krause, Graebner	USDA-ARS/ 58-2074-3- 006	429,239.25	2024-2027	35	Resilient dryland farming alliance
Hagerty, Lutcher, Berry	Oregon Wheat Commission	25,000	2024-2025	10	Seed Care
Busby, Mundt, Myers, Hagerty	NSF/2319568	1,685,440	2023-2028	10	URoL:ASC: Microbiome- mediated plant genetic resistance for enhanced agricultural sustainability
Moore and Hagerty	NRCS	250,000	2022-2025	5	Evaluating lime application strategies to recently acidified dryland wheat production fields in Eastern Oregon
Hagerty	Current industry support: Syngenta, FMC, Albaugh, Valent	112,474	2022-2025	15	Product evaluations
Hagerty	Oregon Wheat	5000	2024-2025	10	Plant health effects of fungicides



**Research Proposal Format**  
**Research Proposal for the Agricultural Research Foundation**  
**Oregon Wheat Commission**

**Title:** Characterizing Pathogens Associated with Lodging in Central and Eastern Oregon Wheat Crops

**Investigator(s):** Jeremiah Dung (PI)

Associate Professor  
Oregon State University  
Central Oregon Agricultural Research and Extension Center  
850 NW Dogwood Lane  
Madras, OR 97741

Christina Hagerty (Co-PI)

Associate Professor  
Oregon State University  
Columbia Basin Agricultural Research Center  
48037 Tubbs Ranch Rd.  
Adams, OR 97810

**Cooperator(s):** None

**Funding History:** None to report

**Amount Requested:** \$9,912

**Abstract:**

*Microdochium nivale* has been reported to cause head blight (scab) and pink snow mold in Oregon wheat crops. It can also be responsible for seedling blight and foot/crown rot in wheat. However, over the last several years the fungus has been consistently isolated from lodged wheat crops exhibiting symptoms that resemble sharp eyespot (caused by *Rhizoctonia cerealis*) in central Oregon, and from which no *R. cerealis* has been recovered. *Microdochium nivale* has also frequently been associated with diseased nodes and crowns in these same plants suggesting an emerging or increasing importance of this plant pathogen in central Oregon wheat crops. To date, a total of 42 isolates have been collected, of which 11 have been identified as either *M. nivale* ( $n=5$ ) using DNA sequencing or as *Microdochium* spp. ( $n=6$ ) based on morphology. The objectives of this project are to: 1) conduct disease surveys in central Oregon and Pendleton, OR to identify the pathogens associated with lodged wheat crops exhibiting sharp eyespot-like and foot/crown rot symptoms; 2) build upon an existing collection of *M. nivale* isolates and other pathogens associated with lodged wheat crops, and sharp eyespot-like symptoms, and foot/crown rot disease in Oregon for future pathogenicity and population genetic studies; and 3) determine/confirm that *M. nivale* can cause sharp eyespot-like symptoms on wheat by completing Koch's postulates on wheat in controlled growth chamber studies. Anticipated results and deliverables from this project will include: 1) a better understanding of the fungal pathogens responsible for lodging in irrigated and dryland wheat crops in Oregon; 2) an isolate collection

that can be used as a resource for future breeding efforts and disease management studies; and 3) a better understanding of *Microdochium* symptomatology in wheat, which can lead to improved diagnostics and management practices.



**Figure 1.** Typical crown/foot rot symptoms caused by *Microdochium nivale* (left). Internodal sharp eyespot-like symptoms (center, right) from which *Microdochium* were also frequently isolated from.

#### **Objective(s):**

The objectives of this project are to: 1) conduct disease surveys in central Oregon and Pendleton, OR to identify the pathogens associated with lodged wheat crops exhibiting sharp eyespot-like and foot/crown rot symptoms; 2) build upon an existing collection of *M. nivale* isolates and other pathogens associated with lodged wheat crops, and sharp eyespot-like symptoms, and foot/crown rot disease in Oregon for future pathogenicity and population genetic studies; and 3) determine/confirm that *M. nivale* can cause sharp eyespot-like symptoms on wheat by completing Koch's postulates on wheat in controlled growth chamber studies.

#### **Procedures:**

*Objective 1:* Field samples will be collected in irrigated wheat fields in central OR (PI Dung) and dryland wheat production fields in the Pendleton, OR area (co-PI Hagerty). The number fields sampled will depend on how many exhibit lodging, and PI Dung will communicate directly with central Oregon wheat growers and local fieldmen/crop consultants to expand the scope of potential fields to sample. Co-PI Hagerty will collect samples during the course of her typical research and Extension activities in the Pendleton, OR area. When present, at least three plant samples will be collected from each symptomatic field.

Wheat samples exhibiting lodging, whiteheads, foot/crown rot, and/or eyespot-like symptoms will be collected and brought/sent to the Dung lab at the Central Oregon Agricultural Research and Extension Center. Symptomatic plant tissue will be surface-disinfested for 30s in 10% bleach and plated onto 1% potato dextrose agar (PDA) plates amended with antibiotics. Emerging fungal colonies will be individually transferred to clean PDA plates and then to 10% water agar. Colonies on water agar will be hyphal tipped to establish pure cultures for further identification (Objective 2) and storage at -80°C.

*Objective 2:* Preliminary morphological identification of previously collected isolates or those collected in this study will be performed through morphological analysis (colony and conidial characteristics on PDA) and confirmed by sequencing partial sequences of the ITS region (ITS1 and ITS4 primers) and *RPB2* gene (RPB2-5f2 and RPB2-7cr). DNA sequence data will be compared to existing sequences in GenBank using BLAST for identification.

*Objective 3:* Five isolates collected in central OR and previously identified as *Microdochium nivale* will be used to test Koch's postulates. Three soft white winter wheat cultivars that have been associated with field infections by *M. nivale* ('Yamhill', 'Reaper', and 'Scorpion') will be included in the study; one hard red winter wheat cultivar ('Eclipse') will also be included. Five seeds each cultivar will be planted in 4" square pots containing potting mix. After emergence, seedlings will be thinned to three vigorous plants per pot. Plants will be vernalized in a cool-temperature incubator (4-7°C) for two weeks prior to inoculation. At Feekes stage 7 (two nodes visible), the internode of each plant will be wounded to a depth of 1 mm with a sterile needle and an agar plug (3mm) colonized with one of five *M. nivale* isolates will be placed on the wound and wrapped in Parafilm. A separate set of non-wounded plants will also be inoculated in the same manner. Each treatment combination (isolate x cultivar x wounded/non-wounded) will be replicated five times. Sterile agar plugs will also be included as non-inoculated controls for each cultivar x wounded/non-wounded combination, as well as controls consisting of plants with no wounds or plugs applied. Plants will be returned to cool-temperature incubator (4 to 7°C) for four weeks after inoculation and then transferred to a growth chamber (10°C/25°C diurnal temperature). Plants will be assessed for eyespot-like symptoms, beginning at the milk stage (Feekes 11.1). If present, eyespot-like lesions will be measured to assess disease severity. Incidence data will be reported as the % of plants exhibiting eyespot-like lesions. Severity data will be analyzed using a mixed model in SAS to examine the interactions between isolate, cultivar, and wounding.

### **Timelines:**

#### Objective 1:

- July-August: Conduct field surveys between Feekes stage 10 through crop senescence
- September-October: Identify new isolates to species

#### Objective 2:

- July-November 2026: Establish, identify, and catalogue isolates for long-term collection

#### Objective 3:

- July-January: Conduct Koch's postulates study

A final report will be available in March 2027.

**Justification:**

The management practices to reduce the impact of *M. nivale* (e.g., crop rotation and chemical controls) used can differ than those used to manage *R. cerealis*, *Oculimacula* species, and other *Fusarium* species that cause similar symptoms in wheat. Accurate diagnosis of the causal agent(s) of these symptoms in Oregon wheat crops will enable more effective IPM practices to reduce lodging and improve yields. The development of an isolate collection can enable future studies focused on *M. nivale* population biology and disease management which can result in long term IPM strategies. This work may have additional importance in central Oregon, where *M. nivale* can also cause pink snow mold in wheat and crops that are commonly grown in rotation with wheat (e.g., Kentucky bluegrass seed).

**Budget:**

Salary:
Faculty (Sr. FRA): \$4,600
OPE: \$3,212
Travel:
Domestic (in-state): \$100
Supplies and Materials: \$2,000
<b>Total: \$9,912</b>

**Relation to Other Research:**

This project has no relation to other research conducted by PI Dung, but one of the principal duties in his position is to provide leadership and be responsive in addressing new or re-emerging disease issues in central Oregon.

**CURRENT AND PENDING SUPPORT**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>
<b>Current:</b>					
J. Dung	Oregon Mint Commission	\$31,806	July 2024 – June 2026	1%	Evaluating the Efficacy of Cover Crops to Control Verticillium Wilt, Reduce Mint- Pathogenic Nematodes, and Improve Soil Quality for Mint Production
M. Garcia-Jaramillo S. Good J. Dung A. Levin	Oregon State University College of Agricultural Sciences Branch Experiment Station Oregon Water Initiative	\$299,997 (Dung: \$70,308)	July 2024 – June 2026	1%	Monitoring and predicting water quality and losses in agricultural irrigation canals at different climate regions in Oregon
J. Dung	Agricultural Research Foundation	\$15,000	March 2024-February 2026	1%	Developing IPM Tools for Powdery Mildew Management in Carrot Seed Crops
J. Zhou N. Anderson J. Dung	Agricultural Research Foundation	\$15,000 (Dung: \$0)	March 2024-February 2026	1%	Investigate the potential of using NIR spectroscopy and hyperspectral imagery to determine seed moisture in carrot seed crops
A. Goyer K. Frost J. Dung J. Chang P. Jaiswal	USDA NIFA National Needs Graduate and Postgraduate Fellowship Grants Program	\$238,500 (Dung: \$0)	September 2023-August 2027	1%	A new multidisciplinary plant disease management experiential graduate training program to prepare future leaders in plant production
J. Dung	Eastern Oregon Kentucky Bluegrass Workgroup	\$18,788	July 2025-June 2026	1%	A Multi-Pronged Approach Towards Integrated Disease Management of Ergot in Kentucky Bluegrass
J. Dung	Mint Industry Research Council	\$34,090	July 2025 – June 2026	1%	Screening for Verticillium Wilt Resistance in Populations of Doubled ‘Black Mitcham’ Hybrid Clones
C. Tanner J. Dung D. Walenta	Oregon Mint Commission	\$5,200 (Dung: \$1,500)	July 2025 – June 2026	1%	Electronic Mint Pest Alert Newsletter Regarding Control of Mint Root Borer, Cutworm Complex and Loopers
J. Dung	Oregon Mint Commission	\$31,806	July 2024 – June 2026	1%	Evaluating the Efficacy of Cover Crops to Control Verticillium Wilt, Reduce Mint- Pathogenic Nematodes, and Improve Soil Quality for Mint Production
J. Dung	Mars Wrigley Confectionery US. LLC	\$69,823	January 2026-December 2027	1%	Genomic guided breeding of improved mint clones for long term sustainability
<b>Pending:</b>					
J. Dung J. Zhou G. Greenway	USDA-NIFA-AFRI-011134	\$649,999 (Dung: \$214,941)	June 2026 – May 2030	2%	Using Remote Sensing for Precision Pest Management of Verticillium Wilt in Mint Grown for Oil and Tea Leaf ( <i>this proposal</i> )

C. Swett A. Smart B. Aegerter C. Cramer C. Hoepfing C. Stewart-Courtens D. Geiser F. Hay F. Martin J. Dung J. Del Castillo L. du Toit N. McRoberts O. Sambucci P. Lazicki R. Wilson S. Mandal T. Turini	USDA-NIFA-SCRI-010974	~\$7,500,000 (Dung: \$623,942)	January 2026 – December 2029	2%	Fight Fusarium! Integrated management of Fusarium basal rot to enhance viability of onion and garlic production in the U.S.
J. Dung	Mint Industry Research Council	\$53,216	July 2026-June 2027	1%	Screening for Verticillium Wilt Resistance in Progenies of Doubled 'Black Mitcham' Clones and Evaluation of qPCR as an Early Resistance Screening Tool
J. Dung	Mint Industry Research Council	\$8,959	July 2026-June 2027	1%	Evaluating sampling strategies for quantifying soilborne inoculum and Verticillium wilt epidemics in U.S. mint production
J. Dung	Oregon Mint Commission	\$14,138	July 2026-June 2027	1%	Evaluating sampling techniques for quantifying soilborne inoculum and Verticillium wilt epidemics in Oregon mint production
C. Tanner D. Walenta J. Dung	Oregon Mint Commission	\$5,200 (Dung \$1,500)	July 2026-June 2027	1%	The Mint Pest Alert Newsletter, Year 13
J. Dung	Washington Mint Commission	\$13,760	July 2026-June 2027	1%	Evaluating sampling techniques for quantifying soilborne inoculum and Verticillium wilt epidemics in mint production
J. Dung	Agricultural Research Foundation	\$14,992	March 2026-February 2028	1%	Evaluating approaches for estimating soilborne inoculum of <i>Verticillium dahliae</i> and modeling Verticillium wilt epidemics in Oregon mint production
J. Dung	Washington Turfgrass Seed Commission	\$12,156	July 2026-June 2027	1%	Screening <i>Claviceps</i> populations for resistance to fungicides labeled for ergot control in Kentucky bluegrass seed crops
J. Dung	Oregon Grass Seed Commissions	\$11,751	July 2026-June 2027	1%	Screening <i>Claviceps</i> populations for resistance to fungicides labeled for ergot control in perennial ryegrass seed crops

**Research Proposal Format**  
**Research Proposal for the Agricultural Research Foundation**  
**Oregon Wheat Commission**

Title: Evaluating Herbicide Programs for Italian Ryegrass Control in Winter Wheat

Investigator(s): Victor Ribeiro, Department of Crop and Soil Science, Oregon State University, Corvallis, OR, 97331

Cooperator(s): Collin Crocker, C & L Farms LLC, Monroe, OR, 97456  
Josh Nelson, Nutrien Ag Solutions, Tangent, OR, 97389

Funding History: \$0

Abstract: Italian ryegrass (*Lolium multiflorum* Lam.) is a major weed problem in winter wheat in western Oregon's Willamette Valley. Management of Italian ryegrass in winter wheat is challenging due to similarities in biology, emergence timing, and maturation between the crop and the weed, which limit selective herbicide options. Reliance on a limited number of herbicides has selected for resistant populations in the region, further complicating management. Growers currently have a few pre-emergence herbicide options for Italian ryegrass control in winter wheat, including the premix flufenacet + metribuzin (Axiom DF; Groups 15 and 5), metribuzin (TriCor DF; Group 5), and pyroxasulfone (Zidua; Group 15). Post-emergence control options are even more limited and include the acetyl-coenzyme A carboxylase (ACCase) inhibitor pinoxaden (Axial XL; Group 1) and the acetolactate synthase inhibitor pyroxulam (PowerFlex HL; Group 2). Despite these options, additional research is needed to identify effective herbicide programs for Italian ryegrass control. Therefore, this proposed research aims to advance Italian ryegrass management through evaluation and demonstration of herbicide programs, coupled with targeted outreach to growers. This research is expected to identify effective and practical approaches that optimize the use of currently available herbicides for Italian ryegrass control. Results will provide growers, crop advisors, and industry stakeholders with science-based recommendations to support sustainable weed management, protect crop productivity, and slow the evolution of herbicide resistance in the region.

Objective(s): **Objective 1:** Evaluate pre- and post-emergence herbicide programs for improved Italian ryegrass control in winter wheat. **Measurable result:** Identify the best herbicide combinations for effective Italian ryegrass control and develop long-term programs through herbicide rotations.

**Objective 2:** Demonstrate and disseminate research findings to growers, crop advisors, and industry stakeholders.

**Measurable result:** Deliver an outreach package that includes at least one on-farm or research-station demonstration, extension publications, and presentations summarizing recommended herbicide programs, with materials made available to stakeholders in the region.

Procedures:

Two field trials will be conducted during the winter wheat growing season: one at Hyslop Farm, Oregon State University, and one on-farm at a site with a history of Italian ryegrass infestation. Individual plots will measure 10 ft by 25 ft. Experiments will be arranged in a randomized complete block design with four replications at each location.

Herbicide programs will be evaluated using a factorial treatment structure consisting of three fall-applied pre-emergence herbicides and two winter-applied post-emergence herbicides. Fall applications will be made at the winter wheat 2-leaf stage and will include flufenacet + metribuzin (Axiom DF; 10 fl oz/A), metribuzin (TriCor DF; 2 oz/A), and pyroxasulfone (Zidua SC; 3.25 fl oz/A). Winter post-emergence applications will be made at the winter wheat tillering stage and will include pinoxaden (Axial XL; 16.4 fl oz/A) and pyroxsulam (PowerFlex HL; 2 oz/A). An untreated control will be included for comparison. Herbicide treatments will be applied using a CO<sub>2</sub>-pressurized backpack sprayer equipped with six AIXR11003 nozzles calibrated to deliver 20 GPA.

Italian ryegrass control and crop injury will be visually assessed at four and eight weeks after both the fall pre-emergence and spring post-emergence applications. Ratings will be recorded on a 0-100% scale, where 0% indicates no weed control or crop injury and 100% indicates complete weed control or crop death. At the final evaluation, aboveground Italian ryegrass biomass will be collected from two 0.5-m<sup>2</sup> quadrats per plot to calculate weed biomass reduction relative to the untreated control. Plots will be harvested with a small-plot combine to obtain winter wheat grain yield.

Data for weed control, crop injury, weed biomass, and wheat grain yield will be analyzed using analysis of variance (ANOVA). When ANOVA indicates significant treatment effects ( $P < 0.05$ ), mean separation will be performed using Fisher's protected LSD test.

Timelines:

**Fall 2026-Summer 2027:**

- **Plant the crop:** Fall 2026 (September-October)
- **Herbicide applications:** Fall 2026 (October-November)-Winter 2027 (January-February)
- **Data collection:** Visual assessments of weed control and crop injury, and collection of weed biomass during Fall 2026 and Spring 2027.

- **Crop harvest:** Summer 2027 (July-August)
- **Data analysis and final report:** Fall 2027 (By November)

Justification:

Italian ryegrass continues to be one of the most challenging weeds in winter wheat production systems in western Oregon, where effective management options are increasingly limited by herbicide resistance and a lack of selective control tools. Growers need practical, science-based guidance on how to best use the few herbicide options currently available to maintain acceptable weed control and protect crop yield. This project directly addresses that need by evaluating and demonstrating herbicide programs that reflect real-world management decisions.

**Immediate benefits** of this work include identification of effective pre- and post-emergence herbicide programs that improve Italian ryegrass control under local conditions, reduce early-season weed competition, and minimize crop injury. Results will provide growers and crop advisors with clear, field-validated recommendations that can be readily implemented in the next growing season. Demonstration trials and extension outreach will facilitate rapid adoption of best management practices across the region.

**Longer-term benefits** include improved stewardship of limited herbicide options through optimized program selection and application timing, which can help slow the evolution and spread of herbicide-resistant Italian ryegrass populations. By improving weed control consistency and reducing the need for repeated or rescue applications, this research may also lower production costs and support the long-term sustainability of winter wheat cropping systems.

**The broader impact of this work** extends beyond individual farms. Effective Italian ryegrass management supports regional grain production, reduces weed seedbank replenishment, and contributes to more sustainable herbicide use. Ultimately, this research will help protect the economic viability of Oregon's wheat industry while promoting responsible herbicide use that benefits growers, industry stakeholders, and society.

Budget:

\$15,000

Relation to Other Research:

This proposed research on Italian ryegrass fits within my broader program focused on developing practical, science-based solutions to weed management challenges in Oregon's field crops. It complements ongoing work on weed biology and ecology, herbicide resistance, and management of troublesome weeds in wheat and other cropping systems. The project also emphasizes engagement with local growers and industry partners, ensuring that results are both validated in the field and translated into actionable management practices. By addressing a pressing need for effective

Italian ryegrass control, this research aligns with regional and national priorities in weed science and provides direct, practical benefits to stakeholders across Oregon's agricultural sector.

## BUDGET

Salary:

Faculty Research Assistant (FRA): \$3,000

Student workers: \$2,000

OPE (FRA): \$2,000

Travel:

Domestic (in state): \$2,000

Supplies and Materials:

Land rental (Hyslop Farm): \$2,000

Fertilizers (fall and spring applications), stakes, chemicals, flags, and paper bags: \$4,000

### CURRENT AND PENDING SUPPORT

NAME	SUPPORTING AGENCY	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
Current:	Agricultural Research Foundation	\$15,00	February 2025 – January 2027	5%	Evaluation of experimental herbicides for broadleaf weed control in grasses grown for seed
	Oregon Clover Commission	\$10,00	July 2025 – June 2026	5%	Understanding and managing bristly hawksbeard in white clover
	Oregon Grass Seed Commission	\$10,00	July 2025 – June 2026	5%	Screening downy brome populations collected from fine fescue seed production field for herbicide resistance
	Oregon Grass Seed Commission	\$29,330	July 2025 – June 2026	5%	Assessing the safening effect of fenclorim on grass seed crops against S-metolachlor capsule suspension
	Oregon Grass Seed Commission	\$7,500	July 2025 – June 2026	2%	New methods to verify reduced translocation mechanism in glyphosate resistant Italian ryegrass
	Agricultural Research Foundation	\$15,00	February 2025 – January 2027	2%	Investigating the genetics of glyphosate resistance in <i>Lolium multiflorum</i> with EPSPS gene amplification

Pending:

USDA NIFA AFRI	\$750,000	Sept 2026-Aug 2031	5%	Two Faces Of The Ryegrass Coin: Managing Weedy Lolium Multiflorum In Grass Seed Production Systems (this grant)
USDA NIFA AFRI	\$650,000	July 2026-June 2029	10%	Adaptive traits in downy brome ( <i>Bromus Tectorum</i> L.): ecology and genetics of a nationwide weed challenge
USDA NIFA AFRI	\$750,000	September 2026 – August 2029	2%	Seed persistence and dormancy dynamics of major agricultural weeds across contrasting environments in the U.S.
Western SARE Professional + Producer	\$84,974	May 2026 – April 2029	2%	Evaluating non-herbicide strategies for hare barley control in western Oregon pastures and haylands
Western IPM	\$85,000	October 2026 – September 2029	2%	Evaluating crop safety, herbicide savings, and weed control using precision spot spraying
Oregon Mint Commission	\$14,500	2026-2027	2%	Optimizing late-season Zidua application in mint using spot-spray technology for extended weed control
Oregon Mint Commission	\$17,000	2026-2027	3%	Evaluation of diflufenican (Convintro) and saflufenacil + glufosinate for weed control and crop safety in mint
Agricultural Research Foundation	\$15,000	February 2026 – January 2028	2%	Evaluation of experimental selective herbicides for controlling hare barley in western Oregon pastures and haylands
Agricultural Research Foundation	\$15,000	February 2026 – January 2028	3%	Evaluation of herbicide treatments for wild carrot ( <i>Daucus carota</i> L.) control in non-crop areas of the Willamette Valley
Agricultural Research Foundation	\$15,000	February 2026 – January 2028	3%	Optimizing pronamide (Kerb) rates and application timings for Italian ryegrass control in white clover
Oregon Clover Commission	\$10,000	July 2026 – June 2027	2%	Diflufenican (Convintro) crop safety screening in clover species
Specialty Crop Block Grant Program	\$250,000	October 2026 – April 2029	3%	Assessing and Managing Italian Ryegrass Resistance in Turfgrass Seed Crops
Oregon Grass Seed Commission	\$25,000	July 2026 – June 2027	4%	Effects of Row Spacing and Herbicide Programs on Weed Control and Tall Fescue Yield
Oregon Grass Seed Commission	\$15,000	July 2026 – June 2027	2%	Efficacy and Selectivity of Fall- and Winter-Applied Convintro (diflufenican) and Tank-Mixes in Perennial Ryegrass

**Research Proposal for the Agricultural Research Foundation  
Oregon Wheat Commission**

**Title:** Controlling Horsetail in Wheat Fallow in North Central Oregon

**Investigator(s):** Jacob Powell, Wasco and Sherman Counties

**Cooperator(s):** Wasco County Wheat Producers

**Funding History:** \$6,297 requested, current and previous three years of funding for other research projects at \$43,109

**Abstract:**

Horsetail or scouring rush (*Equisetum arvense*) continues to be difficult to control under no-till wheat and fallow rotation systems across low and intermediate rainfall regions in the Pacific Northwest due to its easy ability to spread, lack of surface area, and high silica content. Two fields infested with horsetail will be selected in Wasco County to conduct herbicide efficacy trials with two different cultural controls. Four different herbicides chlorsulfuron with metsulfuron methyl (Finesse), 2-Methyl-4-chlorophenoxyacetic acid (MCPA Ester), chlorsulfuron (Telar), and glyphosate (RT3) will be tested, along with an untreated control. In addition, these herbicide treatments will be examined with plots receiving lime and plots mowed two weeks prior to herbicide application. Treatments will be made in the fall of 2026 once fields have been harvested and entering a fallow rotation. Horsetail density and soil pH will be measured prior to treatment and after treatment in the late spring of 2026. A second grant proposal will be submitted in the 2027-2028 fiscal year to determine control impacts on the following wheat crop planted in fall of 2027 and horsetail density.

**Objective(s):**

The objective of this study is to determine the efficacy of various cultural and chemical control methods for horsetail or scouring rush (*Equisetum arvense*) under no-till wheat production. Four different herbicides chlorsulfuron with metsulfuron methyl (Finesse), 2-Methyl-4-chlorophenoxyacetic acid (MCPA Ester), chlorsulfuron (Telar), and glyphosate (RT3) will be tested, along with an untreated control. These herbicides will also be applied with three different cultural controls: lime applied at a 2 ton per acre rate, mowing prior to herbicide application, and herbicide only. Soil pH and horsetail density will be used to quantify effectiveness of treatments.

**Procedures:**

Research plots will be established in two winter wheat fields with uniform infestations of horsetail in Wasco County in the fall of 2026 following harvest as fields are entering into a fallow rotation. This trial will have 15 treatments (five herbicide treatments x three different cultural controls) replicated three times for a total of 45 plots in each of the two fields (90 plots total). Soil pH probes will be used in field to determine soil pH in each plot (probes already purchased).

Four different herbicides will be applied using a backpack boom research sprayer in the fall of 2026 using labeled rates with surfactants recommended for treating scouring rush in fallow. Herbicides include chlorsulfuron with metsulfuron methyl (Finesse), chlorsulfuron (Telar), 2-Methyl-4-chlorophenoxyacetic acid (MCPA Ester), and glyphosate (RT3). Herbicides will be applied with the surfactant Silwet L-77, an organosilicone surfactant used to enhance herbicide

uptake that previous research has found to be the best option for spraying horsetail. An untreated control will also be used. These plots will be replicated three times. In addition, another set of replicated plots will be treated with a two ton rate of prilled lime applied using a push spreader. Another set of replicated plots will be mowed two weeks prior to herbicide treatment to a height of 4 inches using a weed trimmer with a metal cutting blade.

Horsetail density will be determined in each plot prior to treatment and after treatments in May of 2027 using a square foot quadrat frame placed at ten different random locations in each plot and each stem counted. Drone imagery will also be used to try and quantify horsetail density.

Soil pH will also be examined in each plot using a soil pH probe inserted into the top 3 inches of the soil surface to determine a baseline pH level for each plot and in May 2027. At the end of the study in May 2027 soil samples will also be taken to a depth of 6 inches and sent to a lab for soil nutrient and pH analysis.

### **Timelines:**

**September 2026** – two field sites with uniform scouring rush infestations will be selected with wheat producers in Wasco County. Plots will be established measuring a minimum of 10 ft by 30 ft. Soil pH will be determined for each plot in the field using already purchased soil pH sensors. Horsetail density will also be counted in each plot using a 1 square quadrat placed at ten different random points in each plot. Designated plots for the mowing treatment will be mowed to a height of 4 inches using a weed trimmer with a metal cutting blade.

**October 2026** – Herbicides will be applied to treated plots.

**November 2026** - Plots receiving lime will be treated with prilled agricultural lime (already donated by Columbia River Carbonates for a different project) using a push spreader at a rate of 2 tons per acre.

**May 2027** – Soil samples will be taken from each plot in the top 6 inches and sent to a lab for nutrient and pH analysis. In addition, horsetail densities will also be counted in each plot using a 1 square quadrat placed at ten different random points in each plot. Drone imagery will also be taken to help quantify horsetail densities in each plot.

**July 1<sup>st</sup> 2027 – June 30<sup>th</sup>, 2028** Additional funding will be requested to determine winter wheat yield in plots in the subsequent winter wheat crop planted in fall of 2027 and harvested in summer of 2028. Soil pH and horsetail density will also be examined in each treatment.

### **Justification:**

Current no-till farming practices will not be sustainable in fields infested with horsetail unless improved control measures are found. Horsetail continues to be a challenging and costly weed for wheat producers to manage, especially during fallow rotations in arid production regions. It easily spreads vegetatively and has a dense rhizome system with tubers underground that are challenging to kill with just contact herbicides. It has been found to reduce wheat yields and can cause additional wear to sickle bars used on combines during harvest due to its high silica content. Tillage is not an option as it spreads the plant as rhizomes cut or separated into pieces results in each piece growing into a new plant. In addition, this proposal aims to address soil acidity concerns and determine if they are linked to horsetail occurrence. Healthy winter wheat crops can help reduce horsetail through effective competition, but low soil pH may be reducing wheat vigor and ability to compete. Previous research suggests that soil pH and drainage issues are two soil factors that can greatly increase the abundance of this weed. Horsetail continues to be an issue across Oregon and Washington and is both limiting wheat production in infested

areas and increasing input expenses with various control methods farmers try with limited success. Wheat producers in both Sherman and Wasco Counties continue to have issues controlling this weed. Farmers in North Central Oregon need localized data to make informed decisions and use strategies that provide a positive return on investment to continue to be sustainable both in the field and economically.

**Budget: \$6,297**

**Relation to Other Research:**

One of my research priorities is helping farmers find solutions for increasing soil acidity and also addressing any other related needs that farmers have in my assigned region as an extension agent. Horsetail is a weed that is influenced by soil pH and this research will help address control issues with horsetail, while also leveraging other work I have been doing on increasing soil pH. Horsetail is a weed that continues to be an issue for my producers and also other farmers across the Pacific Northwest, therefore I am requesting OWC support as this research not only helps farmers in Wasco / Sherman Counties, but also other farmers in the state.

## BUDGET

**Total: \$6,297**

**Salaries: \$0**

**Travel: \$100.00**

All domestic travel:

Driver	Vehicle	From	To	Purpose	Miles	# of trips	Total Miles	Rate	Total \$
Jacob Powell	POV	The Dalles	Field Locations	Setting up and monitoring treatments	25	4	100	0.70	\$70.00

**Services: \$4,742**

Service	Cost
<b>Soil sampling (\$45 per sample, 90 samples)</b>	<b>\$4,050</b>
<b>Sherman Experiment Station Truck Rental</b>	<b>\$300</b>
<b>Shipping soil samples</b>	<b>\$200</b>
<b>Sherman Experiment Station Trailer Rental (\$64 per day)</b>	<b>\$192.00</b>
<b>Total</b>	<b>\$4,742</b>

**Supplies: \$1,455**

Item	Cost
Metal cutting blades for weed trimmer	\$100
Plot stakes for field trial	\$60
Finesse herbicide	\$400
Telar herbicide	\$225
RT3 herbicide	\$100
MCPA herbicide	\$150
Silwet L-77 surfactant	\$300
CO2 tank refills to run CO2 Field Sprayer	\$120
<b>Total (Liming supplies already available, left over from previous project)</b>	<b>\$1,455</b>

**Equipment: \$0**

Item	Cost
<b>Total</b>	<b>\$0</b>

**Grand Total: \$6,297**

**CURRENT AND PENDING SUPPORT**

<b>NAME</b>	<b>SUPPORTING AGENCY</b>	<b>TOTAL \$ AMOUNT</b>	<b>EFFECTIVE AND EXPIRATION DATES</b>	<b>% OF TIME COMMITTED</b>	<b>TITLE OF PROJECT</b>
Current:					
<b>Powell, J.</b>	Western SARE	\$57,940	2025-2028	5%	Managing Soil Acidity in Wheat Production in North Central Oregon
<b>Powell, J.</b>	OSU Agricultural Research Foundation	\$14,981	2025-2027	5%	Efficacy Of Liming Materials for Soil Acidity Management In Wheat
<b>Powell, J.</b>	Oregon Wheat Commission	\$4,300	2025-2026	2%	Foliar and Seed Applied Nitrogen Fixing Biofertilizers in Wheat
<b>Powell, J.</b>	Oregon Wheat Commission	\$8,821	2025-2026	5%	Additive Effects of Foliar Nitrogen with Fungicides in Winter Wheat
Pending:					
Ranches J., K. Wollstein, <b>J. Powell</b> , and J. Cruickshank.	USDA National Institute of Food and Agriculture; Critical Agricultural Research and Extension (CARE; A1710)	\$300,000.00	2026-2029	15%	Wildfire and Smoke Exposure: Spreading Preparedness to Livestock Producers through Science and Training

<b>Powell. J.</b>	OSU Agricultural Research Foundation	\$14,900	2026-2028	5%	Examining the use of drone imagery and handheld sensors to detect nutrient deficiencies and yield in winter wheat
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