

# OREI Project Details

## Award Year 2024

22 Research Projects

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# Advancing Diversity, Equity, Inclusion, and Accessibility in Organic Agriculture to Strengthen Research, Education, and Extension in the Southeast United States

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<b>Contract / Grant No.</b>	2024-51300-43045
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Kokoasse Kpombrekou-A
<b>Performing Institution</b>	Tuskegee University

## NON-TECHNICAL SUMMARY

Consumption of organic produce in the United States has increased exponentially these last ten years to \ \$52 billion. High demands in organic products in the U.S. are met only by imports. These imports could be reduced if organic agriculture activities are strengthened in the Southeast. The Southeast lags the rest of the nation in certified organic production as none of the states in the Southeast is among the top ten states with certified acreage. This situation represents an unfilled niche, and hence, an economic opportunity for small-scale producers and BIOPOC communities. One of the major reasons the Southeast lags is that it offers little infrastructure to support small-scale family farmers. Therefore, the goal of the project is to strengthen organic agriculture infrastructure. Thus the objectives of are to: 1) bring researchers, extension personnel, and successful organic growers around the country to engage researchers at 1890 schools (in the Southeast) and farming communities, especially the BIPOC communities in the Southeast using a system-based approach to advance their understanding of organic issues and 2) facilitate collaboration, knowledge sharing, innovation, and networking among farmers, researchers, suppliers, and policymakers to overcome challenges, and seize market opportunities presented by the growing organic agriculture industry. Tuskegee University and its partners will organize and implement the conference outcomes. Outputs of the conference will be posted on project partners' websites and published in organic farmers' association bulletins in the Southeast and serve as a backbone of any future initiative to strengthen organic agriculture production in the Southeast.

## OBJECTIVES

The goals of this proposed conference are two-fold: 1) to seek greater collaboration among ten 1890 schools in the SE (Tuskegee University, Alabama A&M University, Alcorn State University, Delaware State University, Florida A&M University, Fort Valley State University, North Carolina A&T State University, South Carolina State University, Southern University, Tennessee State University) in order to obtain and disseminate meaningful and relevant research information that supports and engages farming communities and especially the BIPOC communities to transition to organic agriculture and 2) to promote and strengthen organic agriculture infrastructure in the SE.

## APPROACH

Tuskegee University is proposing a two-day conference to be organized in partnership with Foundation for Food & Agriculture Research, Clif Bar, The Organic Center, and Oregon State University. The Professional Agriculture Workers Conference (PAWC) will co-host the conference in conjunction with its 87th annual conference in Montgomery, Alabama. The PAWC conference is the largest gathering of 1890 schools, sustainable BIPOC farmers in the country, and federal employees and is therefore, a perfect venue to engage many farmers to identify major constraints and challenges hampering transition to organic production in the region. The PAWC is a conference committed to a world that values and promotes equal opportunity equitable access to information and technology for sustainable development of communities and natural resources.

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# Train-the-trainer Training and Workforce Development to Build Resilient and Equitable Organic Farming Community in the Southern Us

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<b>Contract / Grant No.</b>	2024-51300-43046
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Biswanath Dari
<b>Performing Institution</b>	North Carolina A&T State University

## NON-TECHNICAL SUMMARY

Challenges faced by Southern organic farmers: Organic farming plays a critical role in addressing challenges of global climate change, food safety, and the local/regional food supply chain. In 2022, organic fruit and vegetable sales generated \$60 billion in revenue, ~15% of all US retail produce sales. Despite the growing demand for organic products because of their environmental, economic, and health benefits, it has its challenges that are more pronounced in the Southern US. Climates and geology result in different types of soil nutrient cycling than the Midwest causing yield reduction, increased market price, weed, pest, and pathogen pressure. The complicated nature of historic inequalities in the south has led to socioeconomic knowledge gaps and a dearth of certification training amongst small-scale, limited resource, underserved, and Socially Disadvantaged Farmers, Ranchers, and Veterans (SDFRVs). Other critical needs for organic farmers in the south are technical assistance, a consistent flow of information, and an organic farmers' network to discuss the issues and challenges faced by the southern farmers.

Problem faced by small-scale, minority, and underserved Southern farmers: The ripple effects of structural inequity, rooted in slavery and perpetuated by Jim Crow laws, are apparent throughout society, including our agricultural economy. In the Southern US, the preponderance of small-scale farms are disproportionately owned by SDFRVs. These SDFRVs face barriers in accessing resources such as, training programs, technical assistance, technologies, and socio-cultural networks especially related to organic farming. Additionally, these farming communities are predicted to be the most vulnerable to the effects of climate change. Organic Farmers in the Southern US are faced with multiple farming issues such as poor quality or degraded soil, low nutrient holding capacity, high weed pressure, and increased pest and disease infestation. Due to socio-economic barriers and complex certification processes, these stated issues are more prominent for small-scale, limited resource, underserved, and Socially Disadvantaged Farmers, Ranchers, and Veterans (SDFRVs), including Black and Native American, female, and beginning farmers. There is a need to address these complex issues by providing proper education, consistent knowledge sharing, real-time technical assistance, and region-specific management guidance. Our project team is proposing to build a strong, regional, organic SDFRV growers' network to share ideas, information, knowledge, challenges, and solutions to adopting an organic production system at the farm level. The goal of this conference proposal is to enable SDFRVs to participate in the conference workshops through paid incentives that also allow the farmers to attend the SOWTH conference organized by Georgia Organics. We will leverage our strong institutional connection through the 1890s (HBCU) cooperative extension and Small Farm Resource and Innovation Center of NCA&T, the inaugural SOWTH Annual conference by Georgia Organics, and the Southern Piedmont Climate-Smart Project by Rodale Institute. We will provide four bilateral and interactive and farmer participatory workshops for southern organic growers on (i) climate-smart organic production, (ii) marketing strategies and policy relevance, (iii) socio-economic assessment, (iv) organic certification. Our team will provide real-time technical assistance through a "speed dating" event on: (i) Soil and nutrients, (ii) weed, (iii) pest and disease pressure, (iv) integrated livestock, (v) organic certification. The outcomes from this project will provide the USDA with evidence-based, farmer-led recommendations for socio-economic and marketing support to SDFRVs that will promote small-scale organic agriculture in the Southern US.

## OBJECTIVES

We need more regional support for the small-scale, limited-resource, underserved, and Socially Disadvantaged Farmers, Ranchers, and Veterans (SDFRVs) organic farming community in the Southern US through a strong

regional stakeholder network consisting of fellow early adopters/mentor organic farmers, extension staff, USDA-NRCS staff, non-profits, and researchers. To address this stakeholder's need, our conference proposal offers train-the-trainer training through farmers-engaged interactive workshop sessions. Four proposed workshops and a technical assistance "speed dating" event will be held during SOWTH: A Regional Small Farms, Big Community Conference that will cover (i) climate-smart organic production, (ii) marketing strategies and policy relevance, (iii) socio-economic assessment, and (iv) organic certification for Southern organic farming. The overall long-term goal would be to at the grassroots of organic farming issues and provide direction to solve them. Our conference team will provide real-time technical assistance through a "speed dating" event with experts on the following aspects of Southern organic farming management: (i) Soil and nutrients, (ii) weed, (iii) pest and disease pressure, (iv) integrated livestock, (v) organic certification. The Our conference project objectives are four-fold: i) Provide four bilateral and interactive train-the-trainer training and farmer participatory workshops identifying knowledge gaps on the following aspects of organic farming in the Southern US: (1) climate-smart organic production, (2) marketing strategies and policy relevance, (3) socio-economic assessment, (4) organic certification. ii) Create a white paper and extension bulletins outlining the knowledge gaps identified in the four workshops to be shared with the farming community in all 13 Southern states to help move the organic movement forward. iii) Provide free, real-time technical assistance and access to further resources to farmers via a technical assistance "speed dating" event focused on the following aspects of organic farming: (1) Soil and nutrient management, (2) weed management, (3) pest and disease management, (4) integrated livestock management, (5) organic certification. iv) Assemble a regional Organic Workforce Advisory Committee. Our conference team will identify a group of organic farmers and experts in the field who attended the conference and showed the drive and interest needed to initiate change.

## APPROACH

Approach: We will have four interactive workshops and one Organic Technical Assistance 'Speed Dating' Event as a track of this conference. The PD and all Co-PDs will participate in all activities as a team to promote stakeholder involvement during the proposed conference workshops while writing the white paper, extension bulletins, and reports as required by the USDA-NIFA-OREI-RFA for FY-2024. Interactive workshops: The proposed train-the-trainer and farmer participatory workshops will consist of an expert panel (3 panelists per workshop). The PD and all Co-PDs will participate as either panelists and/or facilitators. We will identify our panelists from 13 experts and subject matter specialists who are partners in our Southern Piedmont Climate-Smart Project (13 institutions) or beyond. The project team will capture the farmers' views (both quantitative and qualitative) during the workshops through Mentimeter surveys and documenting open discussions. Our goal is to engage farmers to voice real-world issues and knowledge gaps to better our understanding of SDFRVs research and programming needs. The workshops will begin with a list of feeder questions prompted by the moderator to the panelists. The audience will be encouraged to interact via Mentimeter with real-time questions and open discussion. We chose Mentimeter because it allows farmers to answer questions in real-time while maintaining anonymity. In this way, farmers can be comfortable to respond honestly to sensitive questions. Additionally, these types of surveys tend to open audience members up enabling more free open discussion. The proposed workshops will focus on four critical topics related to Southern organic agriculture: (i) Climate-smart organic farming: Identify stakeholder perspectives and knowledge gaps on what climate-smart organic farming is, how to support farmers transitioning to more climate-smart agriculture, and discuss simple approaches farmers can take to have a more climate-smart operation (e.g., cover crops, no-tillage, amendments, etc.). (ii) Marketing strategy and policy relevance: Receive farmer feedback on the status of supply chains, market availability, financial institutions, and public conservation programs. Identify knowledge gaps and actionable steps to facilitate transitioning to organic agriculture for a profitable, resilient production system. (iii) Socio-economic Assessment: Identify economic and social challenges, opportunities, and knowledge gaps for Southern farmers transitioning to and maintaining organic production. (iv) Organic Certification: Identify knowledge gaps for Southern organic farmers trying to find local and regional resources for organic certification. We will provide travel stipends to 2 selected mentor SDFRVs farmers from all 13 Southern states (26 farmers total) to attend the SOWTH conference. The selected farmers must attend all proposed conference workshops; the workshops will also be open to all SOWTH attendees. Organic Technical Assistance 'Speed Dating' Event: We propose two Technical Assistance on Organic Farming as Speed Dating events. These 90-minute events will be held on Days 1 and 2 of SWOTH. We will have 10 TA coordinators with expertise in soil health, weed and pest management, integrated livestock, organic certification, and USDA funding opportunities. We will utilize our resource TA coordinator from our existing Southern Piedmont Climate-Smart Project (13 institutions) and beyond as per the need of the conference planning. There will be two TA coordinators per 5 expertise categories. Farmers will meet with one TA coordinator per expertise topic for 8 minutes. After 8 minutes, the group will move on to the next table/topic for another 8 minutes. This process will repeat until the farmers have visited all TA stations. Through this this event, farmers will obtain rapid TA for all aspects of their operation while, simultaneously, being introduced to a series of

TA coordinators in their region they can call on in the future and a plethora of resources relevant to their operation.

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# Developing Resilient Organic Wheat Cropping Systems in the Face of Climate Change Related Crop Failure

<b>Contract / Grant No.</b>	2024-51300-43047
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Jennifer Reeve
<b>Performing Institution</b>	Utah State University

## NON-TECHNICAL SUMMARY

The majority of US organic wheat is produced in western States, but farm viability is increasingly threatened by the effects of climate change, leading to declining yields, poor soil health, increasing weed pressure, and periods of droughts and flooding. The long-term goal of this integrated research and Extension project is to develop economically viable and environmentally sustainable dryland grain systems in the face of climate change. To meet this goal, we have two main objectives. The first is to integrate perennial wheat and forages into our long-term on-farm research sites devoted to testing and showcasing organic dryland wheat management strategies and assess the income potential of Kernza, as a product and in carbon markets. The second is to work with Extension faculty, agronomists, growers, and federal agency personnel to enhance the ability of agricultural producers to grow productive, high quality, sustainable, and profitable dryland organic annual and perennial grains and forages. Outreach efforts, guided by input from our Advisory Council, will target producers, Extension personnel, and agricultural professionals who advise producers on organic practices through in-person events (on-farm trials, field tours, winter meetings), printed materials (Extension publications and analysis tools), and digital resources (webinars, webpages, and web-based videos). Perennial wheat combined with low-rates of compost could help diversify organic grain systems for improved water use efficiency, soil health, soil carbon stocks, weed management, and economic viability in the western U.S.

## OBJECTIVES

The overall, long-term goals of this project are to develop resilient dryland grain based cropping systems for the Western US in the face of climate change by: 1) integrating Kernza and or other perennial grains into our long-term on-farm research sites devoted to testing and showcasing organic dryland wheat management strategies for increased water use efficiency, soil health, wheat yield and quality, weed dynamics, and economic viability in the western U.S., and 2) working with county Extension personnel, agronomists, growers, and federal agency personnel to enhance the ability of agricultural producers to grow productive, high quality, sustainable, and profitable dryland organic grains. We will work towards these goals through the following specific objectives: 1. Compare yields and profitability of annual organic wheat systems (wheat fallow or wheat cover crop depending on site and grower interest) with perennial systems (Kernza, Salish Blue, alfalfa and drought tolerant grasses). 2. Measure improvements in soil health, carbon stocks and resilience to drought and weed pressure from integrating Kernza with lower rates of compost. 3. Increase adoption and sustainability of organic wheat production through education and outreach programs including tools to aid decision making by growers on the economic viability of applying compost and integrating perennial grains into organic dryland wheat systems.

## APPROACH

Objective A: Treatments will compare compost rate as the whole plot, year of compost application as the split plot, and Kernza as the split-split plot with four replicates and compare the effect of compost to conventional fertilizer. A locally adapted wheat cultivar will be grown every other year in the wheat-fallow rotation. Sites will be under conventional tillage and wheat will be planted at 150 to 200 live kernels/m<sup>2</sup>/a in fall. Plots will be harvested with a small plot combine. Kernza will be planted in April at a seeding rate of 17 kg/ha. Stands will be mown in the fall to simulate grazing. Grower Demonstration Trials: Growers will select one novel treatment e.g. perennial grains, cover crops or intercrops to compare to their standard practice with and without compost for a total of four treatments each and four replicates. Plots will be sized appropriately to accommodate full-scale equipment.

Growers who have cattle will incorporate grazing after or in lieu of grain harvest. Three long-term unreplicated demonstration sites will be monitored for yields. An on-farm replicated trial where compost was applied once in 1994 will also be monitored. Each year, growers will be consulted on their perceptions and asked to evaluate the new management strategy compared to their traditional strategies in terms of benefits and drawbacks.

**Weed, Wheat and Kernza Growth:** Plots will be evaluated for weed and crop growth in May of each year. The plant canopy will be assessed using a ceptometer to measure photosynthetically active radiation at three locations per plot. Weed, wheat and perennial crop densities will be measured by counting plant numbers in three, randomly placed quadrats per plot. Biomass will be collected in June by harvesting 1.0-m<sup>2</sup> per plot, separating weeds, cover crops, forage and wheat, recording the fresh weight of each and drying a small sub-sample to use in calculating dry weight. Root biomass will be estimated by excavating three crowns per plot (Strullu et al. 2011).

**Wheat Yield and Grain and Forage Quality:** Wheat and Kernza growth will be determined by measuring tillers per plant on 10 randomly selected plants per plot, heads per plant, seeds per head and 1000 kernel weight immediately prior to harvest. Wheat yields will be determined by harvesting with a plot combine. Quality measurements will include test weight, protein, 2 g mixograph, and lactic acid sedimentation. Annual and perennial cover crops will be assessed for forage quality including total N and neutral detergent fiber.

**Multi-State Perennial Grain Variety Trials:** A minimum of six cultivars and advanced breeding lines of Kernza and perennial wheat will be compared to improved drought tolerant grasses. The trials will be established in year one with compost as the whole plot and cultivar as the subplot. Harvest will occur at maturity with a small plot combine and or forage harvester. Phenotypic measurements will include stand establishment and winter survival, height, heading date, yield and previously mentioned end-use quality tests.

**Economic Analysis of Cropping Systems:** Market perceptions, needs, and pricing by market will be assessed through in-person surveys and interviews and will be analyzed with econometric techniques coupled with an in-depth consumer analysis of perceptions and preferences for Kernza/perennial grains in consumer products. We will also look at the most effective ways to inform consumers as well as effective promotion strategies for marketers. This data will be collected through national consumer surveys and local behavioral experiments. The long-term return on investment to compost across the study area will also be assessed. This will entail completing multi-year cost and return studies to determine the long-term financial effects of investments in compost. The economic analysis will include a risk and return analysis for various strategies utilizing stochastic simulation methods. A cost-benefit analysis of all wheat systems under trial will be completed, which will include creating partial cost and return studies by system.

**Objective B: Soil Health and Fertility:** Soil health will be assessed in all treatments and locations over time and compared to current practices. All standard soil tests will be completed using methods described in Soil and Plant Reference Methods for the Western Region (Gavlak et al. 2003). Sites will be sampled in April during the wheat or perennial phase of the rotations at 0-30, 30-60 and 60-90 cm depth and analyzed for nitrate, ammonium and Olsen P, dissolved organic C and N, and TOC and N. TOC and TN, readily mineralizable C, basal respiration and microbial biomass according to Anderson & Domsch (1978); dehydrogenase and phosphatase enzyme activities (Tabatabai 1994) and aggregate stability (Kemper & Rosenau 2006) will be conducted at 0-10cm. Olsen K, DTPA-extractable elements (Fe, Zn, Cu, Mn); EC and pH will be assessed at 0-30cm at the end of the project.

**Soil Moisture and Temperature:** Profile soil moisture will be measured at planting and on a monthly basis from March through June of each wheat and perennial crop at all sites using a 503 DR Hydroprobe neutron scattering device. Topsoil moisture, temperature and electrical conductivity will be measured daily during the growing season with TDR-315 probes. Probes will be installed at three depths (2.5, 5, and 15 cm) in four replicates and four treatments.

**Carbon Market Potential: Harnessing Kernza's carbon sequestration capabilities** opens up opportunities to engage in carbon offset markets. We will leverage existing market prices for carbon emissions permits obtained from platforms like the EU Emission Trading System, the US Regional Greenhouse Gas Initiative, or the California Carbon Allowance markets, as well as voluntary carbon offsets from organizations like Carbonfund.org Foundation. This information will be compiled comprehensively, establishing a distribution of current carbon price estimates and correlated to prices with the greenhouse gas reductions achieved through Kernza adoption.

**Objective C: Assessing needs and barriers to adoption:** An investigation will be conducted of strategies to improve producer adoption of the most economically beneficial compost application rates and cropping strategies. This will include conducting in-depth interviews of both current and potential organic and perennial wheat producers to gauge perceived adoption hurdles and concerns and assessing needed information and preferred delivery methods concerning study outcomes.

**Field days and winter grower meetings:** Field days will showcase different organic wheat management practices on both grower and university farms. Results will be presented at winter crop workshops annually. A multi-regional conference with invited speakers and a grower panel on organic wheat systems will be held in year four. Time will be designated after the conclusion of the public events to deliver additional training and resources. We anticipate that approximately 10-40% of attendees will be Extension personnel or other professionals who advise growers on organic practices. One field tour/workshop in year 3 or 4 will be an in-service training to target Extension educators.

**Digital resources:** Delivery of our research findings to a broader audience will be supported through USU Extension Marketing, the new USDA Transitions to Organic Partnership Program (TOPP) and a public website

(extension.usu.edu/certifiedorganic/) to post research results and publications, support the delivery of webinars and broadcasts, and support social media channels (@USUcrops on Twitter, Instagram, and Facebook). The production of short (1-3 min) videos on dryland wheat production will also be published to YouTube and embedded in the website. -----  
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# From Field to Market: Expanding Experiential Learning for Undergraduates in Organic Agriculture, Emphasizing Diversification, Finances, and Marketing

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<b>Contract / Grant No.</b>	2024-51300-43048
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Mary Rogers
<b>Performing Institution</b>	University of Minnesota

## NON-TECHNICAL SUMMARY

Land grant universities can play an important role in developing an educated workforce that is prepared to address the multi-faceted components of organic production. Stakeholders, including current students and organic farmers, value multidisciplinary instruction and opportunities to put skills to practice. At the University of Minnesota, we have nationally recognized research and teaching programs focused on plant and animal science for undergraduate students specifically within organic production frameworks, however there are no cross-disciplinary activities connecting these two academic programs. Like many student farm programs across the country, our current curriculum in organic agriculture is plant production-oriented and lacks opportunities for students to learn more about the financial management aspects of these systems. We will address this by working across departments to update and expand our current discipline-specific curriculum into a more holistic framework supporting diversified organic production systems. We will integrate organic plant and animal production systems while providing students with valuable skills in financial management and marketing. This approach better reflects the realities of small-scale, organic farms in the upper Midwest and will better equip our undergraduate students with the leadership skills and knowledge needed to support and launch new organic farms. The objectives of this proposal are to 1) expand organic agriculture curriculum for undergraduate students at the University of Minnesota; 2) disseminate new resources and knowledge beyond Minnesota to students at other institutions and to the broader organic educator community; and 3) reinforce connections between the Student Organic Farm and outreach and Extension programs in organic agriculture.

## OBJECTIVES

The overarching goal addressed in this proposal is to foster undergraduate education, leadership skills and professional development to benefit the organic agriculture industry in Minnesota and beyond. The organic industry is the fastest-growing segment of U.S. agriculture, with farmers and ranchers selling \$11.2 billion in certified organic products in 2021 (USDA NASS 2022). To continue to meet the expanding increase in consumer demand for organic products, it is critical that barriers to production and marketing are addressed. In large part, this entails access to technical resources and education centered on organic production systems. The Organic Farming Research Foundation's comprehensive National Organic Research Agenda report for 2022 identified the "clear need for more extension personnel and other service providers trained specifically in organic farming systems" (Snyder et al. 2022). Lack of technical assistance was identified as a key challenge for organic systems nationwide, and recommendations in the report include building the capacity of Extension, NRCS, and other agricultural professionals to serve the organic farming sector (Snyder et al. 2022). Organic programs at land grant universities are well positioned to do this. Organic production systems are complex in nature and rely on a basic understanding of soil science, nutrient cycling, integrated insect/weed/disease management, landscape and habitat management, biodiversity, and ecosystem services; concepts related to the biological and ecological components of organic production. However, production is only one component in building a thriving, long-lived organic farm business. To be successful, farmers need to be skilled at managing budgets and finances, recordkeeping, marketing, risk management, use of technology, and interpersonal skills. Organic farmers, particularly those who are beginning or transitioning to organic production, need reputable sources of information and training to manage these complex farm businesses efficiently. University programs in organic agriculture can play an important role in developing an educated workforce that is prepared to address the multi-faceted components of organic production. Additionally, well-designed programming can help build leadership and

professional skills among students and provide opportunities for shared learning with leaders in the organic farming community. The University of Minnesota (UMN) is a national leader in organic agriculture, both in research and teaching. Our current undergraduate curriculum in organic horticulture on the St. Paul campus includes a formal course with a laboratory component, HORT 3131 Student Organic Farm Planning, Growing and Marketing (taught by Co-PI Grossman). This course is a requirement for students in the 'Organic and Local Food Production' track of our Sustainable Agriculture and Food Systems major, and a popular elective for other undergraduate programs in our college. HORT 3131 provides hands-on learning with labs that take place on the UMN Student Organic Farm (SOF). In addition, all undergraduate students in our college are required to complete an internship and 6-7 students per year complete summer internships at the SOF. The SOF was formed by student initiative in 2004 as a space for experiential learning on campus (Markhart 2006). Originally a 1-acre plot of certified organic land on the edge of the UMN research plots maintained by the MN Agricultural Experiment Station on the St. Paul campus, the SOF now encompasses the organic systems plan for 5.5 acres of organic land used for research while still maintaining 1 acre of annual vegetables for student learning. In addition, the SOF manages 'The Commons,' a 0.5 acre gathering space with plaza, perennial fruit and native wildflowers used for field days, workshops, and other community events. The SOF sells produce to the campus community via three distinct marketing channels from July through September, including the UMN farmers market (Minneapolis campus) organized by our campus wellness center, the Campus Club restaurant, and at our farm stand on the nearby St. Paul campus. Revenue from farm sales (~\$20k/year) helps offset the costs of materials and supplies, field plot maintenance, and greenhouse fees, while also providing wages for undergraduate student interns. Traditionally, the UMN organic curriculum has focused on the production of annual vegetable crops. Our curriculum does not include livestock production, or the economic aspects of farming as a business. Although business management is more frequently included in traditional agriculture curricula at the university level, few instructors report including business management skills and concepts in their organic agriculture courses (Jabbour and Pellissier 2019). Similarly, organic livestock production has not been prioritized within organic programming at universities, with an outsized focus on specialty crops (Jabbour and Pellissier 2019). Colleagues in the Dept. of Animal Science at the UMN including Co-PD Johny recently received a curriculum development grant from the OREI program (2023-51300-40911) to address this gap and develop new courses in organic animal production. The objectives in this proposal will complement these activities while allowing expansion of our current curriculum in organic horticulture. The integration of vegetable production knowledge and animal production, financial literacy, and marketing basics is critical for small farm business management. We will pilot our proposed curriculum on the UMN SOF by uniting these interdisciplinary ideas in an enriched student experience. The hands-on learning modules developed here will be validated by students enrolled at the UMN, then scaled up and made available to other institutions via development of an online course. In addition to serving undergraduate students, the SOF provides a valuable space for demonstration, outreach, and extension events to reach the larger organic grower community, allowing us to extend our deliverables beyond the university walls. In 2023, for example, 75 community members, many self-described as "beginning" or "aspiring" farmers, attended a fruit and vegetable organic field day on the UMN St. Paul campus, which included tours and extension education about the SOF. Those who attended the field day reported they would attend another UMN event (75%), use UMN Extension online resources (60%), and reach out to UMN Extension with a question (41%). We recognize a critical need for basic knowledge related to organic agriculture among a broader audience of undergraduate students, emerging farmers, extension educators, and other technical assistants within and external to our state. Our team has developed three objectives to address these educational needs: Objective 1: Expand organic agriculture curriculum for undergraduate students at the University of Minnesota Objective 2: Disseminate new resources and knowledge beyond Minnesota to students at other institutions, and to the broader organic educator community Objective 3: Reinforce connections between the Student Organic Farm and outreach and Extension programs in organic agriculture

## APPROACH

Activity 1.1.1: Develop a new business planning basics module for current Student Organic Farm class A new curricular module will be developed for the HORT 3131 Student Organic Farm Planning, Growing and Marketing (3 cr) course, covering business planning basics. The module will include one 1-hour online lecture and two 2-hour in-person labs focused on business planning, marketing, and finance basics, led by Key Personnel DiGiacomo. Business planning with a special emphasis on marketing and finance strategies will be introduced during the class lecture and through assigned readings. A second lab will focus on finance basics such as start-up costs and on-going operating expenses. DiGiacomo will utilize records compiled by summer SOF interns for the lab activities. Marketing and production records needed for the fall class will come from information compiled by the SOF manager and interns during the preceding summer. Activity 1.1.2: Revise and update a practicum course for the SOF By partnering with Key Personnel DiGiacomo and Co-PD Johny, and by retaining a SOF educator, we propose to integrate new content on small farm profitability and organic livestock production content into a pre-

existing course and to expand the course to a full semester (15 week), 2 credit offering. The new course will be offered as a Food Systems (FDSY) designator to reflect the interdisciplinary learning outcomes and renamed FDSY 3093: Practical Approaches to Diversified Organic Production Systems. The course will be divided into three separate modules: module 1: Planning for Success: Small Farm Finances and Marketing; module 2: Small Flock Organic Meat Chicken Production; and module 3: Organic Vegetable Production. See Table 1 attached for the draft of the syllabus. The class will be offered starting in spring, 2025.

Activity 1.2.1: Diversify Student Organic Farm via integrated horticulture and small-flock meat chickens We will make the SOF a model for an integrated organic crop-livestock system, focusing on meat-type chickens. SOF interns will receive expert guidance and mentorship from Wayne Martin (see letter of support), a retired Extension Educator with decades of experience in livestock production for small farms, including certified organic operations. With assistance from our new Extension Educator Sabrina Florentino, Martin will provide teaching, mentorship, and support to interns in all aspects of small flock production. The small flock will consist of 250 meat chickens (i.e. "Freedom Rangers") which students will raise in two batches per season (250 chicks per batch, 500 chickens per year).

Activity 1.2.2: Co-create robust recordkeeping skills to guide economics-based decision making within a diversified farming system DiGiacomo and the SOF educator will work with students in FDSY 3093 to develop a robust recordkeeping plan, starting with our current Organic Systems Plan (OSP) to identify the types of data that are needed (i.e. crop rotation plan, soil tests, planting and harvesting dates, seed inventory, input and amendment receipts, yield, and sales data). Identification of critical data needs and the creation of a financial and production recordkeeping system for the SOF will be major assignments for the FDSY 3093 course. Interns in the summer will receive training from the SOF educator on implementing the recordkeeping system and will be assigned specific tasks to complete (i.e. enter harvest data and market sales into a spreadsheet).

Activity 1.2.3: Provide opportunities for learning from more experienced organic growers via a "work & learn" summer series We will partner with Barthelemy (see letter of collaboration) to develop an Organic Farm Buds series for SOF interns to visit organic farms in Minnesota during four "work and learn" events during each summer of the project period (2025-2027). The work and learn events will be day-long visits to organic farms in our region. The rough schedule for these events includes introductions and general background information on the farm history, a tour around the farm, collective work on a predetermined farm task (i.e. weeding, mulching, planting, harvesting, high tunnel erection), and a shared community meal (lunch or dinner, depending on schedule).

Activity 2.1: Develop an online Coursera course on "Foundations of Organic Agriculture" We will develop a 10-week long beginning Coursera course on the "Foundations of Organic Agriculture". This course will provide an overview of organic agriculture within a small to midsize farming system framework for local and direct markets. By the end of the course students will be able to: 1) explain the agroecological principles underpinning organic agriculture and how certification is obtained; 2) describe basic production components of organic vegetable, fruit, and livestock systems (using chickens as a model); 3) acquire practical skills necessary to maintain records, profitability, and organic certification standards. The list of modules to be developed is included in Table 2 (attached).

Activity 2.2: Share outcomes from our curriculum development activities We will disseminate the impacts and findings of our new educational activities with other organic agriculture educators in higher education via presentations at academic and professional conferences and preparation of a refereed publication for submission to a journal focusing on scholarship of teaching and learning in agricultural science.

Activity 3.1: Expand our organic field day to include producers interested in learning more about chickens With the new activities focused on small flock meat chicken system described in this proposal. With Extension Educator Sabrina Florentino, we will expand our organic field day to include producers interested in learning more about chickens or integrating crop and livestock operations as well as reach the numerous home gardeners and hobbyist interested in backyard chickens.

Activity 3.2: Generate short videos on small flock meat chicken production for new and current organic producers Florentino will also use the SOF chickens to demonstrate the new organic livestock standards for outdoor space requirements and will generate at least two short videos for new and current organic producers to be posted on the UMN Extension Small-scale poultry website. These videos can also be integrated into our Coursera course materials for undergraduate students and will be developed starting in 2025.

Activity 3.3: Connect online resources to the Transition to Organic Partnership Program (TOPP) Key personnel Murray will convene a team of organic researchers and Extension specialists at the UMN to help address priorities of the TOPP program, including technical assistance, community building, and workforce development activities. In year 3 after our Coursera course has launched, we will issue 25 vouchers for free access to the Foundations in Organic Agriculture course and make these available to non-student learners who express interest in the course following our annual field day in 2027.

# More Bang for Your Buckwheat

<b>Contract / Grant No.</b>	2024-51300-43049
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Kevin Murphy
<b>Performing Institution</b>	Washington State University

## NON-TECHNICAL SUMMARY

Buckwheat, both common and Tartary, is an under-utilized crop ideally suited for organic systems with strong potential to address critical societal issues, including access to nutrition, diversifying diets, mitigating climate change, and adaptation to low-input agricultural environments, including use in no-till and dry-farming systems. Today, many organic growers utilize buckwheat as a soil building, weed suppressive cover crop, and although cover crops are valued as important parts of the "organic systems plan," they represent an opportunity cost for growers. Recently, demand in the US for CBW and TBW has grown as both species offer a highly nutritious, gluten-free alternative to cereal grains, and an opportunity to revive culturally significant cuisines and heritage food crops, however very few commercially available varieties of CBW exist, and we are not aware of any previous efforts on TBW improvement in the US. Thus, growers rely on seed labeled as "common buckwheat" "Tartary buckwheat" or "variety non-specific" without knowledge of the agronomic or food-value qualities of the seed source. Our project will help address the gap in access to diversity in seed options while optimizing agronomic practices and building markets to expand organic buckwheat production in the US. The More Bang for your Buckwheat project will expand organic farmers' and food businesses' access to a diversity of varieties of CBW and TBW well-suited to varied climates and markets with improved agronomic and food-value qualities. Research activities will advance our understanding of how best to leverage the crop potential for ecosystem services including insights into the genetic, agronomic, and environmental effects on soil health, soil aggregate stability, weed suppression, and pollinator habitat. Nutritional analysis will inform breeding strategies to optimize nutritional value for organic food products. Outreach activities and a farmer-participatory approach to plant breeding will increase farmers' uptake of optimum varieties and knowledge of agronomic management of the crop, ultimately improving the ecological health, productivity, and economic viability of organic farms. A value-chain, or push-pull approach, to outreach through events and promotional campaigns will build market awareness and demand ensuring ready uptake of expanded production of high-quality organic buckwheat. The diversity of stakeholders engaged in outreach along the supply chain will concomitantly build organic buckwheat production and markets. Market development efforts will strengthen stakeholder relationships from field to market by engaging farmers, processors, chefs, and school foods programs. Extension and related outreach activities will include field day/ buckwheat festivals on farms and research stations, development of promotional materials and marketing campaigns, point of sale product promotion at restaurants, farmers markets, organic stores, and schools, and showcasing buckwheat at three Culinary Breeding Network Variety Showcase events. Value chain coordination will engage participation in outreach activities among all project partners and advisors. Outreach activities will build organic buckwheat market opportunities for farmers of all scales and increase buckwheat uptake by diverse buyers and eaters.

## OBJECTIVES

The long-term goals of this project are to develop and release a suite of publicly available common (CBW) and Tartary buckwheat (TBW) varieties that address stakeholder-identified characteristics related to ecosystem services, grain yield and agronomic traits, nutrition, flavor and diverse end-uses, and cover cropping. Our proposed research will address the needs of organic farmers of all scales by developing nutritious varieties capable of diversifying their cropping rotations and market opportunities while providing ecosystem services such as increased habitat for pollinators, enhanced weed suppression benefits, and soil stabilization. Objective 1. Develop new varieties of common and Tartary buckwheat with enhanced traits related to agronomy, yield, ecosystem services, and/or health and nutritive value. Objective 2. Determine agronomic practices that maximize a suite of critical ecosystem services in organic production systems from common and Tartary buckwheat varieties. Objective 3. Develop a diverse and innovative suite of flavorful, affordable, and nutritious common and Tartary buckwheat food products accessible to consumers from all income levels. Objective 4. Conduct value-

chain and market assessments, and disseminate knowledge gained and products developed to stakeholders across communities, schools, and underserved populations through a wide-reaching Extension and outreach effort.

## APPROACH

Subobjective 1.1: Assess existing U.S. and European common and Tartary buckwheat germplasm for key agronomic, nutritional, and ecosystem service-related traits. We will phenotype a diverse group of CBW and TBW accessions from the USDA and European gene banks along with several commonly grown and publicly available buckwheat varieties on certified organic research stations in Washington, New York and New Hampshire. The panel will be planted using a randomized complete block design with four replicates, and plot sizes of approximately 1m x 4m at each location in Years 1 and 2. These buckwheat varieties will be evaluated for traits that a) improve productivity in organic systems, b) enhance ecosystem services (Obj. 2), and c) optimize nutritional value and end-use quality traits (Obj. 3).

Subobjective 1.2: Conduct on-farm evolutionary participatory common buckwheat breeding trials to develop populations adapted to organic conditions across different environments. These populations from SubObj 1.1 will be grown by cooperating organic farmers (3 each in WA and NY, and 1 in NH) using an evolutionary participatory breeding approach throughout the early F2 to F5 generations. These populations will be planted, managed, and harvested by farmers each year, with joint farmer-researcher co-selection events during and after the growing season, depending on the trait. These populations will become the basis for future pedigree/pure-line selection in intermediate and later generations.

Subobjective 1.3: Identify and develop improved Tartary buckwheat varieties for organic growers, processors, and end-users. On certified organic land at the NH Agricultural Experiment Station, we will phenotype the full set of 76 diverse Tartary buckwheat accessions maintained by the USDA National Plant Germplasm System, along with historic lines that can be obtained from traditional growers in the Northeast.

Subobjective 1.4: Develop an efficient and informative genotyping protocol to enable *F. esculentum* variety identification and track the effects of selection. We will use high-throughput sequencing to develop a robust methodology for genotyping US "varieties" (really randomly intermingled populations) of CBW - a first and necessary step toward formalizing variety identification and boosting farmer confidence in the seed system. These genotyping methods will be leveraged in Year 4 to gain insight into genomic regions under selection by organic farmers in the PNW and NE.

Subobjective 2.1: Determine the effects of buckwheat planting date and genotype on buckwheat performance related to ecosystem services of soil nutrient cycling, soil stability, weed suppression and ecology, support of pollinators, and food provisioning (yield). Planting date trials in each location will be set up in a split-plot randomized complete block design with four replications, with planting date as the main plot and buckwheat genotype (or other comparison summer cover crop) as the subplot.

Subobjective 2.2: Determine the effects of buckwheat seeding rate and genotype on buckwheat performance related to ecosystem services of weed suppression, promotion of pollinators, nutrient cycling, and food provisioning (yield). Seeding rate trials will also be in a split-plot randomized complete block design with genotype as the main plot and seeding rate as the subplot.

Subobjective 3.1: Characterize functionality traits of top-performing varieties and breeding lines of each buckwheat species. As described in our previous publications, selected varieties from the agronomic and breeding trials (in both whole seed and whole seed flour forms) will be functionally characterized to determine their unique attributes. Characterization will include flour swelling power, water and oil absorption capacities, foaming capacity, foam stability, emulsification capacity, emulsion stability, thermal properties, and pasting properties.

Subobjective 3.2: Characterize the nutritional composition and end-use quality traits of buckwheat varieties. Our standardized methods include identifying fats (lipidomics), specialized metabolites and other small molecules (metabolomics), minerals and metals (ionomics), as well as a method to facilitate the discovery of novel secondary metabolite biomolecules. Additionally, the PTFI has developed a core minimum metadata module for describing samples in its database and is working on developing additional metadata modules to describe the biophysical and socio-cultural attributes of edible species, including climate variability, sustainable agriculture, and taxonomic modules.

Subobjective 3.3: Product development to optimize nutrition and diversify end-uses. We will develop value-added food products using baking, extrusion, and frying technologies from specific buckwheat varieties selected based on the data from Objectives 1 and 2. We aim to work on four categories of food products: pancakes, extruded snacks, baked products, and fried snacks.

Subobjective 4.1 Value-chain farm-to-school market development. The methods the team will use for value chain development with school partners deploy strategies known to be successful in promoting acceptance of new foods in school meal programs. The methods proposed include a) industry partnership with Cascade Milling in Royal City, WA, to ensure the product is available in a useable form (muffin mix), b) provision of educational materials to school lunchroom and classrooms c) classroom taste testing, and d) immersive experience at a youth farmers' market. Method (a) was developed because milling and mixing infrastructure for organic buckwheat are extremely rare in Washington State as elsewhere.

Subobjective 4.2. Conduct Extension and outreach events targeting farmers, millers and processors, food companies, consumers, and other stakeholders. Outreach events will connect organic farmers

and buyers building supply chain relationships to increase demand and grow regional production and distribution of organic common and Tartary buckwheat flour, grains, and value-added products. Four types of venues will achieve this objective including: i) field days hosted as an on-farm buckwheat festival, ii) Food science Extension activities; iii) Variety Showcase events, and iv) point-of-sale regional market festivals. -----  
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# Culturally Relevant Organic Curriculum, Professional Development, and Experiential Learning: Increasing Justice, Equity, Diversity and Inclusion in the Organic Sector

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<b>Contract / Grant No.</b>	2024-51300-43050
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Amber Sciligo
<b>Performing Institution</b>	The Organic Center

## NON-TECHNICAL SUMMARY

There remains a critical lack of racial diversity across the agricultural sector and the organic industry, especially apparent in the population of organic certifiers, organic inspectors, and in the personnel of organizations and universities who provide much of the nation's technical assistance and educational programming in agriculture. The long-term goal of this project is to jumpstart participation and motivation for a diverse representation in future organic leadership that helps make the organic sector more inclusive, equitable, and just. To meet this goal, our project will develop and distribute innovative professional development and culturally relevant curricula that target 18 faculty members and 8 student fellows. Education modules including inspirational films developed by this project team will equip participants with foundational knowledge about organic through an Organic 101 type of training and offer exposure to a variety of professional career opportunities across the organic industry. This program will include a week-long learning exchange facilitated by The Organic Center and Organic Trade Association and an 8-week paid student fellowship to work with professionals across the industry. Held in parallel with Organic Week in Washington D.C, the learning exchange will expose participants to organic policies, processes, and challenges, and professional networking across the organic sector. Learning sessions/modules will be interspersed with workshops for professional development to help (a) faculty connect with minority students through culturally relevant pedagogy, and (b) prepare students for their fellowship placement with collaborating agencies and businesses committed to centering racial equity in professional development and the organic movement.

## OBJECTIVES

**CRITICAL NEED AND LONG-TERM GOALS:** Through cohorts of inspired and empowered university faculty who will teach organic agriculture in ways that inspire students and offer a greater understanding of and broader participation in the organic sector, our long-term goal is to co-create culturally relevant content and experiential learning opportunities that accelerate an increase in the diverse representation across future organic leadership and workforce. U.S. organic agriculture is the fastest-growing sector of the U.S. farm-to-fork supply chain. Organic food sales continue to increase annually and have reached a substantial \$69 billion per year. To meet industry needs, it is critical that we recruit and train students and other professionals to enter the organic workforce. The vision of a future organic sector that is more just, equitable, diverse, and inclusive is shared by faculty, businesses, federal and non-federal entities, and students across the country. Inspired by the USDA's Federal Equity Commission recommendations for investments in minority-serving institutions better positioned to reach a diverse and historically underserved population, we will target and recruit faculty and students across minority-serving institutions across the country to help pilot a professional development workshop and experiential learning fellowship that are featured in this project.

**OBJECTIVES:** We believe that empowering educators who are best positioned and prepared to reach a diverse set of students and leveraging a willing set of stakeholders and potential employers committed to centering racial equity in the organic movement, will help tackle the distinctive challenges encountered by growers and other stakeholders in the organic industry, especially farmers of color. In this regard, we propose three key objectives as part of our project: 1a. Implement professional development training for agriculture faculty employed at federally designated minority-serving institutions, including 1890 Land Grant colleges, 1994 TCUs, and 2009 HSACUs. This intensive training will aim to facilitate sensitivity to, awareness of, and effective teaching pedagogies that help dismantle deficit thinking, build and nurture cultural competencies, and develop a critical consciousness and awareness in faculty and students. The main goal of this

objective is to task and empower faculty to better support a diverse workforce that helps ensure agricultural education and its opportunities are equitable, resilient, and prosperous for all. 1b. Develop culturally relevant curricula to include Organic 101 to increase faculty and student competence in organic practice standards, certification process and basic rules, organic program governance and the holistic benefits of organic. Some of these modules will be co-designed by faculty participants (objective 1a) and will be made available on a publicly accessible website (see data management plan p 25). 2. Develop and implement inspirational professional training for meritorious students interested in experiential learning in the organic sector. This student internship program leverages the tremendous stakeholder interest and commitment to racial equity in organic and will continue to build on this interest to (as a continuation for this project) eventually host a clearing house for student internships across the organic sector. Students will receive coaching from project personnel to explore ways to receive university credit for the summer-long internship to facilitate progress toward their degrees.

## APPROACH

Activities proposed: 1. Strategic Planning with Advisory Committee Engagement (supports all objectives) In Year 1 PD Sciligo and the Manager of Science Programs will join four advisors and Co-PD Racelis at UTRGV for a 4-day planning session where the objectives, goals, activities proposed and timeline will be revisited and refined. A detailed plan of action for the first two years will be developed and by the end of the summit the whole team will have gained solid grounding in what a culturally relevant curriculum should look like. 2. Curriculum Development (Obj. 1a and 1b) Faculty Development Workshops Week-long learning exchange for university faculty and educators and student fellows, will occur in the summer of Years 2 and 4, to coincide with OTA's annual Organic Week in Washington D.C. This event will bring in professional and community voices who can provide baseline knowledge and common language around issues of diversity, equity, and inclusion across the organic community. 3. Organic 101 Curriculum Development Faculty participants each summer will develop inclusive, culturally-relevant teaching modules and pedagogies for effective minority student engagement in organic agriculture or sustainable agriculture-related courses. New or redesigned teaching modules, along with redesigned syllabi for each participant, will be curated and made available online. 4. Professional Development and Leadership Skills Training with Experiential Learning Fellowship (Obj. 2) Professional development workshops. Week-long learning exchange for university faculty and educators and student fellows, will occur in the summer of Years 2 and 4, to coincide with OTA's annual Organic Week in Washington D.C. Student programming will focus on leadership skills training and learning about organic, its policies, challenges and opportunities, network building and exposure to various career opportunities Organic Student Fellowship program Following the week-long professional development workshops in D.C. students will be placed with their organic sector host to participate in an 8-week experiential learning opportunity. 5. One-on-one coaching with professionals, advisors, and mentors Throughout each year of a student fellowship, following the summer experiential learning opportunity, fellows will have the opportunity to build their networks and professional skills through one-on-one mentoring with industry professionals including advisors. 6. Filming and production of an inspirational documentary sharing a relatable journey along the student-to-organic-industry pipeline to be shared with student fellows and incorporated into the organic curriculum modules for faculty. In Year 1, before the Organic Week workshops, production of an impactful series of short mini-documentary features will be filmed and produced. Four vignettes will tell the singular, but universally relatable stories of a cohort of young Latinx organic leaders who emerged from communities like those targeted by this emerging curriculum. Through immersive storytelling, viewers will be able to see themselves with more clarity and confidence at the organic table. 7. Project Evaluation The evaluation plan includes measures of project execution and goal attainment, and measures for student and faculty-focused outcomes and impacts to determine the extent to which the stated objectives have been achieved. Group reflections will be facilitated annually to review individual experiences and measure goal achievement. These activities will help improve the project after each year of the grant period, following benchmarks that will be thoroughly developed in the planning summit in Year 1. -----  
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# Hunting for Healthy Soils: Organic Management of Soil Micro-predators for Pathogen Control

<b>Contract / Grant No.</b>	2024-51300-43051
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Samuel Martins
<b>Performing Institution</b>	University of Florida

## NON-TECHNICAL SUMMARY

Micro-predators are an essential part of healthy organic soils, but the impact of organic management on most predators is unknown. This project will investigate how organic matter amendments affect soil micro-predator diversity to promote crop health. Aligned with the Organic Agriculture Research and Extension Initiative (OREI) 2024 priorities 1, 4, 5, and 8, it focuses on critical aspects of organic farming, including disease management and soil health, as well as development of educational materials. The primary goal is to enhance organic growers' understanding of the function of soil micropredator communities by examining the interactions between soil organic matter, microbiomes, and plant health. To accomplish this goal, our multidisciplinary team will:- Identify organic management and soil effects on predator function by conducting a "predator-ome" and soil health survey across 12 organic tomato farms in four states (Obj. 1).- Discover how different types of organic soil amendments support predator function and pathogen suppressiveness by conducting controlled microcosm experiments (Obj. 2).- Confirm and apply new knowledge of predator function by developing predator-based soil inoculants and grower testing kits (Obj. 3).- Educate growers and students about the role of soil predators through extension and curricular activities (Obj. 4). This integrated approach of research, teaching, and outreach aims to provide actionable insights for organic farmers, promoting crop productivity and sustainable soil health management. The project's design reflects the needs of organic farmers identified in our OREI planning grant surveys and workshops, ensuring its relevance and potential impact in the organic farming community.

## OBJECTIVES

Micro-predators are an essential part of healthy organic soils, but the impact of organic management on most predators is unknown. This project will investigate how organic matter amendments affect soil micro-predator diversity to promote crop health. Aligned with the Organic Agriculture Research and Extension Initiative (OREI) 2024 priorities 1, 4, 5, and 8, it focuses on critical aspects of organic farming, including disease management and soil health, as well as development of educational materials. The primary goal is to enhance organic growers' understanding of the function of soil micropredator communities by examining the interactions between soil organic matter, microbiomes, and plant health. To accomplish this goal, our multidisciplinary team will:- Identify organic management and soil effects on predator function by conducting a "predator-ome" and soil health survey across 12 organic tomato farms in four states (Obj. 1).- Discover how different types of organic soil amendments support predator function and pathogen suppressiveness by conducting controlled microcosm experiments (Obj. 2).- Confirm and apply new knowledge of predator function by developing predator-based soil inoculants and grower testing kits (Obj. 3).- Educate growers and students about the role of soil predators through extension and curricular activities (Obj. 4). This integrated approach of research, teaching, and outreach aims to provide actionable insights for organic farmers, promoting crop productivity and sustainable soil health management. The project's design reflects the needs of organic farmers identified in our OREI planning grant surveys and workshops, ensuring its relevance and potential impact in the organic farming community.

## APPROACH

Collect soil samples from farms in different states, characterize physicochemical properties and communities. Conduct experiments to assess the survival of pathogens, beneficials and predators in soil amended with different organic matter. Carry out greenhouse experiments to assess the beneficial effects of organic matter amendment in regard to pathogen control using beneficials and predators. Collect soil samples

from up to 300 organic farms for 'citizen science' participation and real world data collection. Develop undergraduate curricula focused on soil microbiome and predators and teach classes at different institutions. Presentations and focus groups at regional and national organic grower conferences. Develop a webpage and an extension article posted on eOrganic to help in identifying organic growers interested in the science of soil microbial processes.

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# Improving the Productivity, Resilience, and Diversity of Organic Small Grain Production in the Northeast

<b>Contract / Grant No.</b>	2024-51300-43052
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	John Wallace
<b>Performing Institution</b>	Pennsylvania State University

## NON-TECHNICAL SUMMARY

We propose to improve the productivity and market potential of spring- and fall- sown organic small grains to increase ecological and economic resilience of organic grain production systems within Pennsylvania and the Northeast US. Understanding the linkages between integrated crop management practices and certain food- and feed- quality endpoints, such as improved understanding of fungal populations and potential benefits to poultry health, is necessary for identifying market constraints and opportunities for small grain sequences within reduced-tillage organic grain systems. In this project, we will integrate multi-disciplinary research and extension-education to improve the viability of organic small grain production. Specifically, we aim to (Obj 1) assess interactions between soil management legacies created by rotational no-till practices, soil fertility, and integrated weed management (IWM) tactics to optimize spring oat production; (Obj 2) evaluate interactions between soil management legacy and cultivar mixtures on yield stability of fall- and spring- sown small grains; and (Obj 3) evaluate yield, quality, and weed suppressive ability of extended small grain sequences using intercropping practices. Evaluations of integrated crop management practices will be extended to include measures of food quality and safety, as well as poultry nutrition and health (Obj 1-3). Our extension-outreach efforts will (Obj 4) grow small grain market opportunities by providing co-learning opportunities for diverse stakeholder groups across the small grain value chain (growers, millers, poultry nutritionists, policymakers). Our long-term goal is to develop climate-resilient, environmentally and economically viable organic grain production systems within the Northeast region.

## OBJECTIVES

We propose to improve the productivity and market potential of spring- and fall- sown organic small grains to increase ecological and economic resilience of organic grain production systems within Pennsylvania and the Northeast US. Here, organic grain farmers capitalize on the strong demand for corn and soybean needed for the rapidly growing organic poultry and egg production sector. Organic grain farmers have traditionally integrated perennial forages in rotation with corn and soybean to break pest life cycles, build soil fertility, and manage economic risk. Integration of small grain crop sequences is an alternative means to manage weed seedbanks, increase soil fertility via expansion of cover cropping windows, and facilitate reduced-tillage and organic rotational no-till corn and soybean production practices. We will integrate multi-disciplinary research and extension-education to improve the viability of organic small grain production. Specifically, we will (Obj 1) assess interactions between soil management legacies created by rotational no-till practices, soil fertility, and integrated weed management (IWM) tactics to optimize spring oat production; (Obj 2) evaluate interactions between soil management legacy and cultivar mixtures on yield stability of fall- and spring- sown small grains; and (Obj 3) evaluate yield, quality, and weed suppressive ability of extended small grain sequences using intercropping practices. Evaluations of integrated crop management practices will be extended to include measures of food quality and safety, as well as poultry nutrition and health (Obj 1-3). Our extension-outreach efforts will (Obj 4) grow small grain market opportunities by providing co-learning opportunities for diverse stakeholder groups across the small grain value chain (growers, millers, poultry nutritionists, policymakers). Our project will help develop climate-resilient, environmentally and economically viable organic grain production systems within the Northeast region. This work builds on sustained efforts to develop viable reduced-tillage and rotational no-till corn and soybean production practices, which we view as the foundation for intensified organic grain systems. Our research products will facilitate more robust local markets for small grains grown for food and feed, and increased adoption of small grain sequences that improve pest regulation, soil fertility, and economic viability. Our research objectives support this goal by (1) identifying ways to improve small grain productivity and resilience through on-

station experiments and on-farm field trials; and (2) exploring effects of integrated crop management practices on feed- and food-grade small grain quality, including important marketability factors such as the grains' vulnerabilities to fungi and mycotoxins, and their potential to benefit chicken gut health, an especially important factor in antibiotic-free production. We will also provide regionally-specific educational and networking events to improve grain growers' and purchasers understanding of sustainability challenges and market opportunities. Project outcomes will improve the ecological and economic resilience of organic grain production systems in Pennsylvania and the Northeast. Our research meets program priority No. 1 by conducting multidisciplinary crop production research (on-station and on-farm) focused on advanced agroecological practices that address production and environmental goals. Project outcomes will increase resiliency to climate change and address both short- and long-term economic viability of organic grain cropping systems. Our project meets program priority No. 2 by fostering regionally specific co-learning events for farmers, millers, bakers, and poultry nutritionists, plus other extension personnel and government agencies. Our project meets program priority No. 3 by evaluating important marketability factors for organic small grains in the context of integrated crop management practices. Anovelapproachof ourcropping sequence experiments(Obj 1 - Obj 3)is our evaluation of integrated crop management practices for small grain production in the context of soil management legacies left by rotational no-till practices for summer annual cash crops. Another is our extending grain performance analysis to include implications for food safety and quality, and poultry nutrition and health for feed grade markets. Advancing management practices and market potential for small grains has yet to be a focus of regional organic cropping system experiments110-113, 28. Few multi-disciplinary projects have addressed the interconnected relationships between soil-management legacy, integrated crop management practices for small grains, food safety and quality endpoints, and poultry feed nutrition and poultry health. We will extend our research to includeon-farm trials(Obj 2)to assess small grain performance across a broad range of soil-environment (E x M) conditions using cultivar mixtures (G x E x M) to increase resiliency of small grains within agronomic windows increasingly influenced by climate change.Finally, we'll support our on-station and on-farm research withco-learning opportunities that bridge the gap between growers and end users(Obj 4). Farmers want more viable grain markets to increase the ecological and economic resilience of their cropping system. Our project will make important advancements toward this goal via sustained engagement with diverse stakeholders gathered at the same table, virtual space, or organic production field.

## APPROACH

**Objective 1:**A two-year crop sequence experiment will be initiated in 2025-2026 and 2026-2027 to generate replication in time at the Russel E Larson Agriculture Research Center (RELARC) near Rock Springs PA. Field experiments will take place on certified organic land (est. 2010; 4 ha) that has been maintained in a corn-soybean-winter grain rotation and uses reduced-tillage and cover cropping practices. Each experimental year will be imposed in sequence following a corn silage phase that will be managed with inversion tillage and blind, inter-row and intra-row cultivation. Field experiments will be imposed as a three-factor complete block design with four replications and a split plot treatment structure. The main plot will include two alternative soil management strategies in the soybean phase, including (1) fall sown cereal rye (67 kg ha<sup>-1</sup>) that is incorporated with inversion tillage 3-4 weeks prior to soybean planting; and (2) fall sown cereal rye (134 kg ha<sup>-1</sup>) that is roll-cripped (I&J Manufacturing) at anthesis (Zadoks 69) prior to no-till soybean planting. Main plot size will be 9 by 36 m. Alternative soil-fertility treatments will be imposed at the split-plot level, including four N-based poultry litter rates (0, 50, 100, and 150 kg N ha<sup>-1</sup>) applied between secondary- and tertiary- tillage passes just prior to sowing spring oats. Alternative weed management tactics will be imposed at the split-split plot level, including (1) standard management practices (STD) for the region, which will include spring oats sown on 19 cm row spacing (Great Plains) using a 300 seeds m<sup>-2</sup>sowing rate and one- to two- tinweeding operations if soil conditions and crop growth stages allow; (2) cultural weed management practices (IWMCWM), which will include use of narrower row-spacing (14 cm, Esch Manufacturing) and higher seeding rates (600 seeds m<sup>-2</sup>) to improve intra-row and inter-row competition with weeds<sup>56</sup>; and (3) enhanced precision-hoeing (IWMPH), which include high seeding rates (600 seeds m<sup>-2</sup>) on 19-cm row spacing coupled with 2- to 3- inter-row cultivations based on summer annual weed pressure and soil conditions. Inter-row cultivation will be conducted using a Kult Kress narrow-row hoeing system with either camera-based guidance or rear-steering system to facilitate narrow-row cultivation in cereal production (Gerhards et al. 2020).**Objective 2.**A two-year crop sequence experiment will be initiatedon-stationin 2025-2026 and 2026-2027 to generate replication in time at RELARC at the same site asObj 1a. Experiments will be imposed in sequence following a corn silage phase and imposed as a three-factor complete block design with four replications and a split plot treatment structure.The main plot will include two alternative soil management strategies in the soybean phase, including (1) tillage-based and (2) no-tillage soybean sequences using the same field operationsdescribed inObj 1a. Alternative small grain species will be imposed after the soybean sequence at the split-plot level, including fall sown hybrid rye and spring sown oats.To achieve a broader environment by management (E x M) gradient to assess yield stability with use of cultivar

mixtures, we will conduct three on-farm trials each year of the study in unique production regions within Pennsylvania on certified organic grain farms. Species- and cultivar- treatments (2 x 4) used in on-station experiments will be imposed on each cooperating farm using a split-plot treatment structure and three replications in two separate fields that represent different crop entry points and soil-management legacies for fall- and spring-sown cereals within their production region. On-farm trials completed at three locations and two fields per location for two years will result in an additional 12 soil-environments that can be combined with on-station data to assess yield stability. Objective 3. A two-year crop sequence experiment will be initiated on-station in 2025-2026 and 2026-2027 to generate replication in time at the same site as Obj 1a. Experiments will be imposed in sequence following a no-till soybean phase and imposed as a three-factor complete block design with four replications and a split plot treatment structure. The main plot will consist of alternative spring oat crop sequences, including a (1) spring oat monoculture followed by post-harvest seeded buckwheat cover crop (CC); and a (2) spring oat/field pea intercrop phase. Split-plots will consist of three alternative fall sown small grains (FG), including (1) winter wheat, (2) einkorn, and (3) hybrid rye. Split-split plots will include two alternative cover cropping strategies in a winter grain/cover crop/corn sequence, including (1) fall grain monoculture followed by post-harvest seeding a hairy vetch/triticale mixture and (2) relay intercropping medium red clover via frost-seeding into fall-sown grains. Spring oat and fall grain monocultures will use cultural weed management practices (IWM/CWM; Obj 1) Intercropped spring oat/field pea and relay cover cropped fall-sown grains will use 19 cm row spacing at standard seeding rate (300 seeds m<sup>-2</sup>). Objective 4. In Year 3 and 4 of the project, we will develop three co-learning opportunities. At each co-learning event, we will invite participants to populate (1) local grains databases, such as that of the Common Grain Alliance (see letters of support), which serves Mid-Atlantic growers and producers, and (2) national databases maintained by LocalHarvest and the Whole Grains Council. Currently, Pennsylvania is underrepresented on these databases. In the third year of the project, we will leverage each on-farm trial (n = 3; see Obj 2) located across production regions for a co-learning event. We will advertise across Penn State Extension's listservs for field and forage crop producers, the poultry production sector, the food safety sector, and family and consumer sciences. In the third and fourth year of the project, we will organize a winter network meeting that includes organic small grain producers, poultry nutritionists, millers and other stakeholders to develop a common understanding of economic constraints to small grain diversification, which will be facilitated by project personnel and co-PI Cornelisse (Agricultural economist). In Year 4, research results from across focus areas (agronomy, food quality and safety, poultry nutrition) will be co-presented in a webinar series hosted by Penn State Extension to increase the extent of our extension-outreach programs. We will advertise across Penn State Extension, PCO, and Pasa Sustainable Agriculture's listservs. We will gauge the efficacy of our co-learning events by conducting pre- and post- surveys that include questions on whether participants met anyone new to conduct business with, or their likelihood of changing their growing, buying, or processing standards based on their improved understanding of other stakeholders' perspectives.

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# Organic Seed Growers' Conference: a Cross-disciplinary Hybrid Gathering Planting the Seeds of the Future

<b>Contract / Grant No.</b>	2024-51300-43055
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Laurajean Lewis
<b>Performing Institution</b>	Organic Seed Alliance

## NON-TECHNICAL SUMMARY

The Organic Seed Growers Conference is a biennial gathering by and for agroecological seed communities in the U.S. and across the world. The event creates spaces where experienced and emerging seed stewards can convene timely conversations, educational training, and strategy sessions. The gathering serves as a conduit for making new connections and catching up with old friends, networking across organic seed communities, sharing knowledge with other participants, and celebrating the growing movement. Organizers curate a conference agenda that reflects the multifaceted needs of seed growers and advocates, no matter the ease or discomfort of the topics. The goal of the Organic Seed Growers Conference is to inspire individuals, communities, organizations, and businesses to take actions that support and improve the integrity of the philosophical and practical systems that make up the organic seed movement and trade.

## OBJECTIVES

The program of the Organic Seed Growers' Conference addresses the following legislatively prioritized goals through conference workshops, posters, proceedings, facilitated panel discussions, an intellectual property symposia, and field tour: 1. Facilitating the development and improvement of organic agriculture production, breeding, and processing methods; 2. Evaluating the potential economic benefits of organic agricultural production and methods to producers, processors, and rural communities; 4. Identifying marketing and policy constraints on the expansion of organic agriculture; and 8. Developing new and improved seed varieties that are particularly suited for organic agriculture. The long-term goals of this conference are to: 1) increase the production and use of quality organic seed; 2) build and bolster regional and national seed systems and policies to support them; 3) foster the development of organic breeding projects; and 4) facilitate the outreach and dissemination of scientific findings and work specific to organic seed and breeding. The overarching goal of the Organic Seed Growers Conference (OSGC) is to convene diverse stakeholders to build relationships and exchange ideas to foster a national network of thriving regional, national and international seed systems that respond to the needs of organic farmers and the markets they serve. This project advances these goals in timely ways by expanding accessibility and participation in this conference, continuing to build a virtual organic seed network, reporting out on organic research including the 2022 State of Organic Seed Report ([www.stateoforganicseed.org](http://www.stateoforganicseed.org)) and developing collective action to implement the Organic Seed Policy Platform (<https://seedalliance.org/publications/a-policy-platform-for-seed/>). The event will also address timely threats to organic seed integrity, diversity, and farmers' access by hosting a pre-conference symposium on intellectual property to provide resources and facilitate stakeholder input on challenges, needs and future strategies.?

## APPROACH

Conference planning: Conference logistics are managed by OSA's staff. Agenda development will be led by the Conference Planning Committee (4 members from past event for continuity and 4 new members) which represents a diversity of disciplines, sectors, scales, geographies, races, identities, genders, and experience in seed. The Call for Proposals and Input will draw on State of Organic Seed priorities and prior program evaluations. Promotion materials and the Call for Proposals and Input will be translated into Spanish and promoted through Committee networks. Interpretation will be available for a selection of sessions as identified by the Committee. We are working to secure various funding streams through sponsorships, donations, and foundation support. Funding from OREI will offset additional expenses of hybrid hosting, ensure robust

programming and equitable compensation for committee members and translators, and allow us to provide a sliding scale to ensure affordable access for farmers, students and socially disadvantaged participants in need of support. Virtual event network development/optimization: The Organic Seed Commons platform will be used for delivery of the virtual conference. The Commons includes 2,500+ members to date and is accessible both through computers and mobile devices. The conference-specific framework allows us to host live presentations, provides easy access to digital resources from presenters, enables polling and other forms of real-time participant feedback, enables analytic tools, and provides community engagement functionality after the workshops. Community guidelines are in place to ensure safe and constructive attendee engagement on the network. Symposium on intellectual property used on seed: The symposium agenda will be informed by the Call for Proposals and Input, OSA's existing IP toolkit, the State of Organic Seed project, and USDA Agricultural Marketing Service's More and Better Choices for Farmers: Promoting Fair Competition and Innovation in Seeds and Other Agricultural Inputs (2023). It will be developed by a sub-committee composed of IP experts and stakeholders from the public and private sectors and stakeholders engaged in developing alternative models from a diversity of communities and demographics. A report of presentations, resources and strategies identified at Symposium will inform recommendations for organic seed growers, plant breeders, researchers, and policy specialists to navigate and develop alternatives to the current IP regime. Delivery: The dates are set February 26 to March 2nd at Oregon State University, Corvallis, OR. eOrganic staff are on-site providing ease of hosting simultaneous delivery of workshops. All facilitators (online and in-person) will complete a virtual facilitator training session prior to the event and have access to OSA's existing guide of best practices. Spanish interpretation will be available for the IP symposium and all workshops.

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# Osprey: Organic Seed Production Resources on Economics and Yield

<b>Contract / Grant No.</b>	2024-51300-43056
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Jared Zystro
<b>Performing Institution</b>	Organic Seed Alliance

## NON-TECHNICAL SUMMARY

Organic seed production and organic plant breeding are crucial to the integrity and long-term success of organic agriculture. Organic seed producers and seed companies have been very clear: the lack of robust, publicly available seed yield data and production protocols is a barrier to the success of the organic seed industry - and a barrier to the wider availability of adapted, affordable, high-quality organic seed for all organic producers who use seed. The long-term goal of this project is to increase the resilience and success of organic seed production systems. By creating a robust, national collaboration of organic seed researchers and practitioners focused on advancing the field of organic seed production research, this project aims to develop practical tools and resources that the organic seed industry needs to develop, test, produce, distribute and maintain seed of regionally and organically adapted cultivars. To achieve this long-term goal, we are pursuing three objectives within this proposal: 1) Better elucidate the effects of genetics, climate, and management on organic vegetable seed yields through multi-location seed yield trials, seed production management trials, participatory seed research, and the development of a robust vegetable seed yield database. 2) Develop economic decision-making tools for organic seed producers. 3) Expand seed production information exchange for and among organic seed stakeholders.

## OBJECTIVES

The long-term goal of this project is to advance best practices for organic vegetable seed production through a national collaboration of researchers and seed producers. Outcomes will facilitate more regional organic farmers scaling up vegetable seed production, providing expanded availability of organically grown seed to support the profitability, integrity, and sustainability of organic vegetable systems. The long-term goal of increasing the resilience and success of organic seed systems will be achieved by pursuing three objectives within this project: 1) Better understand the impacts of genetics, environment, and management on organic vegetable seed yields through multi-location trials and participatory research. 2) Develop economic decision-making tools for organic seed producers. 3) Expand seed production information exchange for and among organic seed stakeholders.

## APPROACH

Our project adopts a comprehensive approach to tackle the primary challenges in organic seed production, focusing on yield, efficiency, productivity, and economic viability. We prioritize participatory research methodologies, integrating them with formalized trials. This includes historical yield data collection, video interviews with producers, participatory seed yield trials, and regional outreach programs such as field days and summits. Objective 1: Organic Seed Yield Research Activity 1.1: Multi-location Vegetable Seed Yield Trials Coordinated by OSA and partners, trials will occur at several research farms across the US, including OSA, Oregon State, Colorado State, University of Vermont, Cornell, and Carolina Farm Stewardship Association. The trials will focus on a Core Crop Set of twelve model crops: tomatoes, lettuce, cucurbits, and brassicas, selected based on their prevalence, value, and the percentage of organic seed use among producers. These trials will utilize a replicated complete block design with four replicates at each site, conducted over three growing seasons to provide comprehensive yield data. Plant spacing and density will follow the specifications outlined in Table 2, with adjustments made based on local climate conditions, recorded via on-site weather stations. Activity 1.2: Seed Yield Management Trials In the first year, trials at four locations will explore different planting densities for

Brassicaceae and Lactuca, using a Randomized Complete Block Design (RCBD) to compare three spacing levels. Additionally, irrigation management trials in Oregon and California will test three irrigation levels to determine optimal watering rates for seed production based on local evapotranspiration rates. Activity 1.3: Participatory Seed Yield Trials Starting in Spring 2025, these trials will be facilitated through the SeedLinked platform, encouraging large-scale grower participation. Growers will document their methods and results via the platform, contributing to a robust dataset that will be analyzed and presented at industry conferences. Activity 1.4: Historical Seed Yield Data Collection This activity will combine a thorough literature review with direct data collection from producers and seed companies. A digital database will be created to standardize and synthesize the collected data, with a focus on identifying and documenting yield-affecting factors. Objective 2: Organic Seed Economics Research Activity 2.1: Seed Enterprise Budgets Highland Economics will develop enterprise budgets for vegetable seed crops to provide a detailed financial analysis of seed production costs and revenues, helping to reduce economic uncertainties for producers. Activity 2.2: Seed Breakeven Price Tool This tool will calculate the breakeven price for various seed crops based on data from the enterprise budgets, allowing producers to assess the profitability of different seed varieties. Objective 3: Seed Production Education, Outreach, and Information Exchange Activity 3.1: Seed Cleaning Guide OSA will compile and publish a comprehensive guide on seed cleaning techniques, supported by surveys, interviews, and literature reviews. Activity 3.2: Seed Equipment Guide This guide will detail the available technologies for seed cleaning and processing, providing valuable information to seed producers and companies. Activity 3.3: Seed Disease Guide Through surveys, field trials, and laboratory studies, we will develop a guide on managing seedborne diseases, focusing on organic management practices. Activity 3.4 to 3.8: Outreach and Education Programs These activities will include regional seed summits, on-farm field days, a series of webinars, and various presentations at national conferences. These events will facilitate knowledge exchange and showcase research findings from the project. By integrating research with practical applications and engaging directly with producers, our project aims to significantly advance organic seed production practices, ultimately contributing to the sustainability and profitability of the organic seed industry.

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# Breeding Biofortified Organic Chickpeas as a Winter Cash Crop for Southeastern States

<b>Contract / Grant No.</b>	2024-51300-43057
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Dil Thavarajah
<b>Performing Institution</b>	Clemson University.

## NON-TECHNICAL SUMMARY

Chickpea (*Cicer arietinum* L.) is a versatile, climate-resilient, and salt-tolerant pulse crop that will become an excellent new winter cash crop for southeastern organic producers. Pulses provide soil health and nitrogen benefits to cropping systems and are a significant source of plant-based protein. Chickpeas can grow as a winter cash crop in the Southeast, from upstate to the coast, replacing acreage left fallow or planted with cover crops. Cultivars bred for conventional production are often unsuitable for organic production, and organically grown pulse crops have lower protein, making organic pulse proteins more expensive. Increasing crop production costs and decreasing commodity prices mean organic growers are exploring new crop options. Our long-term goal is to develop short-season chickpea cultivars for organic production with higher protein quality and superior milling properties, sensory qualities, and adaptability to organic rice/vegetable systems. This project is built on OREI, Good Food Institute (GFI), and SC Department of Agriculture-funded projects to establish a breeding pipeline for the public release of protein-biofortified organic chickpea cultivars for southeastern states. Project objectives are to (1) develop protein-enriched organic chickpea varieties using on-farm field trails (participatory breeding), (2) combine genomic information and trait discovery to enable the best genotype-to-phenotype mapping, and (3) develop on-farm educational and extension activities using the "Going Organic" platform. This project is aligned with the OREI goals to (1) develop and improve organic agriculture production, breeding, and processing methods; (2) determine desirable traits; (3) on-farm research; and (4) develop new and improved seed varieties for organic agriculture.

## OBJECTIVES

Long-term goal: To develop biofortified winter chickpea cultivars suitable for organic adaptation with high protein quality, good digestibility, improved flavor, and acceptable milling quality. Key objectives: Develop an organic breeding pipeline for chickpea varieties using on-farm field selection and participatory breeding to: (i) increase agronomic adaptation toward sustainable organic farming systems, (ii) improve nutritional quality (protein, SAA) balance, protein digestibility, starch, RS, flavor, and milling quality), and (iii) initiate an Accelerated Seed Delivery System (ASDS) with regional industry and state partners. Develop a genomic prediction pipeline for combining genomic information and trait mapping to enable the best genotype-to-phenotype mapping for trait discovery. Develop on-farm educational and extension activities using the Clemson University (CU) "Going Organic" platform, industry partners, eOrganic resources, consumers, and classroom courses for graduate and undergraduate students.

## APPROACH

On-farm field design and selection: In years 1 and 2, the ~50 chickpea cultivars and advanced breeding lines will be planted in a complete  $\alpha$ -lattice field design with commercial checks with three replicates at three on-farm locations in SC (n=450). Each incomplete block will be augmented with Sierra (check cultivar) at random positions to reduce spatial variability. These cultivars will also be blocked based on days to maturity to avoid known phenological variation. Before sowing, soil samples will be randomly taken at 0-15 cm depth to track soil N and other nutrient levels. Cultivars will be sown in 1.2 m  $\times$  6 m plots at a rate of 60-70 seeds/m<sup>2</sup> and a seeding depth of 5-7 cm. Each plot will contain four rows spaced 30 cm apart. On-farm growers will participate in participatory selections. We will invite interested growers to the field and record their responses related to cultivar performance, suitability to their farms, and seed quality, and then will rank these cultivars based on their

preference for inclusion in the breeding program. FT-MIR phenome platform: Single seeds will be analyzed for protein, SAA, RS, total starch, fats, and moisture content using FT-MIR. Breeding Pipeline: The breeding pipeline includes agronomic and nutritional trait discovery, population improvement, product development, introgression effects, seed commercialization, and dissemination. A market segment analysis for biofortified chickpeas will focus on the product traits valued by farmers and consumers. The breeding scheme consists of crossing, evaluation, and selection (CES) tasks and decisions for each trait across breeding stages. Genomic pipeline: We will generate and utilize genomic resources in four stages: 1) developing reproducible computational workflows that enable robust quality control of genomic and phenomic data; 2) applying GWAS to identify large-effect, environment-specific, and pleiotropic loci in chickpea diversity panel; 3) utilizing knowledge of associated loci, comparative genomics, and genomic prediction (GP) to identify high-potential crosses for elite breeding populations; and 4) uploading of phenomic and genomic data to Breedbase as a community resource. -----

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# Organic Perennial Grain System: a Research, Education, and Extension Imperative for the Climate Transition Zone

<b>Contract / Grant No.</b>	2024-51300-43091
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Song Cui
<b>Performing Institution</b>	Middle Tennessee State University

## NON-TECHNICAL SUMMARY

This project proposes to increase the sustainability and resilience of perennial grain crop-based organic grain and forage production systems and the value-added sectors in the southern U.S. The project team aim to enhance the adaptation of organic perennial crop production by posing and answering the following questions: How can scientists/producers design and manage organic perennial grain production systems that could provide successful establishment and weed control capacity with adequate productivity, quality, and economic benefits? How can perennial grain crop-based systems contribute to enhanced agroecological function, climate change mitigation and long-term conservation of soil systems? How will new knowledge be delivered to producers, educators, students, and other stakeholders? The southern U.S. is of particular interest because of the importance and critical issues associated with grain/forage production and organic agriculture in local economy in this dramatically changing climate and land use patterns. The project will take advantages of existing research infrastructure and educational/Extension collaboration to complete the following tasks: assess the grain yield, forage productivity, nutritive value, and weed suppression capacity of three perennial grain species vs. corresponding annual species grown organically under four establishment methods incorporating smother cropping and intercropping practices; assess the impacts on soil health and greenhouse gas emission; evaluate the brewing and malting potential and medicinal properties of organically produced perennial grains compared to their annual and conventional counterparts; conduct comprehensive comparative economic analysis of different establishment methods; synergistically integrate knowledge and information gains from all four previous objectives into Extension and education programs.

## OBJECTIVES

The project idea is based on suggestions and input from stakeholder groups who have close relationships with the participating institutions and research groups. Based on feedback from stakeholders, preliminary findings, and collaborative work, the project team identified the following research, Extension, and education questions deemed critical to this project: Research Question 1 (RQ1): How can perennial grain crops be successfully established without using herbicides? Establishing perennial grain crops can be challenging, particularly when managed organically. Even under conventional methods, perennial grain seedlings are slow to establish and can be outcompeted by weeds, even with pre-emergent herbicides. Better strategies are needed to overcome the establishment barrier without relying on chemical inputs. Research Question 2 (RQ2): What are the key ecological benefits of transitioning to perennial grain systems? Most producers in the southern regions are aware of the contribution of organic farming towards enhancing ecological function. However, they have little knowledge about the contribution of perennial systems to soil health enhancement and the profound impacts sustainable farming systems could have on maintaining the values and ethnics of rural community social systems. Research Question 3 (RQ3): How profitable can dual-purpose perennial grain systems be? For organic growers, the major concern is market volatility. As a harvested crop enters the early stage of commercialization, organic producers, particularly newly transitioned growers, face tremendous financial risk. Thus, system analysis of agronomic and economic factors based on multi-year field studies are highly beneficial to both established and newly transitioned growers. Research Question 4 (RQ4): What starch-hydrolytic enzymes, phytochemicals and bioactive constituents are present in organically produced perennial grains and how do they compare to their annual, conventionally produced counterparts? What are their potential applications? No information is available on how the fermentation of organically produced perennial grains compares to that of conventionally grown perennial grains, and whether the grains can be used as sources of malt. Additionally, there is little published data on the phytochemical composition and biological and pharmacological activities of perennial grain species in general.

Likewise, this type of information for organically produced perennial grains is nonexistent. Extension Question 1(XQ1): Where and how can organic producers find information regarding how to initiate and manage organic perennial grain production? By interacting with different stakeholder groups, the team learned that a key component of information delivery is building community and socializing producers in the network. Thus, involving producers and offering them Extension reports, field days, and scientific data are critical for information dissemination. Therefore, stakeholders, Extension agents, and university researchers need to work synergistically to help build sustainable organic cropping systems using perennial grain crops in the southern U.S. region. Extension Question 2(XQ2): How can traditional organic grain and forage/livestock producers be convinced to transition to perennial systems? One of the most important benefits of perennial grain system is its dual-purpose production capacity, which can greatly help alleviate the financial risk associated with organic farming. For example, Kernza® can be grazed/hayed to remove summer straw, which promotes more uniform fall regrowth and maintains or even enhances stand productivity. Thus, obtaining data-based evidence and introducing producers to the great potential and versatility of perennial grain systems is imperative. The following objectives and corresponding research (RQ) Extension (XQ) and education (EQ) questions will be addressed: Assess the grain yield, forage productivity, nutritive value, and weed suppression capacity of three perennial grain species vs. corresponding annual species grown organically under four establishment methods (RQ1, RQ3). Assess the impact of different methods of establishment and perennial grain crop selection on soil health and greenhouse gas emission under organic production (RQ1, RQ2). Assess the brewing and malting potential and medicinal properties of organically produced perennial grains compared to their annual and conventional counterparts (RQ4). Conduct comprehensive comparative economic analysis of different establishment methods and perennial grain crop systems to identify the most profitable organic production approach (RQ3). Synergistically integrate knowledge and information gains from all four previous objectives into Extension and education programs to increase producer awareness and student understanding of organic perennial grain systems (XQ1, XQ2, EQ1).

## APPROACH

A four-year multi-location, multi-climatic, and multi-state organic perennial grain on-farm trials will be implemented by leveraging support from an extensive group of stakeholders in the southern region. Field experiments will be carried out at three different sites. Site 1 (Lascassas, TN), the MTSU Experimental Learning and Research Center, consists of Hillwood gravelly silt loam (thermic Oxyaquic Fraglossudalf). Site 2 (College Station, TX) at a Texas A&M Research Farm consists of Burleson clay (thermic Udic Haplusterts). Site 3 (Princeton, KY) is the University of Kentucky Research and Education Center at Princeton, which consists of Crider silt loam (mesic Typic Paleudalf). Certified organic land is available at both the MTSU and TAMU sites, and the organic certificate of the UK site is expected to be released in the summer of 2024. Treatments are strategically designed based on discussions with TL1 perennial grain experts and involving producers. The field experiment at each site will be a randomized complete block design with four blocks in a factorial arrangement (3 crop types × 2 life history types × 2 weed management strategies). For crop types, we will test 1) cool-season cereal crops, 2) warm-season cereal crops, and 3) oil crops. For life history, we will test perennial grains vs. their annual counterparts, selected as: 1) Kernza® vs. winter wheat (*Triticum aestivum* L.), 2) perennial sorghum vs. pearl millet (*Pennisetum glaucum* L.), and silflower vs. sunflower. For weed management we will test smother crops vs. smother crops plus intercropping low-growing ground cover crops. Particularly for ground cover crops, we will select perennial grass-legume combinations that meet the following requirements: 1) capable of providing low canopy size and uniform ground cover, 2) excellent tolerance against defoliation (in case in-season between-row mowing is required for weed control), and 3) matching the seasonal growth of the perennial grain crops (cool-season ground cover with Kernza® and warm-season with perennial sorghum/silflower). We will evaluate Grain yield, forage productivity, nutritive value, weeds suppression capacity and a suite of soil health indicators change under different treatment methods across all three locations. The project team will evaluate the potential for organically grown perennial grains to be used in brewed and distilled products and will experiment with the use of Koji for saccharification of the grain. Additionally, the brewing/malting potential of Kernza® (fermentable sugar extract, free amino nitrogen, glucan, mash-active enzymes, foam-positive proteins, etc.) will be tested against barley and conventionally produced perennial grains. The economic analysis of this study will focus on 1) determine the costs of different dual-purpose perennial and annual grain systems and identify the profit maximizing system using a partial budget analysis approach for hay or a grain crop operation; 2) develop enterprise budget to estimate the costs and revenue for organic perennial and annual grain production; 3) compare the overall profitability between organic and conventional perennial grain systems and determine the payback interval for organic producers, and 4) conduct a sensitivity analysis on key cost categories that are identified through the fieldwork and evaluate the economic feasibility of incorporating perennial grain crops into existing organic grain and forage production systems under different environments and market conditions. We will leverage participating institutions, collaborating government and non-government organizations, producers, and

organic/transitional farms in the target region to develop and implement this multi-faceted Extension and Education program to disseminate research findings and knowledge. This includes organizing producer outreach events, field days, workshops, and conferences; developing e-learning modules, incorporating research findings and content into undergraduate and graduate curriculum. Project implementation progress, roadblocks, and further actions will be discussed on a biannual basis with the advisory panel. The following metrics will be used to evaluate the level of success (with anticipated number in parenthesis): peer reviewed journal articles (4), conference presentations (7), future grant proposal submissions (3), Extension publications (3), producer contacts (\~1,000), field day events/tours (6), Extension talks/presentations (8), course content revisions/integrations (6), students taught in revised courses (\~300), graduate students trained (2), and education module downloads (\>100). Pre- and post- course/event surveys will be used for evaluating participants' feedback. The project team will work with Dr. Ying Jin at James Madison University for project evaluation. Dr. Jin has extensive experience in program evaluation, quantitative analysis, qualitative analysis, research methods, and study design. She will serve as an independent third-party evaluator to ensure that the project's guidelines are being followed by the research team and all stakeholders are involved. To ensure that all project team members are aware of the performance metrics, project initiation meeting will be held to discuss them in the first quarter of the project. This meeting will provide an opportunity for team members to ask questions, provide feedback, and gain a clear understanding of the expectations. Dr. Jin will also participate in quarterly meetings via Microsoft Teams® with the project team to stay informed of the project's progress. She will use both formative and summative assessments for project evaluation throughout the duration of the project. At the end of the project, Dr. Jin will conduct a final assessment by comparing the achieved results to the project targets. This will be included in our annual report to NIFA.

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# Integrative Management of Whiteflies for Organic Cucurbit Production in the Us Southern Region

Contract / Grant No.	2024-51300-43092
Grant Year	2024
Investigator(s)	Xavier Martini
Performing Institution	University of Florida

## NON-TECHNICAL SUMMARY

Research Plan: To develop a nano clay matrix to repel whiteflies, we will conduct behavioral assays to investigate the contact repellency of different nanoclays against whiteflies. These assays will be conducted in arenas, and the behavior of whiteflies in contact of the different clays will be observed with a camera equipped with a macroscopic lens. Repellency of clays mixed with limonene will be measured with a Y-tube olfactometer assays. To evaluate capacity of nanoclay to carry limonene, headspace volatiles will be collected after 24 hrs, 48 hrs, 1 and 2-week post application and analyzed through a GC-MS system. The decrease of limonene emission from clay-treated plants will be assessed by collecting volatiles from squash plants and compared to the decrease of limonene emitted by a squash plant where limonene will be directly applied to. Antifeedant activities of mineral oil and polygodial will be investigated with feeding assays where the solution will be coated on a watermelon leave. Feeding of whitefly will be measured by visual observation and by the number of stylet sheaths revealed through the McBrinde stain coloration. We will test the effect of coloring nano clay by adding edible pigments to the clay matrix and conducting behavioral assay in laboratory. Reflectance of the clay will be measured and correlated to the whitefly response. Evaluation of limonene and clay against the whitefly and beneficial organisms will be assessed in laboratory. Behavioral and toxicology assay will be conducted to ensure that natural enemies are not disrupted using kaolin and limonene or other essential oils. Field trials will be conducted to assess the combination of nano clay, colored pigment, limonene and antifeedant. There will be four replicates per treatment. The field trial will consist of 8 treatments: 1) untreated control, 2) M-Pede (positive control), 3) kaolin clay + limonene, 3) kaolin clay+ limonene + colored dye, 4) kaolin clay + limonene + antifeedant, 6) kaolin clay + limonene + antifeedant + colored dye, 7) alternative clay + limonene, 8) alternative clay + limonene + antifeedant. The effects of reflective and live mulch will be evaluated during two field trials on squash. The various treatments will be white plastic mulch, reflective plastic mulch, live mulch 1-buckwheat, and live mulch 3 -hairy vetch. Efficacy of row cover will be evaluated during field trials. The following treatments will be evaluated, 1) Season-long row cover with introduction of bumblebees at start of flowering; 2) Season-long row cover but the ends open at start of flowering to enable pollinators access and close the ends 10 days later; 3) Complete removal of row cover at start of flowering; and 4) No row covers (control). We will evaluate the combination of row cover and UV-reflective mulches in field trials. Treatments of row cover, reflective mulch, and OMRI-approved organic insecticides in watermelon or squash crops will be evaluated against the natural populations of whiteflies, predators, and parasitoids. Augmentation biological control in combination with cover crop will be evaluated during a field trial. Cover crops will be planted in spring and fall. The winter cover crop will be cereal rye (*Secale cereale* L.) and the summer cover crop will be sunn hemp (*Crotalaria juncea* L.). The experimental design will be a split plot design, with presence or absence of a cover crop as the main effect and the post-cover crop treatment type as the sub effect. Three post-cover crop treatments will be applied to relevant plots. These treatments are 1) no additional treatment (control), 2) intercropping squash with sweet alyssum, and 3) releases of predatory mite *Amblyseius swirskii*. Each of this technics will be evaluated for their economic sustainability. We will develop detailed regional enterprise budgets using the different alternative production practices investigate in the proposal (mulch, row cover, nanoclay and repellents, augmentative biological control method), and compare them to current organic production practices. Outreach plan: Growers will be engaged from the beginning of the project. Representatives from the main commodity groups affected by whiteflies will be invited to participate in the bi-monthly Zoom calls and annual workshops. Having growers participate in the workshops will ensure that we have identified the key issues relative to organic pest management and that the methods to be developed can be applied in the field and are economically sound. At each workshop, a printed abstract of the presentations will be given to participants, and growers will be informed through the workshop about the current information regarding whitefly management in horticultural crops. Growers will also be able to interact with the different participants, including industry representatives, to help them understand organic pest

management. Also, a website will be created to include the current recommendations for organic pest management in horticultural crops. This project will be the first step to developing federal-funded research on organic pest management of whiteflies and aphids in horticultural crops.

## OBJECTIVES

1) Organic management of whitefly and their associated viruses with nanoclay mixed with essential oils.2) Evaluation of cultural practices (mulches and row cover) to manage whitefly and whitefly-transmitted viruses in organic cucurbits' production.3) Augmentative biological control and conservation, increase early augmentation of natural enemies. Cover crops may increase the natural enemies, using clover to increase.4) Evaluating the economic sustainability of the newly developed methods compared to traditional whitefly management methods.

## APPROACH

Research plan: To develop a nano clay matrix to repel whiteflies, we will conduct behavioral assays to investigate the contact repellency of different nanoclays against whiteflies. These assays will be conducted in arenas, and the behavior of whiteflies in contact of the different clays will be observed with a camera equipped with a macroscopic lens. Repellency of clays mixed with limonene will be measured with a Y-tube olfactometer assays. To evaluate capacity of nanoclay to carry limonene, headspace volatiles will be collected after 24 hrs, 48 hrs, 1 and 2-week post application and analyzed through a GC-MS system. The decrease of limonene emission from clay-treated plants will be assessed by collecting volatiles from squash plants and compared to the decrease of limonene emitted by a squash plant where limonene will be directly applied to. Antifeedant activities of mineral oil and polygodial will be investigated with feeding assays where the solution will be coated on a watermelon leave. Feeding of whitefly will be measured by visual observation and by the number of stylet sheaths revealed through the McBrinde stain coloration. We will test the effect of coloring nano clay by adding edible pigments to the clay matrix and conducting behavioral assay in laboratory. Reflectance of the clay will be measured and correlated to the whitefly response. Evaluation of limonene and clay against the whitefly and beneficial organisms will be assessed in laboratory. Behavioral and toxicology assay will be conducted to ensure that natural enemies are not disrupted using kaolin and limonene or other essential oils. Field trials will be conducted to assess the combination of nano clay, colored pigment, limonene and antifeedant. There will be four replicates per treatment. 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We will evaluate the combination of row cover and UV-reflective mulches in field trials. Treatments of row cover, reflective mulch, and OMRI-approved organic insecticides in watermelon or squash crops will be evaluated against the natural populations of whiteflies, predators, and parasitoids. Augmentation biological control in combination with cover crop will be evaluated during a field trial. Cover crops will be planted in spring and fall. The winter cover crop will be cereal rye (*Secale cereale* L.) and the summer cover crop will be sunn hemp (*Crotalaria juncea* L.). The experimental design will be a split plot design, with presence or absence of a cover crop as the main effect and the post-cover crop treatment type as the sub effect. Three post-cover crop treatments will be applied to relevant plots. These treatments are 1) no additional treatment (control), 2) intercropping squash with sweet alyssum, and 3) releases of predatory mite *Amblyseius swirskii*. 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management in horticultural crops. This project will be the first step to developing federal-funded research on organic pest management of whiteflies and aphids in horticultural crops. -----  
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# Advancing Organic Agriculture in the Mid-south II: Refining Solutions for Essential Challenges

<b>Contract / Grant No.</b>	2024-51300-43093
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Joseph Schafer
<b>Performing Institution</b>	Winrock International Institute for Agricultural

## NON-TECHNICAL SUMMARY

Despite the overall rapid increase in organic crop production (OCP) in the U.S., the Mid-South region has seen minimal growth in organic acreage and production. The primary reason is the lack of geographically specific production and management strategies for farmers to use. The most significant barriers to organic production include perceived complexity concerning crop management, organic certification, and pest control issues. Of these, weed control has proven the most difficult to overcome, primarily due to the extended seasons, warmer temperatures, high humidity, and diversity of pests. Despite these barriers, relevant organic production research and subsequent information remain very limited. Farmers have justifiable concerns about organic systems when they have few control options. Geographically relevant research and outreach efforts are necessary to address these problems and make OCP more feasible for producers in this region. This project addresses these issues by 1) conducting a replicated, controlled field trials on organic crop production systems; 2) conducting economic research and analyses on organic production systems; and 3) enhancing understanding of organic production through education and outreach activities. This project addresses specific barriers identified in current work and will address the OREI goals of developing organic production methods, evaluating benefits to producers and communities, conducting advanced on-farm research, and examining optimal outcomes of organic production. This project will generate important information to address the most pressing concerns related to organic crop production management in the Mid-South. The project will benefit farmers who are considering or transitioning to organics as well as those who are certified, by answering weed control and economic viability questions. Outcomes will be practical management guidance to address weed control, cover crop use, and tillage systems shared among farmers and agricultural institutions. The stakeholders of this project effort are farmers in the Mid-South region of the U.S.A., and people in the agriculture community in general, who have an interest in organic agricultural crop production. They lack consistent and reliable research data to address geographically prominent organic crop production issues (e.g., pest management, soil fertility, crop rotations) that provide significant barriers to growth in regional organic crop production. Lack of information hinders farmers' transition to organic production as evidenced by the comparatively small number of organic farms and acres in the Mid-South. The long-term goal of this project is to make organic farming a more economic and viable option for Mid-South farmers by generating and disseminating regionally relevant research that addresses these significant concerns.

## OBJECTIVES

The long-term goal of this proposed OREI follow-on project is to make organic farming a viable option for Mid-South farmers through development of regionally tailored management strategies and subsequent dissemination of these research findings to the farming community. High-quality research-based information will be collected and shared, demonstrating practical application of organic management production in the Mid-South region, through the following objectives:

- Objective 1: Conduct replicated research trials on organic production systems. The research plan uses a combination of cover crop types, tillage, crop rotation, tailored weed control methods, and planting differentials. Two weed management systems studies will be conducted - one under conservation tillage (Study 1) and the other under conventional tillage (Study 2). All plots will be under lateral move, sprinkler irrigation systems. We will integrate various weed control tools including mixed grass-legume cover crops, cover crop termination method, soybean planting method, supplemental weed control tools (organic herbicide, flame weeding, hoe-weeding), and tillage (no-till, strip till, conventional till). The selected crop rotations will serve as model rotations focused on evaluation of proposed management systems with the variables as outlined, rather than strictly crop selection and rotation comparisons. Study 1. Integrated weed management programs for organic

row crop production under a conservation tillage system with irrigation. The conservation tillage study will be comprised of 10 weed management programs. The programs will be established in a randomized complete block design with four replications. Data will be collected from the two middle rows such that each pair of data rows are separated by four border rows. The location of each plot will remain the same across years.

### 1.2 Study 2.

Integrated weed management programs for organic row crop production under a conventional tillage system with irrigation. The conventional tillage study will be comprised of 10 weed management programs. These programs represent various combinations of weed management tools as in Study 1. A cereal rye plus crimson clover cover crop will be used for Programs 1 to 5. The cover crop will be terminated by flail mowing then discing and rototilling, to prepare a smooth seedbed. Programs 6 and 7 will be planted with winter wheat double cropped with soybean in year 1, cereal rye plus crimson clover cover crop in year 2 and revert to double cropping wheat and soybean in year 3. Programs 8 to 10 will not have cover crops.

### 1.3 Data to be collected for Studies 1 and 2.

Data will be collected on: Cover crop biomass and weed biomass. Soil nutrient analysis. Nitrogen production from crimson clover. Crop density. Estimate of the viable weed seedbank. Weed density. Weed control and crop injury (percent) from organic herbicide. Overall weed cover. Insect infestation will be monitored for all crop rotations. Diseases will be monitored by scouting plots beginning at emergence, and throughout the season. Yield estimates for commodity soybean and corn. Yield of edamame soybean will be estimated. Cost of all inputs, including the number of man-hours for hoe-weeding, will be recorded and submitted as part of Objective 2.

### 1.4 Data analyses for Studies 1 and 2.

Data will be analyzed as a randomized complete block, one factor design using PROC GLIMMIX in SAS. The response variables are listed under data to be collected. Fixed effect will be the weed management program and block will be the random effect. Weed composition and cover and pest pressure will be analyzed as a repeated measure. In general, data will be analyzed by year since data in succeeding years will potentially have carryover effect from the management system of the previous year.

## Objective 2: Conduct economic research and analysis on the organic production systems.

Determining how economically viable an organic enterprise can be will provide crucial information to farmers considering organic production. The gap in understanding is how cost-effective, or profitable, organic enterprises are as compared to conventional enterprises and systems.

### 2.1 Economic evaluation.

A partial budgeting approach - wherein revenue and cost differences across production systems are tracked - will be used to determine the most profitable system. Sensitivity analysis will be conducted to assess the price premium needed to break even or, alternatively, what yields are needed to break even given available organic price premiums. Since systems are evaluated over the course of three production years, we plan to use net present value analysis and game theory approaches for identifying optimal production systems that will identify and analyze production systems from a dual perspective of maximizing profit and minimizing risk.

### 2.2 Economic analysis of farm-scale trials.

As part of the overall objective regarding the on-farm research demonstrations, economic analyses will be conducted. Farm-scale trials will be used to obtain estimates of profitability of a subset of production practices evaluated at the research scale. This will assist with observing how transferable research results are in comparison to farm-scale trials. Profitability assessment will require collection of data to determine revenue and expenses. Equipment use, time, and fuel as well as all applied inputs will be tracked. Sensitivity analyses will be performed, again, to determine breakeven yield and price as with the research trials.

### 3. Objective 3: Enhance understanding of organic production through education and outreach activities.

The primary audience for this effort will be farmers, but other people in the agricultural industry may benefit from and help convey the information, such as Extension Agents, state departments of agriculture, commodity groups, or market outlets, among others. Outreach deliverables include implementation of demonstration sites, the number of public events held, information disseminated, and media postings.

### 3.1 Farm-scale Demonstration Sites.

Demonstration sites will be located at the University of Missouri Southwest Research, Extension and Education Center near Mount Vernon, Missouri, and another at Agricenter International near Memphis, Tennessee. These sites will replicate, at field-scale, research approaches being evaluated in Objective 1. By placing these sites in the Mid-South region but some distance from the research site, they will further substantiate the research outcomes and provide data, especially for economic analyses, that address regional production challenges.

### 3.2 Field Days and Workshops.

Field days and workshops are valuable tools to share information generated in the project, and they will be scheduled at optimal times during the project period. Through these events, farmers and people in the agricultural industry will have direct access to project information, view the practices being tested in a real-world environment, and interact with researchers and project staff.

### 3.3 Disseminating Information.

This activity will be done through contemporary forms of communication. Sharing information with cooperating institutions. The project will distribute findings to university Extension Services, USDA agency offices, farmer cooperatives and groups, local and state organic associations, commodity groups, agricultural advocacy groups, state departments of agriculture, research universities, USDA ARS facilities and other agriculture-related agencies. Digital outreach. Communication methods using various platforms (e.g., social media, websites, e-mail, tools) will be used for modern information exchange among farmers.

## APPROACH

The 48-month project will consist of replicated, small-plot research on organic production systems, research on economic performance of these systems, and education and outreach to increase understanding of organic production in the Mid-South. The expected results of the project will contribute to long-term profitability and sustainability of organic agriculture by increasing the likelihood of farmers adopting organic practices in the Mid-South, a region under-represented in organic farming activity within the United States, and with unique challenges for organic production. Specifically, Objective 1 (research on production systems) will address the largest barrier to organic production in the region - weed management. By researching and determining optimal weed control practices specific to the region, farmers will be prepared to adopt tested, successful practices on their farms and avoid costly yield reductions or crop failures while transitioning to organics. Likewise, Objective 2 (research on the economics of the tested practices) will inform farmers of how likely various practices and rotations are to be profitable in a certified organic enterprise or transition period. This is necessary information for farmers to have before attempting organic production. The activities of Objective 3 (outreach and education) will connect the outcomes of Objectives 1 and 2, alerting farmers and local agricultural industry people to the vital work being done in this project and enhance the broader information environment for organics in the region. Data collection and analysis Research results will be captured (as described in the Data Management Plan) and analyzed to provide optimal application for farm settings in the Mid-South. The information will be organized, structured, and placed in document formats (Word, Excel, PowerPoint) that are accessible, easily read, and understood by farmers and other end-users. Data collection will occur across the project timeline in cooperation with collaborators.

**Objective 1: Conduct replicated research trials on organic production systems.** The research plan uses a combination of cover crop types, tillage, crop rotation, tailored weed control methods, and planting differentials. Two weed management systems studies will be conducted - one under conservation tillage (Study 1) and the other under conventional tillage (Study 2). All plots will be under lateral move, sprinkler irrigation systems. We will integrate various weed control tools including mixed grass-legume cover crops, cover crop termination method, soybean planting method, supplemental weed control tools (organic herbicide, flame weeding, hoe-weeding), and tillage (no-till, strip till, conventional till). The selected crop rotations will serve as model rotations focused on evaluation of proposed management systems with the variables as outlined, rather than strictly crop selection and rotation comparisons.

**Study 1. Integrated weed management programs for organic row crop production under a conservation tillage system with irrigation.** The conservation tillage study will be comprised of 10 weed management programs. The programs will be established in a randomized complete block design with four replications. Data will be collected from the two middle rows such that each pair of data rows are separated by four border rows. The location of each plot will remain the same across years.

**1.2 Study 2. Integrated weed management programs for organic row crop production under a conventional tillage system with irrigation.** The conventional tillage study will be comprised of 10 weed management programs. These programs represent various combinations of weed management tools as in Study 1. A cereal rye plus crimson clover cover crop will be used for Programs 1 to 5. The cover crop will be terminated by flail mowing then discing and rototilling, to prepare a smooth seedbed. Programs 6 and 7 will be planted with winter wheat double cropped with soybean in year 1, cereal rye plus crimson clover cover crop in year 2 and revert to double cropping wheat and soybean in year 3. Programs 8 to 10 will not have cover crops.

**1.3 Data to be collected for Studies 1 and 2.** Data will be collected on: Cover crop biomass and weed biomass; soil nutrient analysis; nitrogen production from crimson clover; crop density; estimate of the viable weed seedbank; weed density; weed control and crop injury (percent) from organic herbicide; overall weed cover; insect infestation will be monitored for all crop rotations; diseases will be monitored by scouting plots beginning at emergence, and throughout the season; yield estimates for commodity soybean corn, and edamame; cost of all inputs, including the number of man-hours for hoe-weeding, will be recorded and submitted as part of Objective 2.

**1.4 Data analyses for Studies 1 and 2.** Data will be analyzed as a randomized complete block, one factor design using PROC GLIMMIX in SAS. The response variables are listed under data to be collected. Fixed effect will be the weed management program and block will be the random effect. Weed composition and cover and pest pressure will be analyzed as a repeated measure.

**Objective 2: Conduct economic research and analysis on the organic production systems.** Determining how economically viable an organic enterprise can be will provide crucial information to farmers considering organic production. The gap in understanding is how cost-effective, or profitable, organic enterprises are as compared to conventional enterprises and systems.

**2.1 Economic evaluation.** A partial budgeting approach - wherein revenue and cost differences across production systems are tracked - will be used to determine the most profitable system.

**2.2 Economic analysis of farm-scale trials.** As part of the overall objective regarding the on-farm research demonstrations, economic analyses will be conducted. Farm-scale trials will be used to obtain estimates of profitability of a subset of production practices evaluated at the research scale.

**3. Objective 3: Enhance understanding of organic production through education and outreach activities.** The primary audience for this effort will be farmers, but other people in the agricultural industry may benefit from and help convey the information, such as Extension Agents, state departments of agriculture, commodity groups, or market outlets, among others.

**3.1 Farm-scale Demonstration Sites.** Demonstration sites will be located at the University of

Missouri Southwest Research, Extension and Education Center near Mount Vernon, Missouri, and another at Agricenter International near Memphis, Tennessee. These sites will replicate, at field-scale, research approaches being evaluated in Objective 1.3.2 Field Days and Workshops. Field days and workshops are valuable tools to share information generated in the project, and they will be scheduled at optimal times during the project period. Through these events, farmers and people in the agricultural industry will have direct access to project information, view the practices being tested in a real-world environment, and interact with researchers and project staff.

**3.3 Disseminating Information.** This activity will be done through contemporary forms of communication. Sharing information with cooperating institutions. The project will distribute findings to university Extension Services, USDA agency offices, farmer cooperatives and groups, local and state organic associations, commodity groups, agricultural advocacy groups, state departments of agriculture, research universities, USDA ARS facilities and other agriculture-related agencies. Digital outreach. Communication methods using various platforms (e.g., social media, websites, e-mail, tools) will be used for modern information exchange among farmers.

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# New Organic Vegetable Approaches (nova): Breaking Marketplace Boundaries

<b>Contract / Grant No.</b>	2024-51300-43144
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Michael Mazourek
<b>Performing Institution</b>	Cornell University

## NON-TECHNICAL SUMMARY

Organic agriculture provides a key path toward sustainable, ecological production of delicious, nutritious food. Consumers that purchase organic vegetables are often motivated by the desire for nutritious, flavorful, and pesticide-free food for themselves, as well as by the environmentally-friendly farming practices that their food dollars support. We present an efficient approach to deliver on these expectations, using wide, natural, cross-pollinations between vegetable types to create cultivars distinct from commodity crops. By defying existing market classes, breeding becomes faster and easier, and does not limit genetic diversity. As we have demonstrated previously, working with early adopters like chefs and foodies provides a marketing platform to introduce novel cultivars in a way that subsequently appeals to more traditional consumers. The result of this approach delivers on organic consumer expectations in an accelerated pipeline. We call this NOVA: New Approaches for Organic Vegetables. NOVA brings together a team with expertise in breeding, extension, sensory-consumer preference science, culinary vegetable promotion and marketing, economics, nutrition, and climate-adaptive production systems. Our innovation targets three common crop groups grown by most organic vegetable farmers--brassicac (kale, collards, cabbage and broccoli) cucurbits (melons and bitter melon) and peppers. We will deliver these new exciting cultivars through a systems approach, where we assess crops through our team's broad array of disciplines. For a greater impact beyond these three crop types, we will develop, analyze and publicize our approach as a model for others to follow in other crops.

## OBJECTIVES

Obj 1: Creation and Evaluation of New Vegetables. 1a. Plant Breeding to Create New Vegetables. In the NOVA system, we will use existing cultivars from different market classes that have suites of traits, expeditiously combine them in one cross and select lines leading toward a distinctive, productive combination of traits. Co-PI Griffiths will target and combine distinct brassica market classes within leafy, cabbage and broccoli types. PD Mazourek will create cross combinations within diverse melon, gourd and pepper species. 1b. On-Farm Evaluation of Breeding Materials. Sharing parental lines and breeding selections with collaborating farms provides a critical opportunity for feedback and engagement. Seed shared with research farms will be focused on quantitative data to inform the science of plant improvement in objectives climate forecasting (Obj 2), sensory analysis (Obj 4) and economic analysis (Obj 6). Seed shared with growers will allow more experiential engagement. Testing new materials on farms provides a forum for feedback on production and marketing that is essential for cultivar adoption. Participatory plant breeding elicits feedback on attributes growers wish were changed in future iterations. Rather than agronomic data from the farm, grower feedback data will inform Marketing (Obj 5) and Economics (Obj 6). Obj 2: Climate Smart Trials to Predict Future Productivity. The goal of this objective is to identify and develop best management practices associated with climate change for new brassica, cucurbit and pepper crops compared with typical commodities. Thus, we will use crop modeling techniques to select smart climate genotypes according to regions within the U.S. Production based trials and annual regional trials duplicated in Auburn, AL (co-PI da Silva) will serve as the source for data collection on crop development (i.e., biomass accumulation, leaf area index, and yield), which will be used in the identification of smart climate genotypes using the SIMPLE model. The SIMPLE model is a simple dynamic crop model that simulates crop growth, development, and yield using daily time steps based on weather information (daily temperature, rainfall, and solar radiation). Consequently, it will allow the research team to utilize all field data to assess how varying weather conditions in different regions affect all the crops evaluated within organic production systems. Obj 3: Assessment of Nutrients, Aroma and Flavor Active Metabolites. 3a. Quantification of Metabolites. Food sensory quality reflects the food matrix factors of taste, aroma, and texture. These attributes are

derived from food macro and micro molecules and their combinations resulting from processing (acidity, heat, air, and light). For this project, metabolites relevant to human nutrition, aroma and flavor metabolites will be quantified in Brassica, cucurbit and pepper crops. Our target metabolites include: aroma volatiles, bitter saponins, spicy glucosinolates and capsaicinoids, carotenoids and vitamin C.

**3b. Metabolite Levels Correlation with Sensory Data**We will explore correlations between extensive metabolite data generated in this objective with sensory data from Obj. 4 and climate smart trial conditions (Obj 2). This will contribute to a foundation for breeding for flavor through metabolite measurements, and eventual molecular marker predictions, which is more efficient than sensory panels, and more replicable than lone breeder tasting. Similarly, we can explore climate smart trial data impacts more deeply than agronomic impact and delve into quality impacts.

**Obj 4: Sensory Studies to Determine Consumer Preferences and their Drivers**Our testing design will incorporate both descriptive analyses of samples, to categorize their aroma, flavor and texture properties, and consumer analysis of the same samples to determine their sensory appeal. Following this, projective mapping of samples will combine these large data sets to determine the optimal sensory properties of each vegetable category for maximal consumer appeal.

**Obj 5 Marketing and Outreach for Rapid Adoption of New Vegetables**

**5a. Regional Marketing Teams**In order to support and drive these new vegetable markets, this project will create and build partnerships with regional farmers, distributors, retailers, farmers market organizations, value-added producers, restaurants and other stakeholders to communicate awareness and understanding. Marketing teams will be formed in three regions including the Pacific Northwest, Northeast, and Southeast.

**5b. Plug and Play Marketing Resources**In this project, we will create materials that farmers can use on social media, at farmers markets, in Exploration Boxes, in newsletters, etc. We will also work with wholesale distributors, i.e. Organically Grown Company, to develop materials for retailers and restaurant engagement. Content and materials may include: (1) Explanation of NOVA project and the resulting new vegetables; (2) History and background of parents and how they are being improved; (3) Explanation of breeding objectives and farmer needs; (4) Photos of parents, progeny and selections; (5) Video of breeder/grower/chef showing process and explaining why and the benefits; (6) Recipes (later developed by participating chefs); (7) Photos of dishes from recipes developed by collaborating culinary professionals. Everything will be available for free usage and promoted by project partners.

**5c. Consumer Engagement and Public Outreach Events**Co-PI Selman will incorporate NOVA into events such as the Sagra and Variety Showcase events she organizes and specifically organize restaurant popup dinners as well as garden transplant and exploration box distributions.

**5d. Social Media Campaign and Popular Culture Media**Co-PI Selman will conduct an instagram campaign and work with journalists to get project articles and recipes into popular media magazines, newspapers, and podcasts.

**Obj 6: Economic Analysis of NOVA Production Including Profitability, Marketing, and Consumer Preferences**To address changes in production from NOVA crops we will a) assess the current and future benefits of reduced water needs and pest control measures and b) construct cost of production budgets to illustrate profitability. Additionally, it is necessary to develop an understanding of consumer preferences for these crops, including c) calculating their willingness-to-pay (WTP) and d) evaluating the impact of marketing methods.

## APPROACH

**Objectives and Approach**

**Obj 1: Creation and Evaluation of New Vegetables.**

**1a. Plant Breeding to Create New Vegetables.** In the NOVA system, we will use existing cultivars from different market classes that have suites of traits, expeditiously combine them in one cross and select lines leading toward a distinctive, productive combination of traits. Co-PI Griffiths will target and combine distinct brassica market classes within leafy, cabbage and broccoli types. PD Mazourek will create cross combinations within diverse melon, gourd and pepper species.

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# Management of Organic Dairy Youngstock (moody): a Network to Improve Long-term Sustainability of Organic Dairy Farms Through Improved Youngstock Management

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<b>Contract / Grant No.</b>	2024-51300-43145
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Noelle Noyes
<b>Performing Institution</b>	University of Minnesota

## NON-TECHNICAL SUMMARY

The goal of this project is to support long-term sustainability of organic dairies through improved young cow ("youngstock") liveability and performance. Three objectives support this goal: 1) Optimize youngstock management on organic dairy farms; 2) Identify on-farm source(s) and route(s) of *Staphylococcus aureus* intramammary infections in organic youngstock; and 3) Provide organic dairy educational materials to U.S. veterinary students. To accomplish these objectives, we assembled a national team spanning the Midwest, Northeast, Mountain West, Pacific Northwest and Southwest; with experts in youngstock health and welfare; organic dairy production; mastitis epidemiology; national farm surveys; and dairy education. The project is guided by an Advisory Board including major stakeholders in organic dairy production. Integrated project activities include national surveys of youngstock management practices; comprehensive on-farm youngstock health assessments; and multi-year data collection to document long-term outcomes that directly impact farm profitability. Innovative statistical and molecular methods will be used to analyze these information-rich datasets to find relationships between on-farm practices, youngstock health and performance, and profit-bearing outcomes. Findings are brought back to farmers through practical, evidence-based recommendations and support for youngstock management. Project outcomes address a critical need for organic dairy farmers to optimize youngstock outcomes for sustained herd size.

## OBJECTIVES

The long-term goal of this project is to improve the profitability of organic dairy producers through optimal youngstock performance, health and welfare. To achieve this goal, we propose three major objectives, as follows: Objective #1 is to optimize youngstock management on organic dairy farms. To accomplish this, we have 3 sub-objectives: 1a) Establish a network focused on management of organic youngstock ("MOODY"); 1b) Identify management risk factors associated with youngstock health, welfare and performance; and 1c) Provide evidence-based guidance to producers, veterinarians and extension agents to enhance management for optimized youngstock health, welfare and performance. Objective #2 is to identify the on-farm source(s) and route(s) of *S. aureus* intramammary infections in organic youngstock. We accomplish this through an on-farm research campaign that is integrated with the on-farm activities conducted under objective #1. Objective #3 is to provide organic dairy educational materials to U.S. veterinary schools and students. We will do this through two sub-objectives: 3a) Develop and deliver a modular curriculum focused on veterinary-relevant issues related to organic dairy farms; and 3b) Train veterinary and animal science students to conduct on-farm youngstock health assessments specific to organic dairy farms.

## APPROACH

There are several important methods components for Objective #1 activities: The "survey sandwich" method: This term refers to our flipped approach for administering a nationwide survey, and was developed in consultation with key stakeholders. Specifically, our partners reported a notable decrease in survey and research participation by organic dairy farmers over the past 1-2 years. Based on this input, we greatly increased the amount of pre-survey outreach in our approach, leading to the "sandwich method", i.e., pre-survey outreach → survey → post-survey outreach. The pre-survey outreach will significantly increase: 1) farmer participation rates; 2) survey relevance for farmer-drive priorities. Choice of scoping review. The choice of a scoping review (versus a

systematic review) was made because we expect that the scope of available relevant literature may not be large enough to support a formal systematic review. However, if sufficient literature is identified, we will define a question for full systematic review. Use of DAGs and target trials analysis. Causal diagrams (such as DAGs) are increasingly used in epidemiological research to better identify true causal relationships between study variables [21]. DAGs have been shown to improve systematic review and survey usability [22] and generate more accurate results from statistical analyses of applied health datasets, particularly when multiple confounders are present [23, 24]. Target trials are also built on a causal inference framework and can be used to emulate a randomized controlled trial using observational "big data" [18]. We decided to use these methods to maximize the utility of the data being collected, and to generate more useful causal inferences from the datasets. While causal inference has made significant headway in human research, it is relatively novel within livestock research. Longitudinal calf-level follow-up. Individual, serial calf measurements are a major portion of our project budget and effort. We decided to make this investment for several key reasons: 1) provides robust data for causal inference methods; 2) allows us to collect prospective health and outcome data, greatly increasing the accuracy of these key metrics; 3) provides an estimate of variability over time and season. Thus, our investment pays off in terms of accuracy and utility. Objective 2 Methods On-farm samples will be collected from possible *S. aureus* sources, including lactating cows, whole waste milk fed to calves, nurse cows, biting flies, cross-sucking behavior, and skin lesions. All samples will be subjected to culture for *S. aureus* using standard methods and in-depth strain typing of *S. aureus* isolates. To obtain strain-level information, we will extract DNA from cultured isolates and subject the DNA to library preparation and short- and long-read whole-genome sequencing (WGS). Resulting data will be analyzed using the Bactopia pipeline, including use of subworkflows specific to *S. aureus*. We will combine the *S. aureus* prevalence information with the management and health data collected in Objective #1 to identify farm- and animal-level risk factors for *S. aureus*. For strains with high enough prevalence, we will conduct a strain-specific risk factor analysis. We will use the WGS strain-level data to identify likely routes of *S. aureus* transmission to youngstock. Specifically, we will use SNPs as markers for a modified microbial source tracking (MST) analysis, which supports identification of source(s) and sink(s) of specific populations of bacteria (in this case, strains of *S. aureus*), within a defined environment (in this case, the farm). If not enough strain-specific data exist for MST, we will evaluate phylogenetic clustering patterns to identify strains found across youngstock and environmental samples within a farm, indicating a likely transmission route. Objective 3 Methods We will use a four-step process to complete the objective: 1) Information-gathering; 2) Online modules development; 3) Online modules implementation and evaluation; 4) Fine tuning and dissemination. The decision to develop online modules was driven by the realities of dairy education at U.S. institutions of higher education. In essence, individual veterinary or animal science programs are unlikely to possess the requisite students, resources, faculty expertise, or facilities to adequately address the needs of the organic dairy industry on a national scale. Therefore, we decided to pursue a modular online curriculum, which can be an effective education tool for topical areas experiencing faculty shortages; in some cases, such tools even facilitate cross-institutional collaborations.

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# Southeast Organic Agriculture Research Symposium- Identifying Regional Research Priorities

<b>Contract / Grant No.</b>	2024-51300-43165
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Michelle Moreno-Schroeder
<b>Performing Institution</b>	North Carolina State University

## NON-TECHNICAL SUMMARY

While national organic sales and certified acreage is growing, organic production is historically low in the Southeast (SE). SE organic producers face challenges of more intense pest pressures from warmer climates and longer growing seasons, poor soils with fertility and carbon building limitations. A lack of regional research is a critical limitation for SE growers. The goal of this proposal is to bring together regional researchers, farmer organizations and growers in a one-day Southeast Organic Agriculture Research Symposium to identify farmer-focused research priorities. This symposium has two objectives: 1) share current SE organic research together with farmer-identified challenges and 2) identify SE research priorities that increase production, economic returns and improve environmental factors. Research sharing and priority setting will focus on systems-level topics from plant breeding, pest management, soil health, and cover crops. Organized by the Carolina Farm Stewardship (CFSA) and the Center for Environmental Farming Systems (CEFS) at North Carolina State University (NCSU), the symposium will occur in conjunction with the NC Organic Commodity and Livestock Conference (OCLC) providing an opportunity for a large diversity of farmers to hear from research across the Southeast. Symposium participants will be invited to participate in OCLC and the Southeast Organic Agriculture Research Symposium will occur the day afterwards. An outcome of the symposium will be a conference report: Research and Extension Priorities for Advancing Southeast Organic Agriculture Production. Our aim is to increase multidisciplinary and inter-institutional collaborations to support and expand SE organic agriculture and a team ready to address these.

## OBJECTIVES

While national organic sales and certified acreage are growing, organic production is historically low in the Southeast (SE). SE organic producers face challenges of more intense pest pressures from warmer climates and longer growing seasons, poor soils with fertility and soil carbon building limitations. A lack of organic agriculture research targeted for the SE conditions is a critical limitation for regional organic producers. The overall goals of this project are to identify the farmer-focused research and extension priorities to strengthen organic agriculture production in the Southeast (SE) and to develop an interdisciplinary and cross-institutional team ready to address those. We will accomplish this by bringing together multidisciplinary researchers across SE land-grant universities, key farmer support organizations and invited farmers across the region together for a one day Southeast Organic Agriculture Research Symposium. Organized by the Carolina Farm Stewardship (CFSA) and the Center for Environmental Farming Systems (CEFS) at North Carolina State University (NCSU), the symposium will occur in conjunction with the NC Organic Commodity and Livestock Conference (OCLC) providing an opportunity for a large diversity of farmers to hear from research across the Southeast. The objectives of the symposium are to: 1) share current multidisciplinary research focused on organic agriculture in the Southeast (SE), 2) describe barriers to SE organic agriculture production from systems-based approach spanning soil health, pest and fertility management, breeding, climate adaptation and resilience, market access, and certification challenges, 3) identify and prioritize research and extension needs for strengthening and expanding organic production in the Southeast, and 4) disseminate current research and extension priorities for SE organic agriculture with growers, extension agents, farmer organizations and researchers throughout the region

## APPROACH

The Center for Environmental Farming Systems (CEFS) at NC State University together with the Carolina Farm Stewardship Association (CFSA) is proposing to organize a one day Southeast Organic Agriculture Research

Symposium in Raleigh, NC. This forum will be in conjunction with the Organic Commodities and Livestock Conference in March 2025 that brings together hundreds of growers, researchers, extension agents, and stakeholders from across North Carolina and South Carolina each year since 2011. CEFS and CFSA have co-hosted this conference and have many years of experience organizing successful conferences, have staff support to help with meeting and travel logistics as well unique network collaborations to engage diverse organic researchers, farmers, and support organizations. This proposed symposium will provide a unique opportunity for a wider range of regional stakeholders to share their knowledge and experience in organic production challenges and research priorities for the SE. Researchers from diverse disciplines (crop science, entomology, horticulture, plant pathology, soil science, nutrition and food safety, agriculture extension, etc.) at regional universities that are leading organic agriculture research are already engaged as key collaborators and are in strong support (See Support Letters). Moreover, many of the PIs have co-authored the NC Organic Commodity Production Guide (<https://content.ces.ncsu.edu/north-carolina-organic-commodities-production-guide>), a resource for farmers across the region. Key farmer organizations that provide important support for organic agriculture research, extension and education in the region are already engaged in this proposal including Georgia Organics, Florida Organic Growers, and the Clemson Organic Certification Program. These organizations and selected organic growers will provide key guidance on farmer-centered research needs and effective communication strategies for farmers. Key collaborators will meet monthly prior to the symposium to finalize agenda and presentations and organize research briefs that can be shared at the symposium. The breadth of disciplines already engaged as key collaborators ranging from soil health, sustainability, plant breeding, pest management, to support organizations, will generate wide interests among stakeholders. Once funded, we will engage other regional researchers more broadly and announce the symposium through CEFS, CFSA and collaborator websites in fall 2024. It is critical that participants are working in the region to understand the challenges and research priorities unique to the SE. All symposium participants will be invited to attend the Organic Commodities and Livestock Conference (OCLC) on day one in Raleigh, NC and some will be asked to present their research at OCLC to expand grower knowledge of research across the region. Participants will gather for dinner the first day for network building. The symposium will occur on day two located in the new NC State Plant Sciences Building, a state-of-the-art space that has a large auditorium, various breakout rooms and technology for interactive discussions and live broadcasting for participants that cannot be in person. The first half will focus on research presentations that highlight holistic systems-level SE organic challenges. The afternoon will focus on discussions to ensure these groups share their ideas.

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# From Seed to Plate: Improving Produce Safety and Supporting Organic Leafy Green Production Using Natural Biocontrol Strategies

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<b>Contract / Grant No.</b>	2024-51300-43174
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Mary Ann Amalaradjou
<b>Performing Institution</b>	University of Connecticut

## NON-TECHNICAL SUMMARY

Organic crop production is a rapidly growing agricultural sector. However, organic growers face several challenges including the need to maintain integrity of organic produce (microbial safety). Particularly, the lack of defined antimicrobial pre-harvest interventions and limited post-harvest approaches for organic produce. Hence, this multi-regional (AL, CT, HI, MA, NH, PA, RI, TX, VT), multi-institutional, multidisciplinary proposal designed with stakeholder input aims to develop natural, eco-friendly, biocontrol approaches for improving organic leafy green production, focusing on (1) microbial safety and sustaining crop yields, (2) product quality, and (3) consumer perception and cost-benefit analysis. Project results will be disseminated to scientific groups, the community, organic growers, and stakeholders through conferences, workshops, social media, and webinars. Moreover, instructional material will be developed to train the next generation of the workforce in organic production. The program staff consists of a combination of young, mid-career, and senior scientists with expertise in organic crop production, agriculture economics, sensory evaluation, food safety, post-harvest handling, biological controls in food safety, vegetable production extension, produce safety extension and education. Taken together, the proposed integrated research, extension, and education activities will improve the sustainability and viability of organic crop production to meet food security challenges in the US and globally.

**Goals / Objectives** The project aims to develop natural, eco-friendly, biocontrol approaches for improving organic leafy green production, focusing on (1) microbial safety and sustaining crop yields, (2) product quality, and (3) consumer perception and cost-benefit analysis. Project results will be disseminated to scientific groups, the community, organic growers, and stakeholders through conferences, workshops, social media, and webinars. Moreover, instructional material will be developed to train the next generation of the workforce in organic production. Project Methods Given the need to reduce barriers to the production of safe and quality organic leafy greens, our goal is to develop natural, feasible, cost-effective, eco- and organic-friendly strategies that promote produce safety while supporting crop production. Further, we will address the need for technical assistance via the development of educational and training resources for organic production that caters to the diverse organic practitioner demographics. Our project is geared to successfully integrate biocontrol solutions into leafy green operations to build quality, safety, and economic stability, while reducing off-farm input and enhance diversity; (OREI Priority 1) Develop and demonstrate educational tools for Cooperative Extension personnel and other professionals who advise producers on organic practices, (OREI Priority 2) Evaluate, develop, and improve allowable post-harvest handling, and food safety practices to reduce microbial contamination, while increasing shelf-life, quality, and other economically important characteristics, (OREI Priority 3) Develop undergraduate curriculum for organic agriculture including instructional delivery programs and experiential learning for students, (OREI Priority 8). The specific objectives of the project are: Pre-harvest control of Salmonella and E. coli O157 populations on lettuce and spinach using probiotics as a pre-germination soak and canopy spray. Post-harvest control of Salmonella and E. coli O157 populations on lettuce and spinach using essential oil emulsions as a dip and electrostatic spray wash. Quality and consumer acceptability of produce washed with essential oil emulsions as a dip and electrostatic spray wash. Evaluating the effect of probiotic application on germination, produce yield and quality at harvest. Economic analysis of incorporating biocontrols in leafy green production systems and comparison with existing practices while tracking farmer perceptions. Stakeholder engagement and dissemination of results. Advance workforce development through creation of educational materials. Formative and summative evaluation of the project. We plan to involve growers at each stage of the process, obtain input and feedback from the stakeholder advisory committee and communicate our results through comprehensive outreach and education plans. Progress 09/01/24 to 08/31/25 Outputs Target Audience: Nothing Reported Changes/Problems: Project start was delayed due to difficulties with sub-award set up. However, the project has

been initiated and we plan on moving forward with our objectives as presented in the project. What opportunities for training and professional development has the project provided? Students were trained in probiotic culture, development of lyophilization protocols, survival studies and in plant growth How have the results been disseminated to communities of interest? Nothing Reported What do you plan to do during the next reporting period to accomplish the goals? In the next reporting period, we plan to perform produce safety experiments in the laboratory set up. Also, we will work with our collaborators to help initiate the extension and outreach activities as outlined in the project. Further, we expect to develop the lyophilized product that can be shared with our collaborators to perform the field studies. Impacts What was accomplished under these goals? During this reporting period, experiments were run to characterize and establish protocol to lyophilize the probiotic cultures to develop easy delivery mechanisms. In addition, experiments are currently underway to establish protocols to grow different spinach varieties in a laboratory set up. Publications

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# Sustainable Organic Citrus Production Using Improved Agroecological Management Strategies

<b>Contract / Grant No.</b>	2024-51300-43188
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	David Kadyampakeni
<b>Performing Institution</b>	University of Florida

## NON-TECHNICAL SUMMARY

The long-term goal of the project is to improve organic citrus production and sustainability through improved soil health, horticultural and pest management practices, and fruit yield. The critical needs for optimizing the efficiency of organic citrus production, include manipulation of horticultural practices, minimizing inputs while efficiently increasing fruit yields and productivity, pest and disease management, and better physiological responses of citrus trees. The project addresses two of the eight legislatively defined goals: 1) conducting advanced on-farm research and development that emphasizes observation of, experimentation with, and innovation for working organic farms, including research relating to production; and 2) examining optimal conservation, soil health, and environmental outcomes relating to organically produced agricultural products. As described in our methods, improving soil health through the use of cover crops and soil amendments in on-farm experiments in Florida and Texas will improve productivity and fruit yield for organic citrus producers through better pest and disease management while sustaining environmental quality. The project will use field days, refereed/extension publications, and social media to disseminate emerging and imminent findings on the project. Further, in-service training for extension agents will be conducted annually to build capacity and accelerate adoption of sustainable organic citriculture. Graduate students and postdoctoral fellows will also be mentored on the project and collaborate with organic citrus growers to develop the capacity of the next generation of organic agriculture researchers in the US.

## OBJECTIVES

We will seek to achieve the following objectives: 1) Determine the effect of organic soil amendments and cover crops on fruit yield and quality of organic citrus production systems, 2) Establish integrated pest management strategies in organic citrus production systems receiving soil amendments and cover crops, 3) Evaluate the microbial and non-microbial biostimulant to improve soil microbial biodiversity, plant growth, fruit yield and postharvest life in organic citrus production, 4) Increase the adoption of tools for promoting efficiency and production in organic citrus horticulture.

## APPROACH

Objective 1: Sub-objective 1a. We plan to conduct on-farm experiments assessing different soil amendments including compost and/or biochar with and without cover crops (legume and non-legume). These treatments will be focused on altering the agroecology of the organic farm. A total of 5 organic citrus farms will be used on the project. In Florida, four farms have Sugarbelle mandarin, Satsuma mandarin, Valencia and Navel sweet oranges while in Texas one organic farm has the Grapefruit. Typical layouts will take the form of replicated plots assuming selected treatment combinations as follows and replicated 4 to 5 times in a randomized complete block design: 1) Compost with legume cover crop; 2) Compost with non-legume cover crop; 3) Biochar with legume cover crop; 4) Biochar with non-legume cover crop; 5) No soil amendment with legume cover crop 6) No soil amendment with non-legume cover crop; and 7) No soil amendment. Measurements will include soil health dynamics including organic matter, organic carbon, soil texture, soil bulk density, soil cation exchange capacity, soil microbial activity, and soil nutrient content at the start of the project and annually thereafter using indices derived from Stott (2019). Leaf nutrient measurements will be done at the start and yearly thereafter. Sub-objective 1b. The aforementioned treatments will also be compared with two fertilizer sources, organic controlled-release fertilizer and organic conventional fertilizer (as subplots) to assess the efficiency of uptake in the presence or absence of soil

amendment or CCs. Greenhouse gas emissions will be evaluated using the LICOR greenhouse gas analyzer for methane, nitrous oxide and carbon dioxide emissions (LI-7820). Fruit yield and canopy growth per amount of nitrogen applied will be estimated to determine the overall efficiency by the production system.

**Objective 2. Sub-objective 2a.** Evaluate the populations of predators and parasitoids in citrus blocks with and without cover crops and compost. **Methods:** Assessments for predators and parasitoids will be made in trials established to evaluate effects of cover crops and compost treatments. We will sample for diversity and abundance of natural enemies in citrus trees in these trials and in control without cover crops and compost. Sampling in the treatment blocks and control will also help us determine the potential dispersal of natural enemies from the cover crops/compost blocks and any impact on their diversity and abundance to benefit the neighboring untreated blocks. We will employ visual observations, tap sampling, and suction sampling methods to evaluate the populations of predators and parasitoids in citrus trees (Qureshi et al. 2009, 2014, Qureshi and Stansly 2010, Monzo et al. 2015). We will also use potted-infested sentinel plants of citrus or orange jasmine (*Murraya paniculata*) to determine the diversity and abundance of predators colonizing trees in plots with and without cover crops. Potted plants will be placed in the plots with and without cover crops for a period of 5-7 days, and each plant will be observed visually for predators. These data will be recorded for each individual plant.

**Sub-objective 2b.** Evaluate the release and establishment of commercially available predators and parasitoids through cover crops. **Methods:** We have already shown in the laboratory that three commercially available predators, two ladybeetles *Adalia bipunctata* and *Hippodamia convergens* and a lacewing *Symphorobius barberi*, are effective predators of ACP (Qureshi and Stansly 2011, Khan et al., 2016, 2020). *Hippodamia convergens* is a well-studied predator (Sivakoff et al., 2012). *Tamarixia radiata* is the primary parasitoid known to parasitize ACP nymphs and contribute to its mortality in citrus crops (Qureshi et al. 2009, Qureshi and Stansly 2019b). We will obtain *A. bipunctata* and *S. barberi* from commercial sources and *T. radiata* from the FDACS-DPI production facility. We will evaluate these releases in citrus blocks with and without cover crops and with and without compost. We will recover these natural enemies using sticky traps and suction samples. Cover crops and compost treatments improved tree growth and young shoots attractive to pests and beneficial organisms.

**Sub-objective 2c.** Evaluate the biotic mortality of ACP in citrus blocks with and without a cover crop and compost. **Methods:** We will employ exclusion techniques to determine the biotic mortality in the populations of ACP in plots with and without cover crops and with and without compost (Qureshi and Stansly 2009). We will use natural pest infestation in the trees or infested sentinel plants described under sub-objective 2b. Cohorts of counted numbers of ACP nymphs developing on the young shoots will be protected from the natural enemies using the sleeve cages or left exposed to the natural enemies for a period of 7-10 days. At that point, they will be collected and examined under the stereomicroscope in the laboratory to determine: 1) mortality by predators and 2) parasitism in ACP nymphs (Qureshi et al. 2009). The reduction in the developing cohorts of ACP after exposure to the natural enemies will be adjusted using with reduction in the cohorts protected with sleeve cages using Abbott's formula (Abbott 1925, Khan et al. 2016). Assessment of parasitism in ACP nymphs will also be made by collecting these life stages and rearing to adults or examined under stereomicroscope to identify parasitized individuals and parasitoid species (McFarland and Hoy 2001, Qureshi et al. 2009, Chen and Stansly 2014). Percent parasitism (apparent parasitism) will be calculated by the number of parasitized nymphs and the number of hosts available in the sample (Stansly et al. 1997).

**Objective 3.** To examine the effects of novel biostimulants on organic citriculture production. Organic citrus production can benefit from the use of biostimulants because these substances improve plant resilience to the different biotic and abiotic stresses, resulting in yield gap reduction between conventional and organic production. We will use different biostimulants such as humic acid, fulvic acid, seaweed extract, chitosan and plant-growth-promoting microbes. Selected biostimulants will be root applied (individually or in combination) at different growth/phenological stages i.e., flower initiation, fruit formation, fruit color change, and fruit full maturity. It will be a replicated study with 5 replications and 10 trees/replication. We will use commercially available products of our target biostimulants and will follow the label specific rate of application. Soil and tissue sampling will be done at four different growth stages to determine soil health, microbial biodiversity, nutrient uptake, and physiological/biochemical attributes. Fruits will be harvested to determine fruit quality and postharvest attributes. Treatment plan will be as follows: 1) Control (grower standard organic practices), 2) Humic acid (HA), 3) Fulvic acid (FA), 4) Seaweed extract (SWE), 5) Plant-growth-promoting-microbes (PGPM), T6: HA + FA, T7: FA + SWE, T8: HA + SWE, 9) Humic acid + fulvic acid + seaweed extract, 10) Humic acid + fulvic acid + seaweed extract + PGPM

**Objective 4.** We will conduct grower workshops and field days once per year to show performance of treatments and obtain farmer feedback through surveys comparing the treatments proposed in this project. In addition, we will share results in Citrus Industry Magazines and at grower events such as Citrus Expo, Citrus Show and publish results in extension bulletins. We will document numbers of growers and acreage for organic citrus production from year one (ex-ante) and in years 2, 3 and 4 to determine level of adoption.



# Washable Essential Oil Emulsion Coatings to Extend the Shelf Life and Enhance the Safety of Organic Fruits and Vegetables

<b>Contract / Grant No.</b>	2024-51300-43226
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Qixin Zhong
<b>Performing Institution</b>	University of Tennessee

## NON-TECHNICAL SUMMARY

Organic fresh produce products are at the risk of foodborne illnesses due to the lack of practices that can effectively decontaminate incident pathogens, and their shelf life is shortened due to loss of quality and/or fungi spoilage. Current commercial organic-compliant coatings can extend the shelf life but lack preservatives capable of inhibiting foodborne pathogens and fungi. Incorporating organic essential oils (EOs) in coatings may be the solution due to their proven effectiveness against both fungi and foodborne pathogens. The overall research goal of this project is to develop and implement organic compliant coatings with organic EOs to enhance postharvest quality and safety, while the overall extension goal is to train organic producers, packers, and technical service providers with innovative postharvest quality and safety knowledge and disseminate research findings. The research and extension activities will be guided by an advisory board. Two categories of coatings will be studied in Objective 1 for commercial organic coatings implementing EOs and novel acidic EO formulations, with an additional goal to make coatings wash removable. Six coating formulations will be studied in Objective 2 for reduction of foodborne pathogens on organic blueberries, apricots, peppers, tomatoes, and cantaloupe. Shelf-life and quality, including inhibition of decay, for organic produce coated with EOs will be evaluated in Objective 3, while consumer acceptability and economic analysis will be conducted in Objective 4. Extension activities in Objective 5 will include traditional print publications and in person workshops, as well as virtual webinars, a project website, YouTube channel, and X (formerly Twitter) account. The project will enhance post-harvest safety, shelf life, and quality that are critical to sustainable production of perishable organic fresh produce.

## OBJECTIVES

The overall research goal of this OREI project is to develop and implement organic compliant coatings with organic essential oils (EOs) to enhance postharvest quality and safety, while the overall extension goal is to train organic producers, packers, and technical service providers with innovative postharvest quality and safety knowledge and disseminate research findings. The objectives are to (1) Formulate organic compliant essential oil coatings, (2) Reduce native fungi and foodborne human pathogens on organic produce with EO coatings, (3) Evaluate shelf-life and quality of coated organic fruits and vegetables, (4) Assess consumer acceptability and economic analysis of coating organic fruits and vegetables, and (5) Train organic producers, packers, and technical service providers and disseminate project findings.

## APPROACH

In Objective 1, the activity of essential oils (EOs) will be analyzed for Salmonella cocktail, Listeria monocytogenes cocktail, and fungi isolated from diseased peach, blueberry, and cucumber tissues, with the goal of identifying EOs with synergistic antimicrobial activities to reduce their application levels in coatings. For bacterial pathogens, the analyses will include determining the minimum inhibitory concentration and minimum bactericidal concentration of individual EOs against pathogens at different pHs and the fractional inhibitory concentration index of antimicrobial combinations. For fungi, the mycelial growth inhibition will be determined for the chosen EO combinations identified for bacterial pathogens. The chosen EO combinations will be blended with organic vegetable oil to prepare emulsions using organic compliant emulsifiers, and the physical and antimicrobial properties of emulsions will be characterized. Physical and antimicrobial properties of films will be characterized for commercial coatings implemented with EOs and hydrocolloids, as well as novel coatings with acidic EO emulsions and hydrocolloids. Three independent replicates will be conducted, and the data will be subjected to

ANOVA and Tukey's test for significant differences among treatments ( $P < 0.05$ ). In Objective 2, six coatings to be chosen from Objective 1 will be applied on organic fresh produce of known production practices and same cultivar without undergoing postharvest unit operations. Blueberries, apricots, peppers, tomatoes, and cantaloupe will be inoculated with Salmonella or Listeria cocktail at a level of  $\sim 6.0$  log CFU/piece of fruit (or 25-g blueberry), applied with coatings, and enumerated for surviving bacteria during storage at optimal storage conditions. The total yeast and fungi counts will also be enumerated during storage. Controls will include (1) fruits without inoculation but with antimicrobial coatings, (2) fruits inoculated with pathogens and treated with antimicrobial-free coatings, and (3) fruits coated with a commercial organic plant-based coating. Three samples will be evaluated for each replicate. All treatment combinations will be independently replicated three times, using a repeated measures experimental design to account for sampling over time. Experimental data will be subjected to ANOVA and Tukey's test as in Objective 1. In addition, because food contact surfaces and roller brushes are major concerns of pathogen cross-contamination in waxing facilities, the impact of new coatings on the survival of *L. monocytogenes* on food contact surfaces and their easiness for cleaning and sanitizing stainless steel and roller brushes made with different materials will be evaluated in the lab. In Objective 3, six antimicrobial coatings identified in Objective 1 will be applied to fruits, with an uncoated control and a commercial coating control. Four replicates of 20 fruit each (apricot, cantaloupe, pepper, and tomato) or 1 pint each (blueberry) will be studied per treatment. During storage at ideal temperatures for each commodity, fruit quality will be evaluated for color, firmness, soluble solids, titratable acidity, weight loss, fruit respiration, and fruit deterioration (damage and decay). These experiments will be repeated once. Statistical analysis of fruit quality attributes differences by treatment will be analyzed using ANOVA, and means will be separated using LSD. Consumer panels with 120 participants will be recruited to evaluate the effect of coatings on the samples for appearance liking, texture liking, flavor liking, and overall liking. Additionally, residual contents of coating materials on fresh produce will be determined before and after simulated consumer washing. In Objective 4, an online survey instrument will be developed to assess US customers' acceptance and perceptions of alternative organic fresh produce coatings, estimate potential premiums associated with alternative coating options, and identify customer segments and their motivations for accepting alternative fresh produce coatings on fruits and vegetables. The benefit-cost analysis will be used to determine the cost-effectiveness of the alternative organic-compliant coatings with organic EOs applied to fresh produce in this project. In Objective 5, a board of advisors composed of seven total individuals representing industry, governmental and regulatory agencies, trade organizations, and research will be engaged throughout the project to receive research updates from and provide feedback to the project team. Surveys will be developed to gather detailed insights to assess stakeholders' current practices, knowledge, skills, and attitudes, and the collected data will serve as a foundational resource to inform and guide extension activities. Knowledge and research findings from this project will be communicated to the produce industry over the entire project duration via both interactive engagement techniques and knowledge dissemination methods. These will include a dedicated project website providing comprehensive information of the project, project outputs, links to social media platforms (YouTube channel and X account), and a calendar of upcoming outreach events. Besides open-access peer-reviewed publications, project outputs include print materials or videos of extension and demonstration materials, webinars, workshops, and presentations at local, and national meetings. Based on stakeholder needs, a subset of resources will be translated into Spanish. All in-person events and live virtual events (e.g., webinars) will be evaluated by participants for satisfaction with the programming and their knowledge gain. Dr. George Chitiyo at Tennessee Tech University will be an independent external evaluator for this project.

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# Tomi3: Bringing Our Insights to the Farm to Co-create More Effective Methods of Disease Control in Organic Tomato Crops

<b>Contract / Grant No.</b>	2024-51300-43372
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Lori Hoagland
<b>Performing Institution</b>	Purdue University

## NON-TECHNICAL SUMMARY

Demand for organic tomatoes continues to grow, yet farmers struggle to keep up due to foliar diseases that can move quickly through farm fields and decimate entire crops. The tomato organic management and improvement project (TOMI) has spent the past 10 years working with organic farmers to overcome this challenge through breeding and investigating how to promote beneficial plant-soil-microbial relationships. Now we propose to build on the knowledge and resources we have developed and create practical tools organic farmers can use to prevent foliar disease outbreaks and deliver tomatoes with end-use quality traits demanded by consumers in local marketplaces. Specifically, we will: 1) identify critical factors needed to promote the efficacy of biocontrol agents and adapt disease forecasting models to account for these practices; 2) use new molecular markers developed in our breeding program for promoting plant associations with microbes that have biocontrol capabilities and disease resistance traits, establish regional participatory breeding programs to select new germplasm from these pools, and develop a new decision-support tool that will help farmers select varieties best-adapted to their farms; 3) create new support networks that will help organic farmers, Extension educators, researchers, students and local food system actors (ie. chefs) connect, overcome production challenges through participatory research, and foster new marketing relationships; and 4) deliver novel and inclusive educational programs that support these efforts. These programs will be disseminated broadly through our website hosted by eOrganic, in webinars, on-farm workshops, print-based materials, variety showcases and TomatoFests. Results will be applicable to other crops.

## OBJECTIVES

Organic tomato growers need practical approaches to manage foliar diseases while meeting consumer demand for fruit with desirable end-use quality characteristics and protecting soil and water quality. Our project will address these challenges by 1) identifying and overcoming critical factors influencing the survival and efficacy of biocontrol agents, 2) establishing decentralized tomato breeding efforts based on regional needs, 3) creating new decision-support tools (DSTs) to help farmers better manage foliar diseases through biocontrol and varietal selection; and, 4) establishing new support networks and delivering novel and inclusive training programs that will help Extension educators and organic farmers better manage foliar diseases in vegetable cropping systems and connect with local chefs to increase marketability of their produce

## APPROACH

Obj. #1: Identify critical factors influencing the survival and efficacy of biocontrol agents. These studies will focus primarily on SLS and PM due to their growing challenge nationwide and lack of research to develop solutions relative to other foliar diseases. We expect knowledge generated with respect to characterizing the diversity of the pathogens causing these diseases will not only help us in optimizing disease forecasting models, but will also aid in our efforts to breed for resistance to these diseases. We also expect results will be applicable to other critical foliar diseases we regularly encounter like LB, EB, GM, LM, and BS. We will start by screening popular tomato varieties as well as those under consideration in our breeding program in the greenhouse for their capacity to signal, support and respond favorably to soil and foliar applied biocontrol agents. Next, we will conduct on-farm trials in HT and OF systems in three distinct ecoregions (SE, MW, WC) using responsive genotypes and a commercial product containing a broadly adapted *B. subtilis* strain in years 1&2. Soil health, leaf microbiomes, climatic conditions, and pathogen timing & diversity will be quantified and compared with disease

outbreaks. Local *B. subtilis* strains with biocontrol activity will be isolated from each ecoregion, and tested against the commercial strain in years 3&4. The data will be used to develop new disease forecasting models (see Obj. 3). These studies will be co-led by Hoagland, Luis & Davis.

**Obj. #2:** Establish decentralized tomato breeding efforts based on regional needs. The goal of these studies is to provide organic growers with new OP varieties that produce abundant yields of markable fruits under high disease pressure. The major diseases of concern vary across the U.S. Standard management practices for organic market farmers also vary; for example, growing under HTs is more common in the MW, while OF production is more common in the WC. For that reason, the breeding program will tailor breeding and trialing efforts by region, while operating under a shared set of protocols and centralized winter advancement and marker testing. We will make crosses using genotypes identified in Obj. 1 with germplasm from our on-going program as well as others with known resistance genes and desirable end-use quality traits. Crosses for each ecoregion will be selected based on the most problematic foliar diseases in that region. Segregating populations will be evaluated in on-station trials in 5 states, and we will predict performance of new crosses based on traditional and genomic prediction methods. The relative stability and specificity of varieties, populations and traits including ISR, will be analyzed via changes in the genomes of divergently selected populations. Advanced lines will be evaluated in on-farm trials in 7 states in years 3&4. Data from the field trials will be used to support DSTs (see Obj. 3). These studies will be co-led by Dawson, Myers and Zystro.

**Obj. #3:** Create new DSTs to help farmers better manage foliar diseases. Our goal with this objective is to develop new DSTs that will allow organic growers to implement new insights and germplasm generated in Objectives 1&2, effectively reduce foliar disease outbreaks, and increase the yield and quality of their tomato fruit. We will combine data collected over the past 10 years of the TOMI project with new, more specialized data collected during TOMI3 to create two DSTs. One will help growers better manage diseases by using disease forecasting models that have been adapted by our team to account for biocontrol agents and HT production systems. The second will help growers select best-adapted varieties for their farm using on-line data management and forecasting tools. These activities will be led by Raturi.

**Obj. #4:** Establish new support networks and deliver novel and inclusive training programs. We know that there are currently many barriers limiting the effective transfer of new knowledge generated from academic research to stakeholders, and organic farmers often gain the greatest benefits by interacting and learning from each other. Consequently, we will establish regional networks fostering communications between TOMI personnel, organic farmers, Extension educators, chefs and consumers using CBNs developed by Selman as a model. Subgroups will focus on on-farm research activities, and larger events such as our variety showcases and tomato festivals will engage larger groups with regional foodsheds. We will critically review the impacts of previous TOMI outreach programs as well as other relevant projects to design a suite of training programs and products that can best engage and support a diverse audience of organic food system stakeholders. These activities will be led by Gu, Formiga and Selman.

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influencing the survival and efficacy of biocontrol agents.

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# Organic Production and Food Safety Workshop Series for Regional Farmers in California's Southwest Desert Area

<b>Contract / Grant No.</b>	2024-51300-43373
<b>Grant Year</b>	2024
<b>Investigator(s)</b>	Cuong Nguyen
<b>Performing Institution</b>	University of California

## NON-TECHNICAL SUMMARY

The "Organic Production and Food Safety Workshop Series for Regional Farmers in California's Southwest Desert Area" is a comprehensive initiative designed to address the critical needs of farmers in the Imperial and Coachella Valleys. This project, spearheaded by the University of California Cooperative Extension (UCCE), aims to support the region's agricultural sector, which contributes significantly to the nation's winter vegetable production. The primary objective is to equip farmers with essential knowledge and skills for successful organic production and food safety compliance. This initiative is particularly timely, given the 107% growth in organic produce sales over the past decade and the increasing pressure on conventional farmers to transition to organic practices. Key components of the project include: A series of workshops focusing on organic pest management, soil health, irrigation techniques, and food safety practices. Development and dissemination of bilingual (English and Spanish) educational materials tailored to the linguistic and cultural needs of the region's predominantly Hispanic farming community. Implementation of a peer-to-peer learning model, incorporating on-farm demonstrations and round table discussions. Comprehensive evaluation of the program's impact through pre- and post-workshop surveys and on-site farm visits. The project addresses several challenges faced by regional farmers, including: Limited efficacy and higher costs of organic pest control methods. Soil health management in organic systems. Increased food safety risks associated with biological soil amendments. Language and cultural barriers in accessing technical information. By leveraging the expertise of UCCE advisors and specialists, along with partnerships with local farm bureaus, this initiative aims to foster a more robust organic farming community in the region. The project is expected to lead to increased adoption of organic practices, improved food safety compliance, and enhanced economic viability for participating farms. This holistic approach not only targets immediate agricultural needs but also contributes to the long-term sustainability and resilience of the regional food system. Through its focus on historically underserved farmers and emphasis on culturally appropriate education, the project aligns with broader goals of equity and inclusivity in agricultural development.

## OBJECTIVES

This collaborative extension initiative constitutes a proactive response to the mounting challenges faced by organic growers in implementing optimal nutrition management, updated disease prevention protocols, and critically important food safety standards. The project centers on an integrated peer-to-peer learning model, leveraging immersive IPM workshops, conferences, and tailored Spanish-language resources to equip farmers with the latest empirical insights around organic agriculture and evolving food safety governance. The key objectives underlying this cooperative approach are threefold: 1. To furnish Southwest desert farmers with cutting-edge, regionally tailored knowledge on organic pesticides, nutritional supplementation, disease prevention, and changing food safety regulations - promoting a culture of continuous improvement anchored in science-based best practices. 2. To formulate and disseminate cultural and linguistic educational materials that enhance the adoption of sustainable organic and food safety techniques among Hispanic and other historically underserved growers. 3. To evaluate real-world uptake outcomes via on-site surveys and iterate resources in response to user feedback - empowering farmers through responsive, participatory learning.

## APPROACH

D. APPROACH/METHOD: Stakeholder Participation in Project Development and Assessment: Throughout the Food Safety and Organic Production Need Assessment survey undertaken within the geographic area, growers

were conferred with concerning project design and expressed robust endorsement of the initiative's goals. Guided by recommendations from farmers, in conjunction with various local agriculture and food system partners alongside community-oriented entities, project activities will be customized according to cultural and linguistic attributes to fulfill the organic production and food safety extension needs of growers across the region. These tailored activities encompass:

1. Pre-Workshop, Engagement of Organic Farmers: All technical assistance resources and information regarding organic production and food safety-related workshops made available to agricultural producers will be publicized in both English and Spanish through diverse outreach channels. Guided by prior investigative findings within the geographic region, optimal outreach approaches have been identified. Growers barely utilize online resources or digital devices. The vast majority of farmers (~80%) denoted individualized farm visits and on-location demonstrations as ideal contact methods for Extension personnel. Commonly utilized informational channels entail personal networking and communication (75%); one-on-one consultations or training (55%); and print media (35%). Based on these inputs, outreach tactics encompass but are not limited to: Dissemination of informational materials via established growers who are community leaders. Door-to-door canvassing to connect with individual farmers. Round table discussion to gauge the research, education, or extension needs. Additionally, coordination will occur through email announcements, website postings, community partner entities, and brochures distributed at local agricultural supply retail outlets and nonprofit organizations.
2. Workshops on Organic Production and Food Safety Rules: Three workshops will be conducted with Spanish interpretation available spanning the 12 months of the project. These will be in-person events hosted at selected community grower's sites, aligning with preferences denoted during the needs assessment. Workshops will examine topics that include optimal nutrition management, irrigation management, disease and integrated pest management methods, decision-making assistant tools, and updated food safety standards. Technical assistance opportunities will be introduced through one-on-one and small-group training. UCCE advisors and specialists from different counties, government officials including the agriculture commissioner, researchers from partnered universities, and organic fertilizer and pesticide industrial representatives will present on organic production and food safety subjects. The content will be the latest updates on research, government regulation including CA-DPR new regulations and new product registration, and industrial organic fertilizers and pesticides and their effectiveness.
3. Round table discussion: Round table meetings will be organized, each involving approximately 5-10 farmers and any staffers or family members assisting with farming operations. These localized capacity-building sessions will concentrate on feedback from the workshop and identify immediate research, education, or extension needs. Subject matter will entail updated information; or an advanced understanding of organic issues and problems using a systems-based approach. For every topic, requisite paperwork will be elucidated with farmers receiving templates and informational materials carrying appropriate linguistic translations to coordinate logs.
4. Education Materials: Available educational content developed by UCCE, DPR, and other groups will be revised to guarantee up-to-date details and aligned with regional growers' needs. Furthermore, templates supporting agricultural producers in documentation requirements will be created. The entirety of printed materials will be rendered in both English and Spanish.
5. Evaluation Plans: Evaluation mechanisms will be employed to gauge the efficacy of workshops, and informal gatherings in aiding farmers' implementation of organic production and food safety practices, with results informing future educational initiatives. Attendance numbers of historically underserved growers at workshops, receipt of one-on-one or on-location technical help, participation in round table meetings, and circulation of informational content will be documented via sign-in forms and logged distribution figures. Subsequent to each event (workshop, individualized assistance, round table meeting), retrospective post-then-pre surveys will be conducted to determine self-reported shifts in knowledge, awareness, capabilities, confidence, perspectives, or behaviors. Feedback on educational resources will also be solicited. Adoption of on-farm organic production and food safety practices will be evaluated through follow-up visits with growers. These farm visits will incorporate practice implementation checklists, informal gap analyses post-instruction, and farmer's insights on the most and least helpful workshop aspects alongside the easiest and most difficult measures to institute.

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