

**United States Department of Agriculture
Project Initiation**

Project Data for Accession Number 1032811

Project Title

More Bang for your Buckwheat

Project Details

Sponsoring Institution National Institute of Food and Agriculture	Project Status ACTIVE
Funding Source NIFA Non Formula	Grant Year 2024
Grant No. 2024-51300-43049	Cumulative Award Amt. \$3,300,000.00
Proposal No. 2024-03358	Multistate No. (N/A)
Project Start Date Sep 01, 2024	Project End Date Aug 31, 2028
Program Code [113.A] Organic Agriculture Research & Extension Initiative	

Project Director

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Recipient Organization

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Performing Department

(N/A)

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

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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.

Animal Health Component

Animal Health Component: 0%

Research Effort Categories

Basic	10%
Applied	60%
Developmental	30%

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
202	1599	1081	20%
201	1599	1080	20%
502	1599	2000	20%
903	1599	3030	20%
102	1599	1070	20%

Knowledge Area

[202] Plant Genetic Resources

[201] Plant Genome, Genetics, and Genetic Mechanisms

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[502] New and Improved Food Products

[903] Communication, Education, and Information Delivery

[102] Soil, Plant, Water, Nutrient Relationships

Subject Of Investigation

[1599] Grain crops, general/other (includes buckwheat, millet, triticale)

Field Of Science

[1081] Breeding

[1080] Genetics

[2000] Chemistry

[3030] Information and communication

[1070] Ecology

Keywords

ecosystem services, organic plant breeding, organic seed, participatory plant breeding, Buckwheat

Goals / 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.

Project Methods

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,

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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.