

New Jersey (Rutgers the State University of New Jersey New Brunswick Campus) Annual Report - FY2021

Report Status: Approved as of 07/08/2022

Contributing Organizations

Rutgers the State University of New Jersey New Brunswick Campus

Executive Summary

Overview

Rutgers University is New Jersey's land-grant institution and home to the New Jersey Agricultural Experiment Station (NJAES) and its associated extension unit, Rutgers Cooperative Extension (RCE).

New Jersey is one of the smallest states in the United States. With over 9.1 million residents living within 8,729 square miles, New Jersey is the most urbanized and densely populated state in the nation. It is the only state defined by the U.S. Bureau of Census as 100 percent metropolitan.

New Jersey's population is highly diverse compared to the United States as a whole and tends to be better educated than the U.S. population. New Jersey's industrial base has shifted over time from manufacturing and production industries towards more of a service economy. Per capita and household incomes in New Jersey are significantly higher than the national average, and New Jersey consistently ranks fourth or better among all the states in these measures of economic well-being.

As the most urbanized and densely populated state in the nation, New Jersey faces some significant challenges. It is a study in contrast, with large cities, lightly populated rural areas characterized by forests and farmland, and wide swaths of suburban tracts. Industrial development is heavily concentrated in northern New Jersey, particularly in the northeastern quadrant, while southern New Jersey is largely rural, dominated by farms and preserved forested acreage. New Jersey's economic largesse is likewise not spread equally over its entire population, with significant disparities in wealth and well-being across the state. While the overall poverty rate (percentage of the population living at or below the poverty line) in New Jersey in 2017 was 10%, poverty rates in major urban areas range from 20% to almost 40%. Much higher poverty rates are also observed in smaller cities and towns, particularly in the more rural southern part of the state. These communities face significant challenges both now and in the future.

New Jersey represents a unique frontier of the rural-urban interface. Its designation as a highly urbanized state conceals the fact that New Jersey still has a significant agriculture industry. Agriculture remains an active use on 15 percent of the state's land base and represents more than half of the remaining stock of privately owned undeveloped land. Annual farm gate revenues are estimated at \$1 billion. The intersection of rural and urban/suburban interests in New Jersey raises pressing environmental issues and the challenge of balancing environmental, economic, and quality of life concerns.

New Jersey is also a coastal state, which raises another host of issues. Coastal communities rely on tourism, aquaculture, commercial and recreational fishing, and related activities to fuel their local economies. Rising sea levels, environmental threats to ocean and coastal ecosystems, and sustainable management of fishery resources are just some of their local concerns.

For a history of Rutgers University and NJAES/RCE, refer to the 2021-2025 Plan of Work.

The NJAES has three co-equal leadership positions that are responsible for setting strategic goals and policies for NJAES. They have primary responsibility for leadership of, implementation of, and accountability for NJAES activities, both on and off-campus. These are the Director of Research, Sr. Associate Director (NJAES), Director of Strategic Development and Administration and Sr. Associate Director (NJAES), and Director of Cooperative Extension Sr. Associate Director (NJAES).

The research function resides within the NJAES Office of Research and is managed by the Director of Research, Senior Associate Director of NJAES. He/she is responsible for overseeing the SEBS/NJAES research portfolio to achieve research excellence for NJAES and the school. The Executive Director for NJAES has delegated authority for the management of USDA-NIFA's research capacity grant funds to the Director of Research, who serves as the official authorized organizational representative to USDA-NIFA for these funds. The Director of Research leads grant facilitation and research administration to support successful submissions for USDA, NSF, NIH, and other federal and state funding, promotes interdisciplinary research collaborations among SEBS/NJAES faculty and across the university, coordinates missions of SEBS-based institutes and centers with NJAES and departmental research goals, strengthens graduate and postdoctoral training, and deploys strategic investments in research infrastructure and core facilities.

The Director of Strategic Development and Administration and Sr. Associate Director (NJAES) has authority for strategically deploying/utilizing NJAES assets and budgets for on and off-campus farms, research stations, incubators, and auxiliary units. He/she works in concert with unit leadership to maximize the efficiency and effectiveness of their operations, ability to support cutting edge research and outreach, and generation of economic development impacts. The Director of Strategic Development and Administration collaborates with the Directors of Research and Cooperative Extension, as well as the Associate Dean of Planning and Budgets, to strategically administer these assets to support the mission of NJAES, ultimately benefitting the stakeholders and residents of New Jersey. In addition, he/she leads NJAES economic development programming, leads NJAES state and federal relations activities, and serves as NJAES representative to relevant stakeholder groups and associations.

The chief administrator of Rutgers Cooperative Extension has the title of Senior Associate Director and Director of Cooperative Extension. This position is authorized to operate and coordinate the programs of Rutgers Cooperative Extension in the areas of agriculture, resource management, family and community health sciences, 4-H youth development, and marine studies, all consistent with school, university, and USDA policies. The Director of Cooperative Extension is responsible to the Executive Director of the New Jersey Agricultural Experiment Station and works with the NJAES Director of Research to ensure that the needs of New Jersey residents are being met. The Director of Cooperative Extension interacts with NJAES/RCE stakeholders from various commodity and interest groups and may serve as the Executive Dean/Director representative to specific state-level committees or boards. He/she represents the NJAES/RCE Extension functions at regional and national level meetings, as well as to USDA-NIFA.

Critical Issue: Build Sustainable and Resilient Communities

Extension Projects/Reports associated with this CI:

Extension programs associated with this critical issue focus on programs that are supported and enriched by the volunteers who put their time and talents to serve their communities. Trained volunteers help build a more cohesive, safer, stronger community, and increase the social network between communities and neighborhoods. Extension training programs, such as the Rutgers Master Gardener Program, Environmental Stewards, and Green Infrastructure Champions, promote more active civic engagement and concern about citizenship and provide training in the areas of horticulture, environmental issues, and water resources.

Rutgers NJAES Cooperative Extension faculty and staff provide expert and in-depth hands-on training in the areas of plant biology, propagation, soil science, and disease and pest control to Master Gardener volunteers. In exchange for the training, Rutgers Master Gardeners work in their community in programs sponsored by Rutgers New Jersey Agricultural Experiment Station (NJAES) Cooperative Extension to help expand the research and educational capacity of RCE.

Rutgers Environmental Steward program trains volunteers on how to take action to help solve environmental problems in their communities. The program focuses on science and public policy and engaging stewards as they learn about the techniques and tools used to monitor and assess the health of the environment and gain an understanding of the research and regulatory agencies operating in New Jersey in areas such as environmental education, habitat conservation, water quality and stormwater management, wildlife, and pollinator conservation. In addition to working with Rutgers Cooperative Extension to extend NJAES/RCE research and educational capacity, volunteers have been enabled to go back to their communities and engage as informed citizens in better understanding and protecting their local and regional environments and natural resources.

The Green Infrastructure Champions program was created to empower local stakeholders to play a dominant role in encouraging municipalities and other property owners to implement green stormwater infrastructure practices. They have become key players in planning and implementing green infrastructure as a stormwater management approach municipality by municipality

Research Projects/Reports associated with CI: 6 (three active and classified, one active and not classified, two final)

The research projects currently associated with this critical issue focus on areas such as community pest management, land conservation policies to improve urban design, and the importance of value-added and accessible food sources, especially in the unique urban and diverse environment of New Jersey.

The Rutgers Entomology Department and its connected Center for Vector Biology continued their critical work with mosquito and tick surveillance to create better control tools for these invasive pests that spread disease to animals and humans. The highlighted project this year by Dr. Changlu Wang features his many areas of expertise in pest control, especially in the home setting. His research includes testing existing and new and innovative strategies for controlling cockroaches, bedbugs, termites, and house mice in low-income settings. Dr. Wang's research is also an important integrated approach with considerable methods of education and outreach to the residents and owners of the apartments studied as well as outreach to pest management professionals.

Regarding the research on land conservation policies, the project conducted has collected data on housing starts in the New Jersey Highlands and surrounding regions. They found that the Water Protection of Planning Act of 2004 has had no detectable impact on housing development. The preliminary conclusions of this research intend to reach out to policymakers and the public to remind them that political and economic forces tend to "water down" the growth-suppressing features of land conservation policies.

Insofar as accessible food sources, Dr. Sanjib Bhuyan's project found that a demand for pre-cooked Caribbean RTE (ready-to-eat) food is growing in the United States. Additionally, they examined the factors that are influencing consumers' food choices of precooked Caribbean-style food. The results of the study show that the most popular or most commonly bought pre-cooked international foods were Mexican and similar foods (includes South American) followed by Chinese food. The study showed that the factors influencing consumers' decision to purchase pre-cooked Caribbean-style food are price (distance), consumer self-related factors (ethnicity), and environmental factors (employment and income). Entrepreneurs making such foods available in grocery stores are likely to see an increase in demand if those foods are easily accessible to all consumers as well as in areas that are ethnically diverse and relatively economically wealthy.

Critical Issue: Ensure Healthy Outcomes: Food, Nutrition, Health

NJAES researchers identify and document environmental and other causal factors that increase the prevalence of certain cancers and chronic health conditions. They also focus on the nutraceutical properties of various plants to identify health-promoting foods and supplements in so-called "functional foods." Through RCE, NJ residents can access various self-management and community workshops for the management of diabetes, cancer survival, and other chronic health conditions.

Extension Projects/Reports associated with this CI:

Extension continues to provide outreach and educational programs encouraging and facilitating healthy food choices, physical activity, and other strategies to help residents attain and maintain healthy weight levels and address diverse unmet issues of nutrition and health. The programs, from teaching our most vulnerable residents about healthy eating on a budget to promoting the benefits of exercise, bring the best in research and education to respond to the urgent and growing challenges to nutrition and human health.

The programs under this critical issue are aimed at a range of populations, including special programs for NJ schools and early care centers to expose children and their families to healthy lifestyle choices. RCE programs also enable access to healthy food choices in our urban "food deserts." Extension continues to do this with programs such as *Taking Action Against Hunger: Dietetic Interns Learn While Feeding Residents*, a program for dietetic interns to gain rotation experience working at food pantries, farmer's markets, or other food distribution sites to round out their "community experience"; *Wellness Wednesdays*, a webinar series created to move programming to a virtual platform and support NJ residents in making healthy choices while in quarantine. This series focuses on a variety of topics related to food, nutrition, and healthy lifestyles; *School, Nutrition, Garden and Health*, provides programming directly to youth focusing on healthy food choices, the importance of physical activity, tools to shape behavior patterns, and understanding how the food system works; and *Workforce Wellness*, focus on healthy living while working.

Research Projects/Reports associated with CI: 24 (four active and classified, fourteen active and not classified, six final)

The NJAES Critical Issue "Ensure Healthy Outcomes: Food, Nutrition, Health" has a wide range of research projects focused on areas of obesity and chronic diseases. While our researchers study the habitual causes of obesity in projects such as Carol Byrd-Bredbenner's multistate collaboration tracking the food choice decisions and obesogenic behaviors of University students, we also have many faculty in our departments of Nutritional Sciences, Food Sciences and Biochemistry and Microbiology who are delving deeper into the molecular and genetic causes of obesity and potential solutions for controlling the negative impacts of excessive weight gain.

However, obesity is not always the main factor controlling health and disease. Dr. Loredana Quadro studies the mechanisms of beta-carotene transfer from mother to fetus. Beta-carotene is the main dietary precursor of vitamin A, an essential nutrient that critically contributes to embryonic development. Deficiency or excess of this vitamin give rise to congenital malformations in humans and animal models. Dr. Sue Shapses studies the metabolic regulation of Vitamin D and how the deficiency can contribute to the risk of bone loss. Her study's preliminary conclusion is that mice with vitamin D deficiency, consume more food and gain more weight. It is well known that obese individuals have lower vitamin D status. Her group's findings suggest that low vitamin D status may contribute to greater food intake and obesity, rather than obesity causing low vitamin D status (which is the more common belief in the field).

Food safety is another major focus of NJAES researchers. Dr. Kit Yam has been developing innovative antimicrobial packaging systems to improve food safety and quality in the supply chain. Dr. Mukund Karwe's group has demonstrated antimicrobial methodologies of plasma-activated water to be used as an environmentally friendly sanitizer to improve the food safety of fresh produce. This technology offers an alternative to chlorine-based sanitizers which leave harmful residuals. Dr. Don Schaffner's group studies a number of food safety risks. Over the last year they have focused on salmonella on cucumbers, pathogen survival in low water foods, listeria on raw fruits and vegetables and harmful bacteria in uncured meats. Dr. Schaffner interacts with many audiences about food safety issues through his podcast and with direct contact with food producers, researchers, retailers and food service employees.

Critical Issue: Ensuring Positive Outcome for Our Youth

Extension Projects/Reports associated with this CI:

RCE provides positive youth development opportunities to youth, in-person and virtual, throughout the state and continues to develop a skilled volunteer and paraprofessional workforce trained to deliver high content educational and engaging programming. This programming is proven to grow life skills like confidence, independence, resilience, and compassion through stages and developed through experiences, not only instruction. Some of the programs offered this year include 4-H Clubs such as the *Urban Youth Farm Club*, a summer program serving youth in Hudson County ages 11-18 at the community garden, and small urban farm sites led by adult volunteers from the community. Youth gain hands-on experience in gardening, animal husbandry, urban agriculture, or art by volunteering 2 hours a week for 8 weeks in the summer; *4-H Middle Earth Student Ambassadors for Community Health*, a club that empowers youth to identify issues in their community that affects them and then implement self-designed projects to make their communities healthier and more vibrant; *4-H From Home*, a new model of Extension programming as a result of the COVID-10 pandemic that has proven successful in reaching diverse audiences with very positive youth development experiences. This programming model resulted in increased programming in locations around the state where programming is not widely available due to limited resources; 4-H STEM Explorers, a program to encourage urban youth from groups underrepresented in STEM to participate in science and research in a series of interactive activities to gain a better understanding of opportunities available in science, engineering, and technology.

Research Projects/Reports associated with CI: 1 (one active and classified)

This Critical Issue primarily focuses on youth and 4-H programs. During FY2021, there was one research project associated with this critical issue, the multistate project titled "Understanding Recruitment and Retention in the 4H Club Program." Project Director Jeannette Rea-Keywood was able to advance the goals of this project through Qualtrics surveys distributed to first-year 4-H families to improve youth recruitment and retention and Rutgers was key to the group goals as our Office of Research Analytics was contracted to help with providing analysis of the data from the surveys. Unfortunately, Ms. Rea-Keywood passed away in December of 2021 and she was noted as an integral part of the project and co-chair of the multistate group.

Critical Issue: Maintain Viable Agriculture and Aquaculture

Extension Projects/Reports associated with this CI:

NJAES/RCE faculty and staff are committed to investigating novel ways to support commercial growers while striving for economic and environmental sustainability. They continue to work to develop value-added and direct marketing opportunities for growers through programs such as *Beginner Farmer Training*, a program to address the aging agribusiness sector by empowering the next generation of Garden State farmers; *On-Farm Food Safety*, providing training and technical assistance to the fruit and vegetable industry in order to improve food safety practices. This training and technical assistance helps those in the industry to understand their responsibility and comply with federal and state regulations to ensure the fruits and vegetables they produce are grown, packed, and shipped safely; *Barnegat Bay Shellfish Restoration Program*, programming to educate clientele on the status of our coastal marine ecosystems, the important role of shellfish within these ecosystems, and how a change in behaviors can help improve the health of marine ecosystems via responsible coastal stewardship practices; *Agricultural Innovations Program*, designed to meet the evolving needs of growers by providing educational opportunities, field demonstrations, and farmer to farmer networking focused on new crops, sustainable

growing practices, creative marketing, and training for beginner farmers; and *Agritourism Training and Risk Management*, programming for farmers who utilize an agritourism model for direct marketing to customers. This project provides training and resources on agritourism safety and liability for farm and service providers.

As indicated above under the Research projects regarding Hemp, NJAES research & extension faculty have been active with field trials that have provided valuable information to enable the NJAES/RCE faculty to produce a New Jersey Hemp Production Guide, along with educational programs to assist hemp farmers to produce hemp viably and sustainably in a market they have entered late.

Research Projects/Reports associated with CI: 40 (fourteen active and classified, twenty active and not classified, six final)

In agriculture, variety selection is a key strategy for managing pests and diseases, as well as improving yields and profits. At Rutgers New Jersey Agricultural Experiment Station, our breeding programs develop and evaluate varieties for New Jersey and the region. They select cultivars for factors including fruit quality, yield, and resistance to diseases of local importance. NJAES researchers study a wide variety of plants such as cranberries, blueberries, tomatoes, peppers, ornamental trees, basil and other herbs, hazelnuts, and turfgrass. We also support a shellfish research and breeding program which works to sustain the industry against world challenges such as pollution, overfishing and climate change.

Additional goals of plant breeding include heat and drought tolerance and cold hardiness. By creating a greater array of genetic diversity in bioculturally preferred food crops, NJAES researchers are improving the access to, availability of, traditional or indigenous foods crops now universally available. The more basic work in chemistry and bioanalysis conducted by NJAES faculty is designed to lead to new and novel safe and effective products to improve health and nutrition of families.

For example, over his 5-year project, Dr. Thomas Molnar's group field-planted and closely evaluated over 45,000 hazelnut seedlings from controlled crosses made at Rutgers and Oregon State University. They continue to evaluate, make selections, and cull poor performing trees from their breeding nurseries that hold seedlings segregating for eastern filbert blight (EFB) resistance as well as traits of high importance to commercial nut production and for ornamentals. Today, hazelnut breeding and research efforts continue at Rutgers University with goals to support the emerging eastern U.S. hazelnut industry with a diversity of improved disease-resistant cultivars. The team is also working with partners to develop improved hybrid hazelnuts that have excellent kernel quality, high yields, and adaptation to much colder regions.

An area relatively new to NJAES is the Rutgers Hemp Program headed by Dr. Raul Cabrera. In late 2019, New Jersey was among the first three states to have its Industrial Hemp Program approved by the USDA. There is an urgent need and interest in generating knowledge, recommendations and best management practices that allow for the successful production, harvesting and postharvest handling of hemp crop variants: grain, seed oil, fiber, and floral organs (buds). The group's studies are aimed at generating useful, timely and economically sound information on the best agronomic and horticultural management practices for the production of quality hemp crops used for flower bud production under intensive field (plasticulture) and greenhouse systems. (Integrated Research & Extension)

In our Critical Issue of Ensuring Healthy Outcomes, we highlighted our research in food safety and this also extends to this Critical Issue of Maintaining Viable Agriculture as well. Dr. Karl Matthews's group is investigating methods to improve the microbial safety of crops. In particular, they are researching the spread of antibiotic resistant bacteria (ARB) on leafy greens. The research when completed will support development of strategic approaches to reduce spread of antibiotic resistant bacteria and promote sustainable practices to control spoilage and pathogenic bacteria on raw commodities. Collectively, this will serve to mitigate human illness on a global scale.

Critical Issue: Protect and Sustain Our Resources

Extension Projects/Reports associated with this CI:

Extension programming in this critical issue focuses mainly on marine fisheries, and continuing and improving the sustainability of these industries, particularly in stock assessment and fisheries management. Outreach and education include the *Introductory Fisheries Science for Stakeholders (IFISSH)* course in which stakeholders are educated on the science, management, and responsible stewardship of fishery resources so they are better prepared to make progress on and get involved with issues impacting their industries; *Responsible Commercial and Recreational Fishing Practices*. Ongoing research is being conducted to test dredge modifications for the commercial sea scallop fisheries. Recent research has helped to identify ways for recreational anglers to reduce discard mortality and these best practices are being used to educate anglers.

Research Projects/Reports associated with CI: 29 (fourteen active and classified, nine active and not classified, six final)

The research conducted in this critical issue area focuses primarily on how changes to our environment affect humans as well as land and aquatic animals as well as how these changes affect our natural resources. The highlighted results from this period show the diversity of research performed by faculty at the New Jersey Agricultural Experiment Station.

Dr. Jeff Boyd is working to combat antibiotic resistance in bovines. *Staphylococcus aureus* is a major cause of bovine mastitis—a disease that results in decreased milk yield and costs the dairy industry billions of dollars each year. There are promising results with his group and collaborators' research, showing that copper as an antimicrobial compound can prevent the growth of *Staphylococcus aureus*.

With climate change affecting the amount of water available for crops, Dr. Raul Cabera's studied the costs and benefits of installing a water recycling system in commercial nurseries. Since ornamental crops and landscape plantings utilize a large amount of irrigation water and fertilizers, finding alternative water resources and studying their potential effects on plants is a priority. Dr. Cabrera's project is also heavily integrated with extension-based outreach in both English and Spanish to many audiences including nursery and greenhouse growers, county agents, master gardeners and landscape and tree care personnel.

Another major environmental concern being studied by NJAES researchers is plastic contamination, namely micro and nano plastics. Dr. Keith Cooper's group examined different plastics and their effect on developing zebrafish. This research is theoretically translatable to larger vertebrates and may identify toxic effects on organs and show which plastics should be phased out due to adverse effects versus which ones show little adverse biological issues.

Other results this year under this critical issue involve diverse areas such as weed management which is important due to the increase in organic production. Data from a weather station belonging to the Rutgers NJ Weather Network and located at the RAREC station are also used for this project to help with modelling of weed emergence.

Another newsworthy area being studied by Rutgers NJAES researchers involve the effect of offshore wind facilities in the Mid-Atlantic Bight on recreational and commercial fisheries. Preliminary studies in this area involve the effects on water quality and ecological impacts.

Merit and Scientific Peer Review Processes

Updates

None.

Stakeholder Input

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

None.

Methods to identify individuals and groups and brief explanation

None

Methods for collecting stakeholder input and brief explanation

None

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

Most New Jersey counties have established a County Board of Agriculture and an RCE agent assigned to the county serves as a nonvoting member of each county's board. In addition to providing in-kind support to RCE in the form of office space and county-paid staff, New Jersey's counties also provide direct funding to support RCE county agent and programmatic staff salaries. Each county's Board of Agriculture also appoints a representative to the NJAES Board of Managers.

Regular virtual meetings of the New Jersey Board of Managers were held over 2020-2021. These meetings are not only attended by the members elected by each county's Board of Agriculture mentioned above but are also attended by members of the New Jersey Department of Agriculture, the New Jersey Farm Bureau and leadership from the University at large. These meetings provide valuable feedback from every corner of the state and have influenced our various critical issues and drive our research and extension focus areas. Some of the many topics addressed over the year include the following:

- Addressing funding and COVID-delay issues to continue to support research facilities and extension programs.
- Supplemental funding has been appropriated to strengthen the NJAES Equine Science Center and the NJ Climate Resource Center. Supporting research and extension work in agrivoltaics (dual use solar) and tick surveillance and control were also recently approved.
- Reported in the September 2021 Board of Managers meeting, recently there was an in-service in-person training on soil health at Horticulture Farm III. With its redevelopment, this farm is now more versatile and suited to more uses. An interdisciplinary approach brought people from a range of perspectives to this event. In addition to participants from NJAES/RCE, attendees included representatives from USDA, SADC, NJ Dept. of Agriculture, and NCRS.

Highlighted Results by Project or Program

Critical Issue

Build Sustainable and Resilient Communities

Rutgers Environmental Stewards (RES) Program

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7002044



Rutgers Environmental Stewards (RES) Program

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

New Jersey has been a leader in environmental protection since the 1960s. Located within a major metropolitan area between two of the largest cities, NJ is also the most densely populated state in the nation. Due to its geography and ecological diversity, along with intense industrial expansion, transportation hubs, and urban growth, New Jersey was one of the first to enact legislation and policies to address air pollution, land conservation, flood hazard, and hazardous substances, among others. Many of these laws pre-date federal legislation. Despite the dense population and urban land uses, there is much to protect and conserve since NJ is an ecologically diverse state with the highlands, ridge, and valley section to the north, and piedmont and coastal plain to the south. These different physiographic regions, in addition to two major rivers boundaries, the Delaware to the west and Hudson to the east, provide an incredible variety of habitats for native and migratory species. This includes 2000 native plants, 62 land mammals, 85 freshwater fish, 480 birds, and 151 butterflies. Over 800 native plants are listed as endangered or species of concern due to competition from invasive species, habitat loss, and an overabundance of deer. In addition, water quality and quantity for NJ's growing population and agribusinesses, the fragmented forests across the state, lands of state and federal importance, and climate change affect recreation and tourism expectations and access. New Jersey's municipal land use law facilitates how New Jersey's 564 municipalities can plan and zone for development in their towns. The local zoning officer and the volunteer planning and zoning board members are responsible for interpreting the town's master plan and ordinances. Therefore, it comes down to the people of New Jersey to protect the natural resources and make sure that sound land-use decisions are being made to protect the land, air, water, and ecological integrity of the state. New Jersey must have an educated network of volunteers with a sound understanding of the ecology, land use principles, environmental regulations, and the current environmental issues affecting the state.

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

The program has trained close to 1000 volunteers in areas concerning climate change, soil health, alternative energy, water resource protection, invasive species, habitat conservation, pollinator health, environmental policy, and more. Stewards learn about the techniques and tools used to monitor and assess the health of the environment. They gain an understanding of the research and regulatory agencies operating in New Jersey that focuses on environmental issues. Stewards are introduced to a network of expert individuals and organizations who can be of service to them in the future as they wrestle with solving local environmental problems.

The objectives of the program include:

- Expand the research and educational capacity of RCE to provide research-based information about natural resource management and environmental protection through a network of trained volunteers.

- Develop and enhance community programs related to environmental stewardship. These programs may involve education, demonstration, or implementation and address issues such as stormwater management, habitat conservation, alternative energy, wildlife management, climate change education, pollinator conservation, linking nature and artistry, or other programs as determined by local need.

- Enable Stewards to give back to their communities and create positive environmental change. 2020-2021 was a very exciting year as we became more efficient and took advantage of the online learning resources at the University. The course portion was moved to one, state-wide online class with 4-to 5 in-person field sessions. The class is broken up into 5 regions, each with its own coordinator focusing the content on regional issues of importance. Stewards received 20 hours of online content running from January to May, with field trips to ecologically significant habitats. Over 20 Rutgers faculty, staff, and natural resource professionals help teach the course via Canvas (learning management software). The course content consists of live and recorded presentations, breakout discussions by region, fact sheets, and pre and post retrospective surveys. Each week focused on a different environmental topic: Week Topic 1. Introduction, Program overview, and Internships 2. Understanding the Chemistry of Environmental Pollution 3. Water, Watersheds, and Water Resource Management 4. New Jersey Climate Change and Weather 5. Solid Waste Management and Recycling 6. Renewable Energy 7. The Dirt on Your Soils: Introduction to Soil Health 8. Conflict Resolution, Influence and Communication 9. Local Techniques and Ordinances for Environmental Protection 10. Pollinator Conservation 11. Scientific Literacy and Communication 12. Internship Planning and learning from peers 13. Environmental Justice 14. Green Infrastructure Self-paced Invasive Species of New Jersey Self-paced The Ecology of Native Plants 15. Invasive Species/ Natives in the field 16. Wildlife Management/ Habitat Restoration 17. Program evaluation, internship planning, end of class discussion

Students are certified as Rutgers Environmental Stewards once they have completed 60 hours of classroom instruction and 60 hours of a volunteer internship. The internship is one that the steward develops with guidance from the program coordinator. The internship project helps stewards get real-world experience working on environmental problems in their communities. Stewards conduct their internship on their own or with a host organization, such as a local nonprofit or government agency. Planning for the internship project is woven into the course portion of the program and Stewards receive training on creating goals, objectives, and a timeline. A new searchable project database enables Stewards and Extension staff to easily review projects and network with other volunteers working on similar issues. Available at: <https://envirostewards.rutgers.edu/certified-intern-projects/>

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

Rutgers Environmental Steward volunteers work on a diverse array of projects from protecting Pine Snakes in the Pine Barrens, reducing plastic waste, to protecting local rivers and streams with rain gardens. Stewards are typically excited about science and the natural world around them, engage with their local policymakers, doing their part to make a difference, and are self-starters. Many stewards go on to become members of their local environmental commissions, green teams, and planning boards. Anyone can become an Environmental Steward, no environmental degree is necessary. They simply need a passion for the environment, a desire to learn, and a willingness to volunteer to create positive change in your community.

Having the program online and in the evenings enabled more people to participate. There is a 120 enrollees, the largest class to date. Surveys of the 2021 class participants (n=97) indicated that 75% felt the instruction and teaching was excellent and 84% felt the overall program and content was excellent. 81% indicated that the course material delivered via Canvas was easy to use/ learn. 97% indicated that they would recommend the program to their friends and colleagues. 100% indicated that their environmental knowledge increased because of the program and of those respondents 76% indicated their knowledge increased either to a great or considerable extent. 84% indicated that the program has helped them understand how they can improve the environment in their own community. 89% indicated their enthusiasm for environmental volunteerism has increased because of their participation.

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

Twenty Stewards completed certification projects in 2021. \$7,000 grants and donations were garnered for their projects. 6,300 people were educated as a result of their work. 200 additional volunteers were recruited by Stewards. 4,226 volunteer hours were completed which equates to \$117,756 in volunteer time based on 2021 independent sector volunteer hour values.

Examples of projects completed by Stewards include: A Steward (Essex County) worked to amend the town ordinance to reduce permitted periods of gas-powered lead blower use. Residents are now allowed to use GPLB from March 15- to May 15 and October 15-December 15, a reduction of 75 days per year. Residents are also encouraged to leave their leaves to benefit

wildlife habitats. The creation of a website www.QuietMontclair.org provides residents with valuable information about the new ordinance and its benefit to the community and the environment. The website also details quiet alternatives to yard maintenance that are easy to follow and implement. Another Steward (Camden County) created a Monarch Waystation to raise awareness of Monarch habitat needs in Collingswood. She recruited 15 volunteers including a local Girls Scout Troop and 3 Waystations were planted using 21 plant kits donated by the Horticultural Society of South Jersey. Rock and mulch were donated by community members. This project cultivated a healthier ecosystem for Monarchs while raising awareness and interest in protecting the species. A map was developed pinpointing current projects and future sites encouraging community members to get involved. To further support the project a google doc overview was made available to the community in addition to a Facebook page. Another Steward (Essex County) created an informative, easy-to-follow “Home Eco-Guide” with environmentally friendly practices for residents of South Orange and Maplewood. The booklet provides the reader with simple tips on conservation, stormwater management, food waste reduction, native plant gardening, recycling, and more. 20,000 copies were printed and mailed to residents. She secured \$5,000 in donations from Pollack Properties Group, Guaranteed Rate, Ecosmart Kitchen & Bath Design, and Township of South Orange Village. The guide is available online: <https://www.georgiamadiba.com/home-eco-guide>. Several Stewards (Burlington County) developed a “Give a Bee A Home” project to improve native bee habitats by educating the public and providing the supplies needed for a backyard bee home. 1,000 packets were made containing information on native bees, a list of additional resources, and two bamboo nesting tube bundles. The packets were distributed to community members at local events and farmers' markets over 7 weeks. In addition, an informative video was made detailing the project and the importance of protecting our native bee population. This project was conducted in Burlington, Mercer, Ocean, and Bucks counties. One Steward (Burlington County) worked with the Crafts Creek Springhill Brook Watershed Association to increase the knowledge of municipal leaders about planning and zoning impacts on the environment. Organized a symposium dedicated to educating local municipal officials and committee members. She recruited faculty from Rowan and Rutgers to present to over 50 attendees including representatives from 8 municipalities and several local environmental organizations. The symposium was held at the Rutgers EcoComplex and provided attendees with critical information that they have been able to use immediately to advocate for green infrastructure. “The day after the symposium, the mayor of Florence sent a letter to the NJDEP on the negative impacts a major site plan happening in a bordering town could potentially have on his residents and requested additional review based on data gathered from the symposium and NJMAP. Two days later an invitation was received to provide a follow-up lesson for an entire Land Use Board that had only sent their administrator and she reported back that this presentation should be mandatory for all who serve on a Board Social media posts with impervious surface percentages for townships have been popping up in the town groups all over Facebook causing a lot of dialogue and great conversations. This symposium created ecological ambassadors and gave them the tools to continue educating throughout our communities.”

Descriptions of all projects can be viewed at <https://envirostewards.rutgers.edu/certified-intern-projects/>.

Rutgers Master Gardener Program

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7002045



Middlesex County Master Gardener Program

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

Middlesex County and New Jersey urban and suburban populations have continued to rise which has led to the creation of more gardens and landscapes. Middlesex County has over 825,000 residents living in 323 square miles of space making it the second most populated county in New Jersey. As a result, more residents were seeking out non-biased research-based information; thus, more requests for educational programs and assistance. For the Cooperative Extension staff and faculty to address the needs of this large number of clientele's questions and inquiries, the Master Gardener Program was established in 1988, the 5th New Jersey County to have a program.

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

Since the inception of the program 33 years ago, 492 students have completed the requirements of the program for Master Gardener Certification. In 2021, 36 students graduated and received their Master Gardener Certificates. To receive the certificate, each person must satisfactorily complete the classroom instruction and volunteer hours set forth by Rutgers Cooperative Extension of Middlesex County. There are approximately 20 classes and mandatory hands-on field experience to apply what was learned in class. These trained volunteers have reached out to approximately 10,000 extension clientele in 2021 with research-based information and educational opportunities.

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

Master Gardeners received in-depth training in horticulture from NJAES/RCE faculty and professional staff. As part of the training, Master Gardeners volunteered hours, working in their community in programs sponsored by Rutgers Cooperative Extension. Successful graduates became Certified Master Gardeners after they completed their volunteer service. Many choose to continue as active Master Gardener volunteers working in their local Extension office.

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

Beneficiaries of Rutgers Master Gardener educational programs increased their knowledge in the topics of horticulture, environmental conservation, pollinator conservation, composting, and ornamental gardens. This effected behavior change including the planting of native plants and plants for butterfly habitat, composting of lawn clippings, conservation of water through improved lawn and garden watering, and improved cultural practices for growing vegetables in home gardens. Each year, approximately 10,000-12,000 people are reached through various Extension activities, projects and programs for adults and youth. These include demonstration gardens; Garden Helpline; Speakers' Bureau; school gardens; Rows for the Hungry; Horticultural therapy, and community events. Total Master Gardener volunteer hours for 2021 were 4,927. Based on the NJ Volunteer Sector hourly rate in 2021 (\$28.54), the total value of Master Gardener volunteers was \$140,616.

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

This result highlights a Master Gardener program in a New Jersey county.

Water Resources Education and Technical Support

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7001419



Green Infrastructure Champions

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

Green Infrastructure Champions is an Extension program originally piloted in 2019 to empower local stakeholders to play a dominant role in encouraging their own municipalities to implement green stormwater infrastructure practices.

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

This Extension program continues to train and certify Green Infrastructure Champions to be able to: 1) enhance their knowledge through green infrastructure seminars and research 2) engage community leaders to adopt green infrastructure as a stormwater management solution by updating ordinances and municipal master plans 3) encourage local nongovernmental organizations (NGOs) and schools to incorporate green infrastructure in their existing landscaping 4) secure funding for green

infrastructure, and 5) publicize the implementation of green infrastructure. One hundred twenty-two participants completed five or more sessions to become certified Green Infrastructure Champions and leaders who can advocate for green infrastructure in their communities.

2021 Training Program included the following sessions:

["How to identify green infrastructure projects in your town"](#)

This workshop provided an overview of green infrastructure practices and how to identify sites that can be retrofitted with green infrastructure. A green infrastructure site assessment checklist was provided to all attendees.

["Moving from planning to implementation of green infrastructure"](#)

The various components of green infrastructure planning was discussed including tools that can be used to help prepare these plans. Leveraging existing projects, building partnerships, writing grants, project costs, and lessons learned during the implementation were also discussed.

["Maintaining green infrastructure practices/projects"](#)

The key to long-term success of green infrastructure is maintenance. The workshop discussed the maintenance requirements for each green infrastructure practice. Model maintenance agreements were shared and discussed.

["Stormwater management regulations, policies, and ordinances"](#) & ["The Watershed Institute Enhanced Model Stormwater Management"](#)

Many people look to state and local policies, regulations, and ordinances to actuate a long-term change in how communities address stormwater issues. This workshop discussed the current regulations and offered examples of policies and ordinances that help communities reduce flooding and improve the health of their waterbodies.

["Green infrastructure planning and implementation for Sustainable Jersey points"](#) Green infrastructure planning and implementation activities can be used to earn points through the Sustainable Jersey Program. This workshop discussed planning as well as implementation activities that can be completed to obtain Sustainable Jersey points.

["Green infrastructure projects for schools"](#)

Public, private, and charter schools all tend to provide opportunities for green infrastructure. This workshop discussed green infrastructure projects for schools and educational programs that accompany these projects to engage school children, their parents, and teachers.

["How to design and build a rain garden"](#)

One of the easiest green infrastructure practices to design and build is the rain garden. In this workshop, attendees learned how to design and build a rain garden. The workshop included useful tools for design including the New Jersey Rain Garden Manual and the Rain Garden App.

["Retrofitting traditional detention basins with green infrastructure"](#)

Detention basins have been used throughout New Jersey since the early 1980s. While these basins do reduce stormwater runoff peak flows from developed areas, they do very little to reduce stormwater runoff volumes or pollutant loads. This workshop discussed retrofitting detention basins to improve infiltration capacity, enhance their ability to reduce pollutant loads, reduce maintenance.

9. ["Developing green infrastructure master plans for an entire site or neighborhood"](#)

Many communities have installed a green infrastructure demonstration project. This workshop helped attendees build upon that individual project to create master plans for an entire site, municipal complex, school ground, corporate complex, or a neighborhood.

10. ["Using green infrastructure to promote climate resiliency"](#)

Climate changes, including rising sea level, more intense storms, and longer periods of drought between storms, can increase stormwater runoff. Green infrastructure practices can be used to minimize these impacts and promote climate resiliency. This workshop discussed opportunities for green infrastructure to mitigate the effects of climate change as well as the design considerations that must be made to combat changing rainfall patterns and sea level rise.

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

10 training sessions (via Zoom) with an average attendance = 108 # of people who attended at least one session = 226 # of people who attended at least five sessions a.k.a. Green Infrastructure Champions = 122 # government/municipal organizations = 92 # NGOs/Partnerships/Nonprofit Organizations/Academic = 33 # of private organizations = 25. Participants were provided with the following:

- Training on green infrastructure planning and implementation
- Technical support to develop a design for a green infrastructure demonstration project
- Networking opportunities with other Green Infrastructure Champions for mutual support
- Assistance with grant writing and submission

All of the virtual sessions expanded the outreach beyond New Jersey with participants from as far away as Kansas City, KS to Saint Croix, USVI and San Juan, PR.

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

Just like with the first and second years of the program, several Green Infrastructure Champions have begun to advocate for and implement green infrastructure projects in their own communities.

Closing Out (end date 09/07/2023)

Reducing Pest Infestations and Pesticide Use in the Urban Environment

Project Director

Changlu Wang

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1019198



Reducing Pest Infestations and Pesticide Use in the Urban Environment

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

The urban environment is surrounded by multiple pests that are both economically and medically important. Among them, German cockroach, bed bugs, house mouse, termites, and ants are the most common and important urban pests. To reduce the economic damage, nuisance, or health risks caused by these pests, effective methods and materials need to be developed and adopted.

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

Cockroaches. The German cockroach is the number one indoor pest in the U.S. It is found on all continents and a perennial pest of kitchens, hotels, restaurants, hospitals, food manufacturing industries, transportation systems and other facilities. It is an important mechanical vector of diseases and producer of allergens. Sticky traps are standard tools for monitoring German cockroaches. However, because they lack an attractant, their ability to catch cockroaches is by chance and largely dependent

upon the location of placement and length of time they are left in place. Currently, highly effective and economical cockroach attractants are not available. Food-based attractants have the potential to be employed in sticky traps and enhance their effectiveness on trapping German cockroaches. Therefore, we conducted laboratory and field experiments to evaluate the effectiveness of novel food-based attractants. Laboratory results showed that sticky traps containing the following

attractants: apple oil, blueberry oil, orange oil, or their combination, fish oil, peanut butter, Roach lure tablet (a commercial cockroach lure product), and bacon extract had significantly higher trap catch compared to those traps that do not contain an attractant. Apple plus blueberry oil mixture and Roach lure tablet enhanced the trap catch by $\geq 103\%$, and bacon extract enhanced the trap catch by 92% in the field assays. Apple plus blueberry oil mixture and Roach lure tablet were the most promising attractants based on laboratory and field experiments. Apple plus blueberry oil mixture aged for 2 weeks was as attractive as fresh oil mixture to German cockroaches. The information can be used for improving the current cockroach monitoring methods and better manage cockroach infestations through more attractive baits.

German cockroaches in apartment buildings are routinely controlled using insecticides applied by residents or through contracted professional pest control services. Many of the natural cockroach infestations have low cockroach numbers. Whether they can be effectively suppressed without insecticide application is unknown. We carried out two studies to compare the effectiveness of mass trapping and baiting to control cockroaches in apartments with very low number of cockroaches. We used apartments with 1-9 cockroaches based on four glue boards deployed over 14 days. A total of 68 and 41 apartments were included in study I and study II, respectively. In each study, the apartments were divided into three groups (baiting, trapping, and control). In the trapping group, glue boards were placed in each apartment in studies I and II respectively. In the baiting group, five and 10 g of bait was applied per apartment in study I and II, respectively. We monitored the cockroach population monthly for up to three months. Baiting and trapping had similar effectiveness in suppressing low-level German cockroach populations in apartments. They significantly reduced the German cockroach numbers in study II.

Bed bugs. The common bed bug (*Cimex lectularius*) resurged as an important urban pest in the last 20 years, yet there are no commercial repellent products labeled for bed bugs available in the U.S.. There are concerns on how to avoid getting bed bugs during travel or working in bed bug infested environment. We evaluated the repellency of two catnip oils from newly developed cultivars, CR3 and CR9, and compared each to 10 and 25% DEET. DEET is the most commonly used insect repellent on the market, but it is corrosive, and is not labeled for bed bugs. Arena studies showed that CR3 and CR9 oils were more effective than DEET within a 24 hour period. At 10% concentration, both CR3 and CR9 oils exhibited a repellency of over 94% during the first 8 hours. At 25% concentration, the repellency of CR3 and CR9 oils increased to 100%, and repellency of DEET was 92% during the first 24 hours. Repellency of 25% CR3 and CR9 oils became lower than 25% DEET after being aged for 3 days. Soiled socks were placed above repellent treated bands to determine if the repellent can protect soiled socks from being infested. The 20% CR3 oil prevented 100% of bed bugs from infesting soiled socks showing that it was more effective than DEET. These results indicate that catnip oils from CR3 and CR9 cultivars are more repellent than DEET over a 24 hour period following application, but their longevity is shorter than DEET after 72 hours. They are also safer to human compared to DEET. Additional studies are being carried out to commercialize the CR3 and CR9 catnip oils for repelling blood sucking arthropods.

It is widely established that bed bugs have a strong host preference for humans. However, there are records of bed bugs feeding upon a range of mammalian and avian hosts, including rodents, in the field. There is little information available about how frequently common bed bugs feed on alternative hosts in residential settings, but understanding this phenomenon has implications for both management of infestations and public health. We examined bed bugs collected from 13 different dwellings in the state of New Jersey, that were known to be simultaneously infested with house mice. Host specific quantitative polymerase chain reaction (qPCR) was used to determine if blood meals were taken from mice. We found no evidence that any of the bed bugs we collected fed on mice. However, host-specific qPCR detected feline DNA in a pool of bed bugs from one dwelling, suggesting that interaction with domestic pets should be further investigated.

Bed bugs are difficult to find. Common methods of detection include interview with clients, visual inspection, using monitors, and using trained canines. We compared the above four methods at Linden Housing Authority for detecting bed bug infestations. A total of 53 apartments were accessed and 25 residents were interviewed. The most reliable method is placing Climbup interceptors under furniture legs for two weeks. It detected 91% of the infestations. The 2nd most effective method is conducting a comprehensive visual inspection of the furniture and surrounding areas. It detected 45% of the infestations. Residents interview found 20% of the infestations. Canine inspection was the least effective. It only detected 12% of the infestations. Our study helped residents and the property management identify 34 bed bug infested apartments.

Termites. Native to eastern Asia, the Formosan subterranean termite (*Coptotermes formosanus*) is recognized as one of the 100 worst invasive pests in the world, with established populations in Japan, Hawaii and the southeastern U.S.. Despite its importance, the native source(s) of *C. formosanus* introductions and their invasive pathway out of Asia remain elusive. Using ~22,000 single nucleotide polymorphisms (SNPs), we retraced the invasion history of this species through approximate Bayesian computation and assessed the consequences of the invasion on its genetic patterns and demography. We show a

complex invasion history, where an initial introduction to Hawaii resulted from two distinct introduction events from eastern Asia and the Hong Kong region. The admixed Hawaiian population subsequently served as the source of new introductions to the southeastern US. A separate introduction event from southcentral China subsequently occurred in Florida showing admixture with the first introduction. Overall, these findings prove that multiple introductions occurred out of China and these events helped prevent the loss of *C. formosanus* genetic diversity within its invasive range.

House mice. The house mouse is a very common pest in low-income multi-family residential dwellings. They cause significant property damage and produce allergens that are linked to asthma and allergy. Current mouse management practices in these dwellings are not effective. We conducted a study to gain insights into residents' impressions of house mice, develop more effective mouse detection methods, and evaluate the effectiveness of building-wide mouse management programs. The programs were implemented by researchers for 63 days and the results were monitored for up to 12 months. Significant differences were found in the efficacy of two commercial blank baits for detecting house mouse activity. Chocolate spread was significantly more effective than both commercial blank baits for detecting house mice. Between the two commercial toxic rodent baits tested, FirstStrike® (0.0025% difethialone) was more palatable than Contrac® (0.005% bromadiolone) rodent bait. A building-wide mouse control program resulted in an 87% reduction in mouse activity after three months in two buildings. After 12 months, the number of infestations decreased by 94% in one building, but increased by 26% in another building. Long-term house mouse control requires continuous efforts and the incorporation of multiple strategies.

In collaboration with New Brunswick Housing Authority at New Brunswick, NJ, we conducted house mouse control in 6 low-income buildings (48 apartments). A one page pamphlet on house mouse prevention and control was handed out to each resident. Traps and baits were used for monitoring and control of house mouse infestations. Dust samples were collected from kitchen floors and bedrooms in apartments with known infestations. At the beginning of the study, 43 and 73% of the sampled bedrooms and kitchens had mouse allergen (*Mus m1*) above the threshold that is associated with sensitization, respectively. After 6 months of intervention, the number of apartments with mice decreased from 32 to 5.

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

Our research and extension activities benefited the housing authorities, residents, and pest management professionals by providing new information on the pest biology, better pest management methods and tools, and reduced pest infestations. More specifically, our community-wide rodent infestation survey at the New Brunswick housing authority (258 units) provided them information on the status of rodent infestations. Our treatment program helped the residents in eliminating 27 infestations in apartments. Our study at Linden housing authority reduced house mouse infestation rate by 94%. We also conducted building-wide surveys of cockroach infestations at Paterson, Irvington, and Jersey City. We treated 109 apartments with German cockroaches and resulted in cockroach elimination in approximately 60% of the apartments. Pest management professionals can use mass trapping instead of gel baits for managing low level cockroach infestations. This will help reduce insecticide use and insecticide resistance management.

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

Our projects will have the following benefits to the general public:

- More communities adopt proactive monitoring of house mouse infestations and preventative treatments
- More residents and communities will adopt more effective bed bug monitoring methods
- Pest management professionals will more likely adopt non-chemical methods to manage low level German cockroach infestations
- Professionals increase the practice of building-wide pest management
- The long-term benefits would be sustained control of pest infestations

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

Three undergraduate students, four graduate students, two technicians, and a post-doctoral researcher participated in the studies. The opportunities helped them broadening their knowledge on pest biology, epidemiology, effective pest control strategies.

Approximately 300 pamphlets were distributed to residents. These pamphlets include information on cockroaches, bed bugs, and house mice prevention and control.

Pest surveys. We contacted 54 housing authorities or low-income communities in New Jersey to investigate the current pest infestation status and impact of Covid-19 pandemic on pest infestations. Among them 13 agencies filled out the survey forms. The pest control cost did not change significantly from 2019 to 2020. Frequencies of pest control visits reduced in 2020 compared to 2019. Residents' complaints about bed bugs and house mice slightly increased in 2020 compared to 2019. Twelve out of the 13 interviewed agencies expressed interest in receiving educations on pest management.

We presented educational seminars at the following events:

- Mercer county master gardener training, 25 people.

- University of Georgia pesticide applicator training. About 40 people.

- Healthy Homes Virtual Conference

- Annual Maine pest control conference. About 90 people.

- USDA Northeastern IPM center webinar. 162 people.

- Environmental Public Health worker short course. 60 students.

- 7th Tennessee bed bug, cockroach, and rodent control conference. 60 people.

- University of Georgia school IPM training. 30 people

- New Jersey chapter of National Association of Housing and Redevelopment Officers meeting, about 25 people.

Plans for next reporting period:

We plan to conduct research and extension activities in at least 6 housing authorities in New Jersey. This will include seminars, pest surveys, pest control. We will also collaborate with manufacturers and government agencies in evaluating new products, policies.

Major changes or problems

The Covid-19 pandemic resulted in lack of access to some communities. We are still facing some restrictions. But we were able to conduct field studies and in-face educations, though at reduced frequency. It is expected that some field sites may still not be fully open to outside researchers in 2022. We will closely coordinate with the collaborators in conducting our research and extension activities and provide assistance to the communities.

Books and book chapters:

Wang, C., C. Y. Lee, and M. Rust. 2021. *Biology and management of the German cockroach*, CSIRO Publishing.

Lee, C.-Y., and C. Wang. 2021. German cockroach infestations in the world and their social and economic impacts, pp. 1-16. In C. Wang, C.-Y. Lee and M. Rust (eds.), *Biology and management of the German cockroach*. CABI, Boston, MA.

Wang, C. 2021. Rearing German cockroaches for research, pp. 75-83, 90-91. In C. Wang, C.-Y. Lee and M. Rust (eds.), *Biology and management of the German cockroach*. CABI, Boston, MA.

Wang, C. 2021. Monitoring, pp. 153-164. In C. Wang, C.-L. Lee and M. Rust (eds.), *Biology and management of the German cockroach*. CABI, Boston, MA.

Miller, D., J. B. Black, and C. Wang. 2021. Management in multi-unit dwellings and commercial kitchens, pp. 269-298, *Biology and management of the German cockroach*. CABI, Boston, MA.

Peer reviewed journal articles:

Abbar, S., and C. Wang. 2021. Laboratory and field evaluations of food-based attractants for monitoring german cockroaches. *Journal of Economic Entomology*. 114: 1758–1763. doi: 10.1093/jee/toab080

Blumenfeld, A. J., P.-A. Eyer, C. Husseneder, J. Mo, L. N. L. Johnson, C. Wang, J. Kenneth Grace, T. Chouvinc, S. Wang, and E. L. Vargo. 2021. Bridgehead effect and multiple introductions shape the global invasion history of a termite. *Communications Biology* 4: 196. 10.1038/s42003-021-01725-x

Potts, R., V. Peta, D. D. M. Agany, E. Z. Gnimpieba, R. Cooper, C. Wang, and J. E. Pietri. 2021. Molecular analysis of the blood meals and bacterial communities of bed bugs (*Cimex lectularius* L.) to assess interactions with alternative hosts. *Parasitology Research* 120: 1209-1217. 10.1007/s00436-021-07079-x

Sked, S., S. Abbar, R. Cooper, R. Corrigan, X. Pan, S. Ranabhat, and C. Wang. 2021. Monitoring and controlling house mouse, *Mus musculus domesticus*, infestations in low-income multi-family dwellings. *Animals* 11: 648. doi:10.3390/ani11030648

Zhang, J., Q. Liang, Y. Xia, D. Kong, C. Wang, S. Mo, Y. He, and D. Wang. 2021. Behavioral response of the tropical bed bug, *Cimex hemipterus* (Hemiptera: Cimicidae) to CARBON Dioxide. *Journal of Economic Entomology*. 114: 2198-2203. doi.org/10.1093/jee/toab159

Shi, X., C. Wang, J. E. Simon, W. Reichert, Q. Wu. 2021. Repellency of novel catnip oils against the bed bug (Hemiptera: Cimicidae). *Journal of Medical Entomology* 58: 528–534. doi.org/10.1093/jee/toab159

Critical Issue

Ensure Healthy Outcomes: Food, Nutrition, Health

Cultivate Healthy Communities (Community level)

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7002109



Taking Action Against Hunger - Dietetic Interns Learn While Feeding Residents

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

Hunger and health are deeply connected. Healthy bodies and minds require nutritious meals at every age. But when people don't have enough food or have to choose inexpensive foods with low nutritional value, it can seriously impact their health. Dietetic interns need rotation experience working at food pantries, farmer's markets, or other food distribution sites to round out their "community experience". RCE FCHS Educators are helping to meet these needs.

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

An FCHS educator is assisting local food pantries and mobile food markets with dietetic interns and nutrition professionals who volunteer. They provide food demonstrations and assist at food distribution sites in Union County including pantries, housing sites, non-profit agencies, and community farmers' markets. A strong partnership has developed with the Food Director of a pantry in Elizabeth which has allowed 5 Montclair State University interns, to have a diverse community experience that included the food pantry as part of their two-week rotation. In 2021, this pantry provided over 550,000 pounds of food including more than 130,000 pounds of fresh fruit and vegetables, and tripled its output due to the pandemic

A major goal of Union County Commissioners has been to reduce hunger in the county which escalated due to the pandemic. RCE and FCHS goals have included projects to reduce food insecurity and promote healthier food intake to ultimately improve the overall health of county residents. The pantry serves meals to over 300 adults/day along with a soup kitchen serving additional residents. Commissioners continue to support this program and others with additional funding to expand food distribution to additional hungry residents.

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

In 2019, the number of food-insecure people in Union County, NJ was 40,200. The rate of food insecurity was 7.3% and estimated program eligibility among food insecure people in Union County was 22%, with the average cost of a meal at \$3.66 and an annual food budget shortfall of over \$ 25 million per year according to Feeding America.

Once the cycle of poor diet and poor health begins, it can be hard to break. Interns were surprised to learn when family members are sick, having to choose between food and treatment can lead to serious complications. For example, food-insecure adults living with diabetes, are choosing between eating healthy food and controlling the disease or experiencing complications like kidney disease, eye disease, and nerve damage. Interns also had no idea that family members in food-insecure households are also more likely to struggle with psychological and behavioral health issues. They also learned that kids struggling to get enough to eat were more likely to have problems in school and other social situations. Over 50% of the adults at the pantry had one or more chronic diseases, most with diabetes.

Interns interacted with pantry residents listening to and seeing the effects of food insecurity, bringing some to tears. Interns expressed their surprise that residents loved their food demonstrations and the nutrition education they received. Interns not only provided education but received a wealth of food insecurity knowledge for their future careers as dietetic professionals. Community and professional partnerships provide a richer experience for students.

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

Dietetic interns are more aware of the needs of hungry families. Food distribution at pantries needs to provide access to healthy foods with more fruits, vegetables, whole grains, low-fat dairy, and lean proteins. Some of the causes of food insecurity include poverty, unemployment, or low-income, lack of affordable housing, chronic health conditions or lack of access to healthcare, systemic racism, and racial discrimination. Interns learned that food insecurity can have a wide impact. Some of the most common, yet complex, effects of food insecurity were serious health complications like diabetes, which many at the pantry faced. They then were forced to choose between spending money on food and medicine or medical care. Interns commented on their experience at the food pantry, "Every day we observed difficult decisions that residents had to make such as choosing between paying for food or heat, electricity, rent, and transportation." Interns were surprised by how thankful residents were for the food pantry nutrition program and local soup kitchen. Another intern commented: " I am more aware of the complications of food insecurity and causes of hunger. It is NOT just a nutrition issue and I plan to volunteer at a food pantry in my town." Thank you for this experience."

[Engineering for food safety and quality](#)

Project Director

Mukund Karwe

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1023526



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

Major goals of the project: (1) Develop advanced and sustainable processing and packaging technologies to transform raw materials into safe, high quality, health-promoting, and value-added foods. (2) Develop mechanistic and data-driven mathematical models to enhance understanding and optimization of processes and products that will ensure sustainable and agile food manufacturing for safe, high quality, and health-promoting foods

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

We have developed methodologies for demonstrating cleaning-in-place potential of plasma-activated water, demonstrated antimicrobial activity of plasma-activated water during growing of sprouts, conducted numerical simulation and experimental validation of bacterial detachment using a spherical produce model in an industrial-scale flume washer, and demonstrated that calcium can be infused in baby carrots using high pressure.

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

Scientists, regulating agencies, equipment manufacturers, and consumers were the primary audiences. We have reached them with beneficial and innovative discoveries through presentations and several publications

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

Plasma-activated water has the potential to be an environmentally friendly sanitizer to improve food safety of fresh produce. This technology offers an alternative to chlorine-based sanitizers which leave harmful residuals.

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

One graduate student and two postdoctoral associates were trained to gain hands-on experience on application of cold plasma technologies and effective fresh produce washing technologies to promote food safety. Two presentations were made at virtual conferences involving basil and vegetable growers (attended by approximately 80 participants).

This next period, we will 1) Install scaled up plasma activated mist (PAM) system in a greenhouse and grow sweet basil with PAM treatment and collect data on plant quality, 2) Install scaled up a plasma activated nutrient solution (PANS) based hydroponic system in a greenhouse and grow sweet basil in the green house, 3) Continue to investigate plasma-activated water as a cleaning-in-place sanitizer, 4) Continue to investigate potential of plasma activated water to improve the safety of sprouts.

Changes/Problems

1) At Rutgers Greenhouse, getting the scale-up trials started this year proved to be very challenging due to delay in delivery of supplies and highly restricted access due to COVID-19 pandemic, 2) Also, the initial hydroponic trials for basil growth were unsuccessful as a result of unanticipated high levels of sodium and chlorine in tap water. The high levels of sodium and chlorine were due to the salts that was sprayed during snowstorm which leached into local tap water supply.

Publications:

Huang, K., Tian, Y., Tan, J., Salvi, D., Karwe, M., & Nitin, N. (2020). Role of contaminated organic particles in cross-contamination of fresh produce during washing and sanitation. *Postharvest Biology and Technology*, 168, 111283. (<https://doi.org/10.1016/j.postharvbio.2020.111283>)

Tan, J., & Karwe, M. V. (2021). Inactivation and removal of Enterobacter aerogenes biofilm in a model piping system using plasma-activated water (PAW). *Innovative Food Science & Emerging Technologies*, 69, 102664. (<https://doi.org/10.1016/j.ifset.2021.102664>)

Metabolic Regulation of Vitamin D

Project Director

Sue Shapses

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1020225



Metabolic Regulation of Vitamin D

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

These studies are expected to result in a better understanding of how vitamin D deficiency affects the function of the intestinal barrier and endotoxin exposure to influence risk for bone loss. Overall, our goal is to contribute to future guidelines for healthy foods and lifestyle choices to prevent osteoporosis and obesity.

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

An objective in this project is to determine whether vitamin D and alcohol intake affects intestinal permeability and bone mineral density (BMD) in older female mice. In a secondary aim, we will examine endotoxin levels, food intake regulation, energy expenditure, and physical activity level to determine if they can explain changes in body weight and BMD. This past year, there has been effort to understand whether mice exposed to vitamin D deficiency (VDD) or alcohol (Alc) had a differential effect on body weight and bone.

Our preliminary findings show that there was no negative effect on bone mineral density, but because fracture risk is dependent on bone quality, bones were also examined for ultrastructural properties. Findings indicated a differential effect of VDD on some bone quality parameters (such as bone thickness and parameters suggesting more brittle bones) as compared to normal control diets. We also examined body weight and composition. Body weight at baseline was 27.4 ± 1.8 g and did not differ between groups.

During the 8 week study, the VDD mice gained more weight than other mice ($p < 0.010$) and while physical activity did not differ between groups, the VDD mice consumed more calories ($p < 0.050$). Mice drinking alcohol had a decreased food intake ($p < 0.001$) compared to mice drinking water. Increases in weight were 0.81 ± 2.9 , 0.82 ± 2.0 , 2.0 ± 1.7 , and 2.95 ± 2 g, in the control, Alc, VDD, and VDD+Alc groups, respectively ($p < 0.05$). There was a significant increased amount of fat gain over time for VDD groups ($p < 0.05$) that did not occur in other groups.

Our preliminary conclusion is that mice with vitamin D deficiency, consume more food and gain more weight. It is well known that obese individuals have lower vitamin D status. The findings here suggest that low vitamin D status may contribute to greater food intake and obesity, rather than obesity causing low vitamin D status (which is the more common belief in the field).

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

Medical and agricultural researchers and health professionals on a local, state, national and international level benefitted from reports, lectures and from original abstracts written in the past year. Volunteers in our research and community programs benefit from lifestyle counseling and during the pandemic, we have continued virtual counseling for wellness and exercise. Vitamin D nutrition and obesity are important areas of research and interest to the public, especially during the COVID pandemic, and results from these studies have been presented by doctoral students and the PI at nutrition and bone national conferences this past year.

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

Lectures discussing the vitamin D metabolism updates have been disseminated to the community and at conferences. In addition, I have organized programs throughout the country including: American Society of Bone Min Research, Symposium "Dietary Patterns and Bone Metabolomics", Chair of Nutrition Working Group and Symposium, Oct 2021. Also, I am an elected member of the NJ State Osteoporosis Agency and at these quarterly meetings and in the classroom disseminate updates on osteoporosis and micronutrients as it pertains to the Institute of Medicine recommendations. I have served on a few grant study sections (eg, NIH and at the university related to obesity concerns) and I review many articles from national and international journals. At the university, I lead a center (Human Nutrition, Exercise and Metabolism; NEXt Center) and our research and others were presented at a large meeting with nearly 200 attendees and we serve the community to promote healthy lifestyle in small groups (including nutrition counseling and exercise-conditioning classes). Together, these scholarly, educational and service activities represent significant contributions to advance the fields of obesity, vitamin D, and osteoporosis on a local, state and national level.

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

There are 3 graduate students who gained training and professional development working on laboratory projects. There was part-time employment for a radiology technician and phlebotomist. In addition, there were 3 undergraduate senior Honors students who have worked in the lab during the academic year and/or during the summer months.

Bone samples have been sent to a bioengineering laboratory at the University of Mass-Lowell (Dr. Lamy Karim, PhD) to better understand how VDD or alcohol affect advanced glycation end products and biomechanical properties of bone. We are anxiously awaiting the results from this new collaborative arrangement since it will explain more about bone quality with these dietary interventions. In addition, because VDD mice gain more weight than others with adequate vitamin D, we want to determine mechanisms that may be regulating this effect. One potential mechanism may be related to the microbiome. This goal (and the microbiome analysis) will be achieved in collaboration with the Dominguez-Bello lab (Department of Biochemistry and Microbiology) at Rutgers U. In addition, because the mice also consumed more food, food intake regulation may be altered and could be explained by changes in orexigenic or anorexigenic neuropeptides in the brain. Briefly, increased hypothalamic expression of orexigenic molecules neuropeptide Y (NPY) and Agouti-related protein (AgRP) stimulate food intake that can lead to weight gain and obesity. Conversely, increased hypothalamic expression of anorexigenic molecules pro-opiomelanocortin (POMC) and cocaine- and amphetamine-regulated transcript (CART) can ultimately cause a decrease in food intake. We hypothesize that vitamin D deficiency in mature female mice will cause an increase in NPY/AgRP and a decrease in POMC/CART, which may partly explain the increased food intake and weight gain observed. The goal to examine neuropeptides is in-progress and in collaboration with NT Bello (Department of Animal Sciences) at Rutgers University.

Publications this period:

Meng L, Su C, Shapses SA, Al-Dayyeni A, He Y, Wang X. Lower total 25-hydroxyvitamin D but no difference in calculated or measured free 25-hydroxyvitamin D serum levels in patients with primary hyperparathyroidism. *J Steroid Biochem Mol Biol.* 2020 May;199:105616. doi: 10.1016/j.jsbmb.2020.105616.

Petropoulou PI, Mosialou I, Shikhel S, Hao L, Panitsas K, Bisikirska B, Luo N, Bahna F, Kim J, Carberry P, Zanderigo F, Simpson N, Bakalian M, Kassir S, Shapiro L, Underwood MD, May CM, Soligapuram Sai KK, Jorgensen MJ, Confavreux CB, Shapses S, Laferrère B, Mintz A, Mann JJ, Rubin M, Kousteni S. Lipocalin-2 is an anorexigenic signal in primates. *Elife.* 2020 Nov 24;9:e58949. doi: 10.7554/eLife.58949.

Closing Out (end date 09/07/2023)

Controlled Release Packaging to Improve Food Safety and Quality of Fresh Produce

Project Director

Kit Yam

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1019195



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

The traditional method of adding antimicrobials to food is often unacceptable because it requires large amounts of antimicrobials to be effective. This project is aimed at developing an innovative technology using the package as a delivery system to release antimicrobials in a controlled release manner to food, such that less antimicrobial is needed to adequately inhibit microbial growth. This technology will not only help improve food safety but will also help improve food quality and reduce food loss.

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

The objective of this project is to develop innovative antimicrobial packaging systems to improve food safety and quality in the supply chain. Below are the experiments and the results during this reporting period:

Experiments were conducted to develop an antimicrobial coating by incorporating hydrogen peroxide and thymol in the chitosan matrix; the coating was applied on a low-density polyethylene film. The efficacy of this antimicrobial film was evaluated by using it to package fresh strawberries. The results show that moisture from the respiration of the strawberries could trigger the release of hydrogen peroxide and thymol, significantly inhibiting microbial growth and maintaining higher firmness and redness quality of the fruit during storage.

Experiments were also conducted to evaluate the potential of metal-organic frameworks (MOFs) as ethylene adsorber to extend the shelf life for fresh produce. Metal-organic framework (MOF) is a relatively new synthetic porous material widely used for gas separation and storage, but its applications for food packaging have only been barely investigated.

The objective of this study was to evaluate the potential of MOFs as ethylene adsorbers, embedded in packaging films, to control ripening and extend the shelf life of fresh produce during distribution. The potential was evaluated at two levels. The first evaluation was at the MOF powder level, where ethylene adsorption capacities of eight commercial MOF powders were measured by GC. The results show that Mg formate MOF (MgF) and Al(OH) fumarate (AlF) have much higher ethylene adsorption capacities than the other six MOFs. MgF is a better ethylene adsorber than AlF because MgF has higher ethylene retaining capability and shows stable ethylene adsorption under various temperatures, relative humidities, and ethylene concentrations. The second evaluation was at the packaging film level, where MgF is embedded into three different packaging films. The results show that MgF embedded LDPE film has higher ethylene adsorption than MgF embedded PLA film and MgF embedded PVA film. Furthermore, a bio-efficacy study confirmed that the MgF embedded LDPE film could effectively delay ripening and extend the shelf life of bananas. In conclusion, this study indicates that MgF has good potential as an ethylene adsorber to extend the shelf life for bananas, probably also for some other fresh produce products.

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

Our target audience is fresh food processors who make value-added products to serve the busy lifestyle of consumers. These products (such as ready-to-eat pre-cut fruits and vegetables) offer the benefits of labor-saving, convenience, shelf space reduction, and help promote a healthy lifestyle. Although the demand for these products is growing, the processors also face the problem that these products are highly susceptible to microbial attack, leading to an average of 22 food safety mandated recalls per year in recent years, causing significant food loss. These problems have sadly brought some processors to bankruptcy. The technology developed in the project will help alleviate these problems.

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

Our technology will provide the public with the benefits of safer, higher quality, and convenient fresh fruit and vegetable products to meet their busy and healthy lifestyle. It will also reduce food loss for the processors and lower product costs for the consumer.

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

This project has attracted the collaboration of two companies. ProAmpac is a leading packaging company with 6000 employees and well-equipped facilities including a new building for its innovation center. MirTech is a company that specializes in technology transfer for the food industry, especially the fresh food industry. We are collaborating with these companies to refine our technology and demonstrate its technical and commercial feasibility.

For the next reporting period, we will develop packaging systems to control the release of antimicrobials at desired rates needed for different applications, which will broaden the usefulness of the technology. We will also evaluate the efficacies of releasing and non-releasing antimicrobial packaging systems to improve food safety and quality.

Closing Out (end date 09/07/2023)

[Enhancing Microbial Food Safety by Risk Analysis](#)

Project Director

Donald Schaffner

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1018396



Approaches and tools to mitigate the risks associated with hazards in food

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

The long-term goal of this project is to perform comprehensive and integrative risk-based research, education, and outreach to improve food safety and advance public health. The project establishes multi- and trans-disciplinary teams of academics, food producers/processors, retailers, consumers and local, state, and federal agriculture and health officials. The research conducted under this project contributes to the understanding of foodborne pathogen ecology and transmission, including the emergence and spread of antimicrobial resistant bacteria, in fresh and processed foods so that more effective mitigation strategies can be designed and applied at various stages of the farm-to-table continuum, including pre-harvest steps.

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

- 1) Risk Assessment: Characterize food safety risks in food systems. Our primary risk assessments over the last year have focused on the survival of Salmonella on whole cucumbers, pathogen survival in low water activity foods, Listeria monocytogenes growth whole intact raw fruits and vegetables, Clostridium botulinum growth during cooling of cooked uncured ground beef and the behavior of Staphylococcus aureus and Bacillus cereus during manufacturing of table spreads. Details can be found in our many publications.
- 2) Risk Management: Develop, validate, and apply science-based interventions to prevent and mitigate food safety threats. Risk management efforts relate to all of the above risk assessment areas, as well as two other publications that provide guidance to risk managers in government and industry. The first is a document written at the request of FAO and WHO as part of their Microbiological Risk Assessment Series. The second is a document written at the request of the American frozen food institute, on alternative approaches to the risk management of Listeria monocytogenes in low risk foods. Citations are provided in the reference section.
- 3) Risk Communication: Convey science-based messages to stakeholders to improve food safety behaviors and practices. The primary means by which I convey science-based messages to stakeholders is via two podcasts which I cohost with Benjamin Chapman from North Carolina State University. From October 2020 through September 2021 we produced 25 episodes of our podcast Food Safety Talk. The website where we host the podcast receives over 15,000 visits per year, with about 15,000 episode downloads per month. From October 2020 through September 2021 we produced 175 episodes of our new podcast Risky or Not which addresses everyday risk from germs. We get about 230,000 episode download per year, and each episode gets downloaded about 1,300 times.

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

Our target audience includes risk managers in government and industry including food producers, researchers, food processors, retailers, and food service employees. We also target food consumers with some of our work. Much of our work includes the development of mathematical models. When published these mathematical models can be used to guide decision making for those that are charged with managing the risk of the areas where the models are developed.

Risk managers in government and industry received microbiological risk assessment guidance from our FAO/WHO publication. Food producers, food processors, and retailers benefited from our models for the survival of Salmonella on whole cucumbers. Risk managers in government and industry and food processors and researchers benefitted from our models for pathogen survival in low water activity foods. Risk managers in government and industry including food producers, researchers, and retailers from our finding that ComBase models are valid for predicting fate of Listeria monocytogenes on whole intact raw fruits and vegetables. Risk managers in government and industry including food processors, benefitted from our model for Clostridium botulinum during cooling of ground beef. Risk managers in government and industry including food processors benefited from our alternative approaches to the risk management of Listeria monocytogenes in low risk foods. Risk managers in government and industry including food processors benefited from our evaluation of the behavior of Staphylococcus aureus and Bacillus cereus during manufacturing of table spreads.

We know from interaction with audience members that our podcast listeners include risk managers in government and industry including food producers, researchers, food processors, retailers, and food consumers. These listeners benefit from our discussions of complicated food safety topics in a way that makes them clear and accessible.

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

As noted above, some of our podcast listeners include members of the general public, and they benefit from our discussions of complicated food safety topics in a way that makes them clear and accessible. Members of the general public benefit indirectly when risk managers are able to use our mathematical models to make good decisions about food safety. This results in unsafe product never making it to the marketplace or being removed from the marketplace. It also reduces food costs by ensuring that some foods which may be or uncertain food safety, are assessed using robust scientific tools and thus can enter the marketplace with the assurance that disease risk is minimized.

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

At least 40 different training opportunities were identified in the reporting period. This includes presentations to those interested in hand hygiene, viral surrogates for SARS-CoV-2, statistical aspects of testing for safety of leafy greens, safety of novel food processes, risk assessment for processed foods, the safety of canned foods, decision making for emerging risks, the nature of foods which require temperature control for safety, and numerous other topics.

There is significant overlap between training and professional development opportunities identified above and dissemination of results to communities of interest. Many of the same topics are covered in these activities as well. As noted above our podcasts reach thousands of people every month with discussion of many of the same topics

We currently have funding for three different research projects in my lab. The focus of future research activities includes bacteriophage phi 6 as a surrogate for SARS-CoV-2, as well as microbiological risk assessment for fresh produce. We plan to continue existing workshops and short courses, to respond to invitations for invited talks, and to continue to produce two podcasts.

From October 2020 through September 2021 we produced 25 episodes of our podcast Food Safety Talk.

<https://foodsafetytalk.com> receives over 15,000 visits per year, with about 15,000 episode downloads per month. From October 2020 through September 2021 we produced 175 episodes of our new podcast Risky or Not (<http://riskyornot.co>) which addresses everyday risk from germs. We get about 230,000 episode download per year, and each episode gets downloaded about 1,300 times.

Publications this period:

FAO and WHO. 2021. Microbiological Risk Assessment - Guidance for Food. Microbiological Risk Assessment Series No. 36. Rome. <https://doi.org/10.4060/cb5006en>. Expert authors were: Nakashima, A. A., U. G. Barron, N. Bouchriti, E. Hartnett, I. Karunasagar, A. Kiermeier, K. Koutsoumanis, F.-Q. Li, T. Ross, D. Schaffner, M. L. Signorini, B. Wang, and M. Zwietering.

Jung, J., Schaffner, D.W., 2021. Modeling the survival of Salmonella on whole cucumbers as a function of temperature and relative humidity. Food Micro. 100, 103840. DOI: 10.1016/j.fm.2021.103840 Igo,

M.J., Schaffner, D.W., 2021. Models for factors influencing pathogen survival in low water activity foods from literature data are highly significant but show large unexplained variance. Food Micro. 98, 103783. DOI: 10.1016/j.fm.2021.103783

Girbal, M., Strawn, L.K., Murphy, C.M., Bardsley, C.A., Schaffner, D.W., 2021. ComBase models are valid for predicting fate of Listeria monocytogenes on 10 whole intact raw fruits and vegetables. J Food Prot. 84, 597-610. DOI: 10.4315/JFP-20-327

Juneja, V.K., Purohit, A.S., Golden, M., Osoria, M., Glass, K.A., Mishra, A., Thippareddi, H., Devkumar, G., Mohr, T.B., Minocha, U., Silverman, M., Schaffner, D.W., 2021. A predictive growth model for Clostridium botulinum during cooling of cooked uncured ground beef. Food Micro. 93, 103618. <https://doi.org/10.1016/j.fm.2020.103618>

Arserim, E.H., Salvi, D., Fridman, G., Schaffner, D.W., Karwe, M.V., 2020. Microbial inactivation by non-equilibrium short-pulsed atmospheric pressure dielectric barrier discharge (cold plasma): numerical and experimental studies. Food Engineering Reviews, <https://doi.org/10.1007/s12393-12020-09256-12397>.

Farber, J.M., Zwietering, M., Wiedmann, M., Schaffner, D., Hedberg, C.W., Harrison, M.A., Hartnett, E., Chapman, B., Donnelly, C.W., Goodburn, K.E., Gummalla, S., 2020. Alternative approaches to the risk management of Listeria monocytogenes in low risk foods. Food Cont., <https://doi.org/10.1016/j.foodcont.2020.107601>

Kottapalli, B., Quaranta, D., Akins-Lewenthal, D., Schaffner, D.W., David, J.R.D., 2020. Evaluating the behavior of Staphylococcus aureus and Bacillus cereus in dairy- and non-dairy-based aqueous slurries during manufacturing of table spreads. Journal of Food Protection. 83, 1801-1811. DO: 10.4315/JFP-20-060

Promote Healthy Lifestyles (individual and family level)

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7001733



Customized and Community Based Diabetes Education for South Asians in New Jersey Year 3

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

Diabetes is a leading Public Health concern, nationally as well as in NJ. In NJ, it is the 6th leading cause of death as reported by the New Jersey State Assessment data (SHAD) System, New Jersey Department of Health. According to 2010 census data, NJ has the highest proportion of South Asians living in the United States. South Asians are persons who trace their ancestry to the countries of Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka. South Asians have a higher prevalence of Type 2 diabetes at a relatively lower BMI compared to other populations. NJ's South Asian communities are primarily concentrated in three NJ counties with the largest concentration living in Middlesex County. Middlesex is also listed as one of the counties with the highest diabetes prevalence (11.0%). Although the majority of South Asians are educated, multiple native languages and cultural barriers result in disparities in access to care, service utilization, and health outcomes. This program is meeting the unmet critical health need of South Asians who are burdened by significant morbidity and mortality associated with the onset of diabetes at a lower weight and earlier age than other populations.

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

Since the risk for diabetes is high in this population, developing programs to increase awareness and educate community members about causes, symptoms, diagnosis, and management of diabetes is important. South Asians speak many different native languages and maintain a variety of traditional diets. Thus, the available diabetes education materials needed to be

adapted and customized to meet the cultural, and dietary needs. In July 2018, funding was awarded for three years for this project. In year 1, twelve (12) South Asian peer leaders, speaking 6 native languages were recruited and trained on the evidence-based Stanford University curriculum, Steps to Healthier Living, Diabetes Self-Management Program. In addition, they were also trained on a culturally tailored curriculum focusing on Diabetes pathology, medications, and South Asian dietary patterns. This curriculum was created by the FCHS Educator and Co-PI from the Institute of Quantitative Biomedicine, Rutgers University. The peer leaders were recruited from the community and had to meet the criteria of either having Diabetes, pre-diabetes, or being a caregiver for a family member living with Diabetes. This network of trained peer leaders conducted two in-person twelve (12) session series and five virtual twelve (12) sessions series. The project reached 86 South Asian families in total. Due to the pandemic, the delivery mode was changed to a 100 percent distance learning model using zoom and WebEx. This past year, 51 families completed the program. Engagement with these families is ongoing through monthly support groups.

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

Adult South Asians living with Diabetes, pre-diabetes, or caregivers for a family member living with Diabetes were recruited using radio advertisement, peer leader community networks, and partner agencies. Participants were recruited primarily from Middlesex, Somerset, Monmouth, and Mercer counties. Due to the online delivery mode participants also joined from Pennsylvania, Delaware, California, North Carolina, and Missouri. Demographics of four cohorts include: Year 3 Total Participants who completed: 51; Gender- Male: 14, Female:37; Age range: 34 - 85 years Race/Ethnicity: South Asian

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

This year a total of 58 participants were recruited for this project. Fifty-one (51) participants completed 120 hours of instruction. The rate of retention was 87.9%. Each series offered 12 sessions. A total of 48 sessions of 2.5 hours each were delivered in Year 3. 89 percent of participants surveyed reported adopting at least two new lifestyle behavior skills they learned in class. Participant testimonials: "Presentations significantly improved my understanding of the disease. More than anything this program gave me huge support, pulled me out of depression, the support my family couldn't give. The things I learned not only helped me manage my diabetes but also help my other family members. The Educator was amazing with her help, support, and her beautiful warm smile," "Overall, the program was an excellent source of information for me. Not only did I benefit but I could also share the information with family and friends, so they all benefitted from it and made appropriate changes as needed. I loved the textbook shared, that gives insight into so many other issues we may go through and how we could take care of ourselves. We learned self-management skills." "The Educator and her team were patient, well updated, and on point with the subject. "



Wellness Wednesdays

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

The COVID-19 pandemic has altered many aspects of life, particularly the first year of the pandemic. For several reasons, COVID-19 may have resulted in weight gain across the population. Two months into quarantine some became concerned with the "Quarantine 15" as much as they were concerned about COVID-19 (Zeigler et al., 2020). "Quarantine 15" refers to the average weight gain experienced by some people due to gym and park closures, closer proximity to food in the home, and the change in food purchasing patterns (Zeigler et al., 2020). A May 2020 research study found that nearly 59% of the respondents reported they had remained relatively weight stable while 22% reported they had gained 5–10 pounds thus far (Zeigler et al., 2020). A similar study reported that the average American gained approximately 7.08 lbs. from February to June 2020 (Lin et al., 2021). In addition to weight gain increases in the average population, there has been research linking metabolic syndrome with the progression and prognosis of COVID-19 (Xie et al., 2020). Metabolic syndrome is a cluster of symptoms that can lead to diabetes and heart disease. In a late March 2020 study conducted by Tulane University School of Medicine, researchers found that metabolic syndrome was a greater risk factor for death from the virus than heart disease, obesity, and diabetes individually (Xie et al., 2020). Of the 287 patients, metabolic syndrome was present in 66% of the individuals (Xie et al., 2020). Metabolic syndrome was significantly associated with mortality intensive care unit (ICU), invasive mechanical ventilation, and acute respiratory distress syndrome (ARDS) (Xie et al., 2020).

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

With Executive Order 107 signed on March 21, 2020, restrictions were placed on social gatherings and business operations to slow the spread of COVID-19. The new "Shelter in Place Order" had both direct and indirect impacts on the Family & Community Health Sciences (FCHS) Department. With an increased need for evidence-based nutrition and health information, the FCHS Department mobilized to produce virtual programming to meet a growing need among NJ residents. Through a department-wide collaboration, extension faculty and staff developed the *Wellness Wednesday with FCHS* webinar series. The Wellness Wednesday with FCHS webinar series commenced in mid-May 2020 in response to the need of the Family & Community Health Sciences (FCHS) department to move programming to a virtual platform and support NJ residents in making healthy choices while in quarantine. The series focuses on a variety of topics related to food, nutrition, and healthy lifestyles. Webinars walk participants through the easy steps that they can take to add positive health behaviors to their days from fitting in more physical activity throughout the day to understanding how to read the new nutrition facts label. All 45-minute sessions were led by FCHS faculty and staff and provide free of cost to the public on Wednesdays at 2 pm through a videoconferencing application.

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

The Department of Family and Community Health Sciences (FCHS) conducted forty-six Wellness Wednesdays with FCHS presentations from October 2020, through September 2021. The program had a total of 4,800 attendees. An average of 104 people attended each presentation, peaking at 231 attendees for the Seafood and Healthy Living Part One on March 17, 2021. Compared to the first four months of this program in 2020, the average attendance has increased from 70 attendees. There was a large dip in both registrations and attendance in June. This is attributed to the start of summer and the losing of the social gathering restrictions. The program website viewership has increased from 2020 to 2021-time frame. There was a total of 7,089 visits for the main site and 5,472 visits for the subpages. The total website views since inception in May of 2020 is 19,529. Most participants (64.7%) of Wellness Wednesdays with FCHS were between the ages of 35-64, while 24.7% were age 65 and older, and 10.5% were aged 18-34. Of the 2,961 participants who responded, 88.3% self-identified as female, and 11.7% identified as male. The highest number of males attended the Seafood and Healthy Living presentation. Of the 3,390 participants who responded, 220 self-identified as Hispanic or Latino. The largest proportion of participants self-identified as White (80%), followed by Black/African American (9%), Asian (6%), and Other; two or more races (5%), and American Indian /Alaska Native (2%). In 2021, 28% of program participants were new to FCHS (1,355 new of 4,800 who responded to the survey). On average, there were 34 new participants per presentation. Notable trends on new participation show that more than half of participants (53%) were new to FCHS during the Lessons for a Long Life and the Unexpected Health Benefits of Gardening presentations. There was a marked increase in the number of participants during the Summer Herbs - Cooking & Preserving presentation, where 70% of participants were new attendees to FCHS. This upward trend continued into the following week where the number of new participants (133) exceeded the number of returning participants during the Stress with Laughter presentation. The Wellness Wednesdays program reaches a national audience as well, with people from 41 states and 2 territories attending at least one presentation. In addition to the 41 states illustrated below, other territories included Guam and the U.S. Virgin Islands. The program also reaches an international audience with audiences attending from Norway. Participant input has become an increasingly important component of the Wellness Wednesdays program series, providing feedback to organizers on the quality of presentations, lessons learned, and potential subject matter. Participant evaluations that assessed the program showed results consistent with previous Wellness Wednesdays presentations that were overwhelmingly positive, with an average of 4.63 out of 5 awarded to the program for instruction and 4.63 out of 5 for program content. After the conclusion of the Summer edition of Wellness Wednesday, a survey went out to all participants who attended at least one Wellness Wednesday session. A total of 136 attendees responded. Approximately, 82.2% (88) indicated that they have incorporated a new behavior into their daily lives due to Wellness Wednesday programming. Examples of changed behaviors were noted through a comment section, one participant reported changing their portion sizes and adding more veggies into their diet; another tried to get up and move 3-5 min every 45 min at work; another made conscious efforts to move more and eat more greens. "Your programs are very beneficial for coping with the here and now. Thank you for sharing your expertise."- Participant Quote.

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

See benefits above.

[Promote and Support Health and Wellness Among Community Organizations](#)

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus



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

Many of today's health problems (obesity, heart disease, diabetes, and cancer) are often exhibited during the long workdays of professionals. However, several of these ailments can be reduced through good nutrition and a healthy lifestyle. Educating the community through wellness programs that stress the importance of healthier living and a more active lifestyles can lead to a reduction in the risk of chronic disease and obesity and health care costs.

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

FCNS in Monmouth County conducts many programmatic efforts that focus on healthy living while working as part of the Work Well - Workforce Wellness program. During 2021, a few initiatives were offered to the employees of Monmouth County, stretching beyond normal parameters, and engaging in the new virtual platform. In conjunction with a texting program, where wellness nudges are sent twice/week, an online wellness webinar series was coupled with other county events to encourage healthy lifestyles, healthy eating, mental health, reducing stress, mindfulness practices, improving finances and physical activity. The weekly topics provide concise evidence-based information related to the following health messages: • Eating certain foods can contribute to healthy lifestyle • Lowering stress levels • Increase well-being, self-image and self-esteem • Strategies for better eating and exercise habits, along with boosting brain health • Tips for adapting lifestyle & managing personal finances • Management strategies on time, stress and balancing work with family.

During the course of the year, RCE faculty and staff also provided weekly newsletters and resources that offered an education on nutritious foods, ways to improve eating and exercise habits, along with practical suggestions for adapting to a healthier lifestyle. In addition, the outreach stressed the importance of an increase in physical activity, mental wellness, better management of home finances, and how wealth is related to overall health. Collaboration in policy, systems and environmental impacts continue to show linkages between county administration and Family and Community Health Sciences educators that have reinforced the following: recognize wellness as a priority; continued wellness committee support; more events offered through wellness portal for employees; continually improving on wellness programs offered each year; offer incentives (completers entered in drawing for a free 'day-off' from work); changed vending machine choices to encourage healthy options; Wellness Champions at various worksites to inspire employees; and continued monthly wellness newsletter that celebrates employee Success Stories in the newsletter.

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

This web-based program was offered to all Monmouth County employees and their dependents, through the Family and Community Health Sciences (FCNS) department. Involvement in different modalities offer many learning opportunities leading to an improved relationship with food and health, a more active lifestyle, encouraging stress management, mental wellness and personal financial health. The audience consisted of diverse socio-economic employees and their families within the community. Participants expressed a desire to continue with more programmatic efforts, especially those that included a module like this and making healthier choices.

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

As this program continues, the statistics improve each year. With 213 registered, 206 participants completed the Work Well - Workforce Wellness final survey. The survey results showed 97% of participants finished the full 12 weeks of the program. Of those that responded 95% of the participants felt that the newsletters and resources were helpful for them to make positive changes to adopt a healthier lifestyle. 92% of the participants are monitoring daily steps and making great efforts to add more steps each day. Along with that, 91% have increased their activity as well. Many commented on some creative ways to add that extra activity into their daily routines included: . "walk around on breaks; usually I don't break- but I take some now"; "parking further away, using stairs, standing at work console and walking in circles"; "exercise while doing laundry, or watching tv"; "Always take the stairs, try to take stretching breaks to relieve tension from sitting."; "getting up earlier to include stretching / movement exercises in the morning."; "mow the lawn with the push mower instead of the rider."; "I try to take walks with my child when I get home from work. This allows me to spend quality time and also get in extra steps."

Concluding series, over 50% rated their physical condition as “good”, while over 21% give themselves a rating of “very good-excellent”, which is a 9% increase from when they initially took the pre-survey. The post survey data also shows that 39% of the participants have increased their savings over the duration of the program, while 65% have reported to decrease their debt overall. In addition: 50% improved their physical condition 72% increased their number of steps per day, 37% increased vegetable consumption 36% increased fruit consumption 37% decreased sugar consumption 44% lost some body weight 41% could identify healthier foods/recipes, 35% improved their level of energy, 39% improved their quality of sleep, 24% managed money more effectively, 23% improved their physical appearance, 49% used strategies to prevent disease, 22% reduced consumption of sodium, 30% lost some inches around their body, 49% decreased consumption of fats, 3 people quit smoking (out of 7). During this program, resources were also included on mental wellness and stress reduction: 56% of the participants reported having stress levels at 5 and below based on a 1-10 rating scale. Just a few ways the participants have managed stress are listed below: “Healthy Eating, Exercising, Meditation, Yoga and sound sleep Etc”; “Reading, eating well, trying to get more sleep, practicing minimalism.”; “I try to get outside as much as I can for fresh air and walks”; “BY EXERCISING, HEALTHY EATING, MEDITATION & YOGA, BREATHING EXERCIZING ETC.”; “In addition to getting quality sleep and great nutrition, I remind myself to focus on the 'big' picture, I involve myself in healthy activities w/ like-minded people, meditate and engage in positive self-talk!”

Healthy employees prove to be a productive workforce and is vital to living longer, healthier lives! Many of the success stories below reflect how small changes can offer great reward! “I AM MANGING TO SAVE \$700 DOLLARS A MONTH AND I HAVE NO IDEA WHERE I FOUND THE MONEY BUT WE ARE DOING GOOD AND ALL BILLS ARE PAID PLUS WITH CHRISTMAS THIS MONTH I STILL SAVED.”; “I have lost 10 lbs. since September by making a conscious effort to be more active and eat better. I can see the difference in making an effort! I am also cooking healthier so my family also benefits from my new strategies for better health and wellness.”; “I have learned that I don't get up enough from my chair at work and that sitting too long is very bad for health. I need to get up for five minutes maybe every hour. I have learned that sleep, nutrition, less stress, exercise and social support are the best things that we can do for our life in order to be happy and healthy.”; “Thank-you for your newsletters and reminders that good health is an important goal to work towards. I appreciate your efforts. My small successes are cooking for the family and rarely eating fast food or take out meals because they are not real food. I walk the dog sometimes when I have a little time. He loves to go for walks and is my personal trainer who motivates me. I need to make time for exercise more often, other than walking. I also have made a goal to drink more water, which is a really important habit. I noticed an improvement in my energy levels, etc. I also have a vegetable garden now, which helps me to eat more vegetables.”



NJ Farmworker Vaccination Project

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

There was significant concern among farmworkers and farmers about the on-farm transfer of the COVID- virus. The ability to connect with vaccine providers has proven difficult for those with language and technology/internet barriers, and those without established relationships with health care providers. Undocumented farmworkers are less likely to have a healthcare connection and are particularly vulnerable as these workers have concerns about making themselves visible to ICE, and subsequent deportation, through the vaccination process. These communities tend to be harder to locate, and more difficult to communicate and establish trust with. The goal of the project is to help the NJ Department of Health Office of Primary Care and Rural Health to vaccinate migrant seasonal farmworkers.

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

NJAES/RCE faculty/staff have been creating connections between the NJDOH Office of Primary Care and Rural Health with the farming community more broadly in several ways, including using existing listservs and social media accounts to push out information about vaccines to farmers, some of it tailored to the migrant farmworker population; employing a specialized email address, njfarmvax@njaes.rutgers.edu, for farmers to send questions and get connected to vaccination opportunities; meeting regularly with NJDOH and healthcare providers to discuss how to best meet the needs of the farming community and schedule vaccination outreach and clinics; conducting direct outreach by phone, text, and email, to specific farmers identified by healthcare partners; and increasing connections between healthcare and the farming community, for example, by inviting the director of the DOH to select County Board of Agriculture meetings and the NJ Agriculture Convention.

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

It has been a challenge to understand the impact of the work so far because of the difficulty in measuring who has actually been vaccinated. However, measurable impacts include:

- creation of a website for the project: <https://onfarmfoodsafety.rutgers.edu/vaxinfo/> and email address [njfarmvax@njaes.rutgers.edu](mailto:nfarmvax@njaes.rutgers.edu)
- In-person events: 22 in-person events, through which 571 people have been reached.
- Social media: Through the Plant & Pest Advisory, On-Farm Food Safety Facebook Page, and On-Farm Food Safety website - 45 posts and reached 11,061 people
- Phone calls and direct farmer outreach: Over 200 phone calls and direct contacts with farmers
- Virtual events: Virtual live events held through Atlantic, Middlesex, and Somerset counties reached 350 people
- Direct mailings: Extension monthly agricultural newsletter, reached 2,193 people with vaccine information over three months through direct mail and email.
- Emails to the farm community. Through 40 emails a total of 16,056 individuals were reached. Current digital assets including the Plant & Pest Advisory and the Vaccine Resources for Farmers Page on the On-Farm Food Safety website:
- Attended partner meetings: Weekly meetings with the Office of Primary Care and RuralHealth which include reps from FQHCs during June through early October.

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

Increasing the percentage of farmers and farm workers getting COVID-19 vaccination, protects the farmers and farmworkers, their families, co-workers, and their communities. Healthy workers help to ensure the availability of a safe and plentiful food supply.



School Nutrition, Gardens and Health

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

High childhood obesity rates are putting children at risk for chronic diseases starting early in life. Many children eat unhealthy foods and drink too many sugared beverages leading to weight management challenges and chronic disease risks. Providing programming directly to youth that focuses on healthy food choices and the importance of physical activity, gives them important information and tools that can shape their behavior patterns during their most formative years, hopefully leading to a lifetime of healthy decision making. Youth also need to better understand the food system – how food is grown and produced. Youth who participate in garden projects – growing & harvesting food are more likely to eat that food.

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

The objects of this program include that youth:

- Learn where the food comes from, the growing process, its nutritional value, and the role the food plays in a healthful diet.
- Prepare and/or taste the food.
- Grow herbs or vegetables from seed or seedlings.

As a partner in Healthier Somerset Coalition, RCE Family and Community Health Sciences (FCHS) educators have made strides in achieving the goals of launching school gardens and providing nutrition education in 2 Somerset County school districts with lower-income populations and larger health disparities. FCHS is a member of a team that secured a Healthier Communities Grant for Healthier Somerset to create a school garden and provide education for two special needs classrooms at Alexander Batcho Intermediary School (ABIS) in Manville and classrooms at Smalley School in Bound Brook. The garden-enhanced nutrition education typically takes place in person and is hands-on, which presented a challenge when schools switched to remote education due to COVID-19. FCHS pivoted and provided virtual lessons via Zoom that included hands-on garden and nutrition activities for the students. A few in-person lessons were provided during the summer and fall of 2021. Funding from Healthier Communities Grant Network and Healthier Somerset made it possible so that each student at ABIS would have an indoor hydroponic garden that would be easy to transport home if schools moved to remote education which did end up happening. In total, hydroponic gardens were provided to eighteen students from both classrooms and one for each of the classroom teachers. Providing virtual education and the at-home gardens was crucial as the students have special needs and were more engaged in learning when the material was interactive.

From Our Farms workshops focused on seasonal fruits, vegetables, or dairy foods. The 20-minute to one-hour workshops were conducted at preschools/schools for children ages 3-10. The program includes an introduction to the food and how it grows, a children's story or craft, and making and/or tasting a healthy snack with the food.

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

The target audience included youth in two schools in different communities, Manville and Bound Brook, with greater health disparities than the rest of Somerset County. The participating students in Manville are in special needs classrooms. Preschool youth in different daycare/preschools participated in From Our Farms. This included 26 classrooms and about 440 students (some duplicated). Gardens were created using a garden box, tower garden, and/or individual aero-gardens.

From Our Farms - Children thoroughly enjoy From Our Farms programs. They have fun tasting the featured food and often ask for seconds.

School garden- Enhanced nutrition education projects (2 schools) - Response from both students and teachers were overwhelmingly positive and participation in trying at home activities demonstrated an interest in gardening and nutrition outside of class time. The students and teachers at Alexander Batcho Intermediate School (ABIS) continue to care for their AeroGardens with great success. Since September 2020, ABIS's two special education classrooms have been growing lettuce greens, tomatoes, and herbs in their indoor gardens.

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

Despite earlier setbacks due to COVID-19, this program has taken off and been embraced by all involved. ABIS Principal has been a supporter of this program since its inception and has seen first-hand the positive benefits this initiative is having on his students and school. "Aside from the educational value of the garden project, the aesthetic value within the classrooms is immeasurable. One of the first sights, as you enter both classrooms, is the blossoming greens that are coming from the AeroGardens. Students have taken great pride in the upkeep, water, and anticipation of harvesting some of the pods.

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

The project is so successful that it will continue with gardens containing new crops as the current ones expire or if we decide to try to replant them to grow bigger. It has been an enjoyable experience from all sides.

Critical Issue

Ensuring Positive Outcome for Our Youth

Leadership Development Opportunities for Youth

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7000223



NJ 4-H Leadership for Life Program

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

A 2025 Vision reinforces the mission of 4-H, which is to "provide meaningful opportunities for all youth and adults to work together to create sustainable community change." The NJ 4-H Leadership for Life Program fulfills the 4-H mission by satisfying a gap in leadership programming in NJ 4-H, which afforded faculty the opportunity to plan and deliver a high caliber program unique to the state and the country. Not only does the Leadership for Life Program enable youth to learn, develop, and put into practice their leadership skills, it also supports the development of 21st Century skills as outlined in the Framework for 21st Century Learning (2019). The Leadership for Life Program and curriculum mirrors this framework by addressing communication and collaboration, research and information fluency, critical thinking, problem solving, decision-making, and leadership and responsibility. Most important, youth are putting these skills directly into practice and becoming active participants in their community by identifying a community need and addressing that need through action. This fulfills

the idea that “community exists in the collective actions of its members. These collective actions allow residents of all ages and backgrounds to participate in the creation, articulation, and implementation of efforts to support local change” (Brennan, Barnett & Baugh, 2007). A myriad of community needs across our state are being met through this program.

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

This program equips youth with the tools needed to effectively plan and carry out a service project beneficial to their community. The in-depth nature of this leadership program, with 25 hours of training for Modules 1, 2, and 3, offers the time to help young people develop their leadership skills in an inclusive and safe setting. They are able to explore personal leadership skills and areas for improvement, determine their style of leadership, and envision their future as leaders. The goals and objectives of the NJ 4-H Leadership for Life Program are twofold: provide youth with the knowledge and skills to become effective leaders and empower them to make a positive difference in their communities.

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

Youth are taught key concepts and characteristics of good leadership; identify personal strengths and the motivations that inspire them to become leaders; clarify their personal ethics and values; develop problem solving and critical thinking skills; and set clear goals and develop action plans to achieve them. In short, “I also learned why leadership is such an important skill for life, in general.” (participant response)

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

4-H members plan and conduct a service-learning project that meets the community's needs. To date, 25 youth have planned and implemented 23 service-learning projects in 50% of NJ's 20 counties. Projects ranged from the development and delivery of community-based emergency preparedness training to nutrition education classes taught at farmers' markets to a technology camp for urban youth. More specifically, one member researched and provided mental health workshops for 4-H clubs in her county and youth at her school, helping create greater understanding and awareness of mental health issues that youth face, while another member organized a teen letter-writing campaign for members of the military resulting in more than 1,000 letters being written, collected, and mailed. A five-day summer camp called Tech Innovation was developed and conducted to introduce the world of STEM, such as circuitry and coding, to underserved youth.

Two 4-H members, with assistance from club members they trained, taught 17 youth for a total of 18 hours of programming. They provided this program so that youth with limited resources had an opportunity to learn and get involved in the STEM field and hopefully spark their interests in future STEM careers. A 4-H member designed and established gardens at the Cape May Point State Park by addressing the declining Monarch butterfly population due to the lack of milkweed that caterpillars require to survive. The plants selected for the garden will provide sustenance for the Monarchs as they migrate through the southernmost tip of New Jersey and will promote growth for future generations.

Once 4-H members complete Modules 1, 2, and 3, they are eligible to apply to complete the Advanced Module during an international travel experience to the Foróige Leadership for Life Conference at the University of Ireland in Maynooth, Ireland. This module enables participants to explore vision and strategies for overcoming challenges, and ethics and values in relation to leadership. They also have the opportunity to work with more than 250 youth from Ireland and other countries to utilize the leadership skills they learned in Modules 1-3 to identify social issues and propose solutions for addressing them.

4-H Clubs

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7001192



4-H Middle Earth Student Ambassadors for Community Health (SACH)

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

When identifying problems and creating solutions that support the community culture of health, youth perspective is often overlooked despite their fresh outlook. Somerset County 4-H and Middle Earth, an at-risk youth service provider, teamed up to empower youth in this community to identify issues that affect them, hence, the 4-H/Middle Earth Student Ambassadors for Community Health (SACH) Club was created. This group of teens, ages 15-19, implement self-designed projects that make their communities healthier and more vibrant. Many participants in this club are from traditionally at-risk communities and are not the customary youth who participate in the Somerset County 4-H club program. SACH focuses its efforts in the town of Bound Brook, NJ, a low-income Hispanic community in Somerset County, NJ, one of the wealthiest counties in the state. Middle Earth and 4-H share equally in the effort – club coaches are from each organization, and the groups work in full collaboration, each taking on 50% of the work.

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

The objectives of this program are 1. Youth develop leadership skills such as independent thinking, time management, effective communication, responsibility, creativity, and commitment, through self-designed and led projects. 2. Youth acquire a sophisticated understanding of the problems in their community; create and implement solutions. 3. Youth form collaborations between community organizations and elected officials. 4. Youth collaborate with community organizations to sustain each year's projects to create lasting change that positively impacts community health.

The Bound Brook Town Council and Mayor are consulted and approve all projects. SACH works in an "as-needed" partnership with the Bound Brook police, other community organizations, Rutgers University's Bloustein School of Planning and Public Policy, and the Healthier Somerset Coalition to gather the information that gives rise to the projects completed by the SACH teens. The 4-H/Middle Earth Student Ambassadors for Community Health (SACH) club developed their 2021 project with a focus on the health of the local Bound Brook economy. They pinpointed specific social determinants of community health to address based on information gained from meetings with the Downtown Bound Brook Manager from the Bound Brook Revitalization Partnership Special Improvement District. The Manager communicated concerns directly from the small businesses in the local area. Students learned that the businesses were hugely impacted by the effects of COVID-19 shut-downs and social distancing restrictions. During the pandemic, especially in the initial months, these businesses were left with no choice other than to close for extended periods, or severely limit the capacity for their services. This resulted in an economic loss that rippled beyond the business owners to their staff, and ultimately the surrounding community.

According to a report from the New Jersey Department of Labor and Workforce Development Office of Research and Information Division of Economic and Demographic Research, titled "Economic Brief: New Jersey's Changing Economy and the Recent Impact of the COVID-19 Pandemic," In just one month all of the gains made in the past decade were lost, New Jersey losing 750,000 jobs in April alone. By the nationwide trend, by 2020 New Jersey's economy shifted towards mostly service-providing industries versus the production of goods. In 2020 more than 90% of all employment in New Jersey was in service-providing industries. This exacerbated the losses felt in our state, as these types of jobs require close human interaction, an impossibility during the pandemic when social distancing was a necessity. In the 24 weeks ending on August 29, 2020, more than 1.5 million unemployment insurance claims were filed. This represents nearly 40% of New Jersey's total workforce. Underrepresented groups were impacted disproportionately as Latinx and black workers were more likely than other racial and ethnic groups to have filed for unemployment insurance during this period, and 54% of the claims were made by women. More than half of all claimants were made by five occupational groups; office and administrative, sales, transportation, food services, and personal services which all require close human interaction, putting those workers at higher risk. The three industry sectors most likely to have been shut down causing unemployment during the height of the pandemic were accommodation and food services, healthcare, and retail. Small businesses in the service-based industries took the biggest hit, with an estimated 30% loss of New Jersey small businesses within the last year. As a majority of the small businesses in downtown Bound Brook and South Bound Brook are service-based such as salons and barbershops, restaurants, event spaces, and educational services, this area took a big hit during the pandemic.

In 2021, SACH met twice monthly (and once weekly from August-November) to research, create, and plan their large-scale, youth-led community service projects in the Bound Brook and South Bound Brook, NJ communities. They designed and implemented two projects: Rediscover Your Community and The Storybook Trail.

The group applied for and received a mini-grant from Building Bridges to Better Health funded by Sanofi. These grants aim to empower organizations and local residents to make Bound Brook and South Bound Brook healthier and stronger communities. Students determined that economic revitalization and physical health were issues that needed to be addressed.

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

These project not only helps the youth realize that they can make a real difference in their own community, they learned the valuable skills that will help them become the next generation of leaders in Somerset County. The program instilled skills in leadership, business, government operations, problem-solving, teamwork, and creativity. Comments from members reflecting on the most rewarding aspect of their experience in the Student Ambassadors for Community Health: "Being a part of a group that can have meaningful impact in the community. The impact from group effort is more than you can do alone." "Feeling as if I am making a difference and getting involved with the community." "Getting to make connections with government officials is very important—I feel like I wouldn't have the opportunity to do that outside of this group." "Receiving credit and support from government officials—these relationships are priceless." "The program instills skills in leadership, business, government operations, problem-solving, teamwork, and creativity. Comments from members reflecting on the most rewarding aspect of their experience in the Student Ambassadors for Community Health: "Being a part of a group that can have meaningful impact in the community. The impact from group effort is more than you can do alone." "Feeling as if I am making a difference and getting involved with the community." "Getting to make connections with government officials is very important—I feel like I wouldn't have the opportunity to do that outside of this group." "Receiving credit and support from government officials—these relationships are priceless."

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

Rediscover Your Community: By supporting community members and their local businesses, the event helped boost the foot traffic in the downtown area while encouraging healthy activities for participants. This challenge was designed to enable residents to explore the shops, restaurants, and services of the area. It allowed people to be outside and active as they discovered the walkability of the downtown area. Buying local adds money to the local economy, directly improving the area and the community. To address the social determinate of economic stability of the community, the students envisioned a downtown that is a welcoming space with thriving businesses. Another social determinant focuses on physical health, so an additional goal of the event was to get residents out and about by promoting family-friendly outdoor activities. Having participants walk or bike from destination to destination shows that getting exercise can be worked into one's daily routine. This reduced the number of vehicles and associated noise, pollution, and traffic creating a safer space for walking and biking while increasing safety, health, and quality of life. Residents were reminded that their community is an accessible place to visit without a car. The increased foot traffic makes it more likely people will enter businesses, vs. passing by in a car. The Rediscover Your Community event encouraged participants to walk around the community while visiting spotlighted small businesses in downtown Bound Brook and South Bound Brook. After completing the challenge, one of the participants, a young girl exclaimed, "I had so much fun on our journey!" Three of the participating businesses were interviewed and rated the experience a 5 out of 5 that they would be "Very Likely" to participate again in a similar event, and all three businesses rated 5 out of 5 that the event was "Extremely Easy" to be a part of. A Somerset County Commissioner and the South Bound Brook Mayor attended the event to show support for the students' efforts to engage community members to support the small businesses in their town. Comments from members reflecting on their experience from the Rediscover Your Community event: "The most rewarding aspect of being a part of this event was to see someone enjoying what we put together." "It was fulfilling to see kids being excited to go on our adventure!" "Engaging with the community members was the greatest benefit of this event."

The Storybook Trail: In June 2021, the 4-H/Middle Earth Student Ambassadors for Community Health (SACH) club collaborated with the Somerset County Library System to host an event for children and their families to promote the new story introduced to the Storybook Trail. This is a series of 12 butterfly sculptures paired with podiums along a walking trail in Billian Legion Park and was established in 2019 by the SACH members. Each podium contains an illustrated page of a children's story presented in English and Spanish that was written by SACH members. The purpose of the new story is to inform the community about the Little Free Pantry that they installed in town to supplement the growing need in the community for food resources, especially during the pandemic. The new story discusses food insecurity and the purpose of food pantries to educate the community about this relevant issue in a way children find entertaining and can understand. The event included a live reading by children's author Diana Lee Santamaria, who writes in both English and Spanish. She read from her book series DLee's World, an educational book series promoting bilingual and early literacy, diversity, and fun! Her presentation encouraged the audience to stand up, sing, and dance along. The event also included student-led guided tours of the Storybook Trail, a rock painting craft, as well as an interactive bubble display. The Somerset County Commissioners and Bound Brook Mayor were in attendance to support SACH and the library system's mission to highlight the importance of children's literacy. The Student Ambassadors received citations from the Somerset County Board of Commissioners for their community service efforts that address health disparities in Bound Brook. SACH has recently received the following awards from the National Association of 4-H Youth Development Professionals: 2021 National Winner, Excellence in Teamwork Award; 2021 Regional Winner, Search for Excellence in Teen Programming Award; 2021 Regional Winner, Excellence in Healthy Living Award; 2021 State Winner,

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

Hudson County is one of the most diverse, densely populated, and fastest-growing counties in NJ. According to U.S. Census data, 43.2% of adults are foreign-born and 59% of households speak a language other than English at home. While Hudson County has rich cultural diversity, there are vast disparities in household incomes as almost 14% of residents live below the poverty line. In fact, according to the 2020 Hudson County Needs Assessment Report, the authors assessed that the annual cost of living for a two-parent-two-child family was the 12th highest in NJ, with a lower median household income than the state median income. In addition, Hudson County has limited green spaces for residents. Sustainable Jersey City has documented how Jersey City residents in some of the most under-resourced neighborhoods experience the urban heat island effect and poor air quality. Jersey City has the highest adult asthma rate in Hudson County. Given the potential to reach a diverse population of youth in an area that is densely populated with little to no green spaces, health disparities, and the challenges some of these underserved communities experience, Youth Urban Farm Club provided a great opportunity for youth to gain new skills in urban agriculture, animal husbandry, and/or gardening; connect with their peers and gain a sense of belonging after a disrupted school year due to the global pandemic; and serve their community through the production of fresh food, the maintenance, and beautification of green spaces. This was especially poignant for youth as many of them were ready to transition from virtual to in-person learning that they experienced during the Covid-19 pandemic.

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

Youth Urban Farm Club is a summer program serving youth in Hudson County ages 11-18 at the community garden and small urban farm sites led by adult volunteers from the community. Youth gain hands-on experience in gardening, animal husbandry, urban agriculture, or art by volunteering 2 hours a week for 8 weeks in the summer. Youth registered for the program and were then invited to join a virtual orientation to understand the expectations of the program and to meet their adult leaders. At each site, 4-H adult volunteer garden leaders facilitated the program, which was fully hands-on with some sites incorporating deeper education on food systems. Each site had its own unique focus yet all incorporated learning agriculture and horticulture skills, and youth community service by helping with the maintenance of the site and beautifying the community. Hudson County 4-H shared resources with all garden site leaders but provided them with flexibility on how they implemented each session. Since this program was centered on hands-on education, many of the adult leaders did not use a set curriculum. Rather, they identified some learning goals and asked the youth what they wanted to focus on throughout the program. Youth truly learned through doing by observing their adult leaders, sharing their own experiences with gardening/farming (if any), and participating in multiple tasks involved around production, horticulture, and husbandries, such as animal care, planting, harvesting, pruning, weeding, pest identification, and application of organic fertilizer. To conclude the program, each site had a closing ceremony. Every youth that completed the program received a Certificate of Community Service for their time (anywhere from 7 to 16 hours) and received a 4-H pin. Some youth were also assigned a final project. In one of the sites, for instance, youth were asked to present about a crop that related to their cultural heritage: this included them researching the crop, interviewing a relative or friend, and doing an oral presentation in front of their peers.

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

The audience included youth participants and adult volunteers. 30 youth from Hudson County ages 12-18 joined the program. While the targeted audience was teenagers, Youth Urban Farm Club also attracted children. A total of 5 children participated at one site throughout the summer. Evaluation Results from Survey: 92% of youth surveyed reported that they want to learn more about this subject, 92% of youth surveyed reported that the program was "excellent" and 4% reported that the program was "very good". A few comments included: "It was great being part of this program. The presenters were amazing. It was lots of fun and learning. I'm grateful I had the opportunity to be a part of this." "Everyone was fun and kind and made this experience one to remember..."

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

As a result of the Youth Urban Farm Club, 30 teens gained new skills in urban agriculture, animal husbandry, and horticulture and contributed anywhere from 7 to 16 hours of community service in different projects guided by a dedicated 4-H adult volunteer. The program expanded from 1 to 4 sites in Hudson County, allowing multiple gardens and urban farm sites to have

increased support to maintain these spaces and bring visibility to the space. Additionally, new partnerships were forged between Hudson County 4-H and stakeholders in the community. 8 adult volunteers were onboarded for the program. The youth had access to fresh produce from the garden during the season to take home, share with their families, and learn how to cook these different herbs, greens, and vegetables. This is especially important as many of the youth may not have had easily accessible fresh and sustainably grown produce. From conversations with youth, they reported forming a community with their peers in the program and having the chance to disengage from digital technology and social media and be fully present in the experience. Evaluation Results from Survey (Qualitative): Youth reported learning about growing food, art, herbalism, connection to the environment, food system, culture, diversity, healthy soil, managing farms, chicken care, bees, monarch butterflies, pest management, pruning, plant care, and gardening. Youth reported they will use this information for establishing a garden at home – either a personal garden or with a parent or relative; oil infusions at home; advocate more about food systems; join a community garden; take care of our environment by recycling and picking up trash; educate friends and family about gardening or animal care; plant their own garden in the future. Comments included: “I learned how to grow my own food. I also learned that growing your own food helps connect to the environment and can improve your mental health.” “I had a nice time, met new people, and I learned a lot about gardening and food in general. I'm glad I signed up and I hope to learn more.” “I learned about the importance of farming in everyday life, whether it is as a hobby or as a job. It's very calming and very informative. While it was fun and sometimes eventful being surrounded by nature. I learned about monarchs, their cycles, and the plants that help them lay down their eggs, I also learned they migrate from America to Mexico. I also learned to take out weeds while the plant grows since they can rob the plant of its nutrients. I also learned the difference between a plant that is infested by a disease or a pest. I have learned many other things and I hope to keep learning more and more!!”

4-H From Home and Cross County Engagements

Project Director

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Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7000151



Mission to Mars

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

In March 2021, in-person programming restrictions were still in effect because of the COVID-19 pandemic. These restrictions prevented many counties from hosting their annual, and wildly popular, science-themed events. Youth and families were still interested in some form of science programming through 4-H because they were seeking an opportunity to connect with others, explore a specific science topic more in-depth, and enjoy a much-needed distraction from daily stressors. With the common goal to provide hands-on science programming to youth through a virtual format, the 4-H staff in Morris, Ocean, and Somerset Counties partnered to create and deliver the “Mission to Mars” program every Monday in March. The National 4-H Science Experiment, Mars Base Camp, was selected for this project because grant funding provided kits for each participant in these counties. The subject matter also connected perfectly to the ongoing Perseverance Rover mission which landed shortly before the program’s start.

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

The objectives of the tri-county “Mission to Mars” program were to increase youth knowledge and interest in science, strengthen skills in inquiry-based learning, and connect youth with peers across the state that share a common interest. This program was also a test of the feasibility of a multi-county partnership offering exclusively virtual programming based on traditionally hands-on learning experiences. 4-H Teen Science Ambassadors were selected to serve as the teachers for each week’s lesson. The teens received training in the National 4-H Science Experiment and had previous experience leading the activities in an exclusively virtual setting. Their knowledge and experience were invaluable to the success of the program as they modified lesson plans to accommodate the needs of the participants and overcome program limitations experienced in an all-virtual setting. 4-H staff in Morris, Ocean, and Somerset served as the program’s coordinators with recruitment and registration, communication to families, weekly lesson plan meetings with 4-H Teen Science Ambassadors, Zoom room facilitation, booking guest speakers, and distributing an end of program evaluation. Staff also contacted subject matter

experts to participate in an end-of-program career panel. Guest speakers included graduate students working with the Rutgers University ENIGMA research team, a representative from NASA, and the Raritan Valley Community College's Planetarium Director. Each Monday in March, youth in grades 5-7 joined a Zoom meeting led by 4-H staff and the 4-H Teen Science Ambassadors. Staff would report on the latest developments and announcements from NASA's Perseverance Rover mission and demonstrate interactive features of the NASA website. Participants would then split into smaller Zoom rooms led by a Teen Ambassador who guided them through that week's hands-on science activity. These activities included building a rover, selecting the best landing spot on Mars, basic coding skills, and more. Each meeting would conclude with the participants sharing something they learned and what fact they found most interesting/surprising. The month-long program ended with the career panel where participants rotated through Zoom meeting rooms to listen to each guest share their career journey, discuss some of their current work, and hear what these adults are most excited about with the Mars Perseverance Rover mission.

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

The program was open to both 4-H members and the general public in Morris, Ocean, and Somerset Counties. Youth in grades 5-7 were invited to participate in the program. The participation limit was restricted due to a limited number of kits and the known effectiveness of teaching smaller class sizes virtually. The program's target goal was to reach 20 youth which was exceeded with 22 participants.

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

22 youth from 15 towns registered for the 2021 Mission to Mars in March program. 11 youth participants indicated on end-of-program evaluations their reaction to the month's program. The overall program received positive ratings from 92% of respondents. The Teen Ambassadors and adults (staff and guest speakers) received positive ratings from 82% (Teen Ambassadors) and 91% (adults) of respondents. The information presented received positive ratings from 91% of respondents. The activities received positive ratings from 100% of respondents. A pre/post assessment of interest completed by participants demonstrated that even in an exclusively virtual setting, the model of teens as teachers was successful in increasing youth's interest in STEM topics.

Space and/or Mars Missions - Somewhat Interested - BEFORE 54.55% - AFTER 9.09% - Very Interested - BEFORE 36.36% - AFTER 90.91% Careers in Science - Somewhat Interested - BEFORE 45.45% - AFTER 18.18% - Very Interested - BEFORE 54.55% - AFTER 81.82% Computer Coding - Somewhat Interested - BEFORE 54.55% - AFTER 36.36% - Very Interested - BEFORE 45.45% - AFTER 63.64%. The rover build activity was rated the most popular with 64% of respondents sharing it as their favorite part of the program. For future 4-H science program topics, engineering was the most popular with 82% of participants selecting "very interested" in this topic. When asked for two things participants learned during the program, all respondents shared facts about the current Mars missions or features of Mars. In this program, 91% of respondents agreed they felt safe. 91% of respondents agreed that adults cared about them. 64% of respondents agreed they connected to others like them. 100% of respondents agreed they figured things out for themselves. 100% of respondents agreed that it was ok to make mistakes. 100% of respondents agreed that they got to do things they like. 73% of respondents agreed they thought about their future.



NJ 4-H From Home

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

In March of 2020, responding to community needs resulting from impacts of the COVID-19 pandemic, NJ 4-H from Home was created along with a website (<http://nj4h.rutgers.edu/4h-from-home/>) and a series of one-hour interactive workshops. The website was designed to promote the interactive workshops and house resources youth and families could access and participate in from the safety of their own home. Furthermore, this website served as a resource for both current 4-H families and those families new to 4-H, as families would not have access to extracurricular and out-of-school time educational activities during the early stages of the pandemic. As the pandemic evolved, so too did 4-H from Home. The program and the platform continued to grow as clientele needs changed. 4-H from Home was able to incorporate feedback from 4-H and Extension professionals, 4-H families, and program participants to create new interactive webinars, add new resources to the website, and expanding the range of virtual youth programs being offered. The 4-H from Home website became a hub for much of the state's 4-H virtual programming.

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

4-H from Home has continued to evolve to offer two different types of virtual interactive programming including one-hour interactive workshops and six (or more) hour STEP 4-H clubs (short-term exploratory program). The 4-H from Home website provides a platform to disseminate information about these programs and serves as a hub to share other virtual opportunities offered by the Rutgers Department of 4-H Youth Development as well as other relevant opportunities from other Extension programs. Additionally, a thorough marketing plan was created to engage audiences from all over New Jersey and beyond, regardless of their affiliation with 4-H youth programs.

The NJ 4-H from Home website has quickly grown and evolved to include six different pages, one which is fluid and continues to focus on different themes as needed (including virtual summer camp programs and statewide contests). Two pages focus on the different real-time offerings including the interactive workshops and STEP clubs. Additional pages provide support to youth and families – focusing on other at home self-paced activities (STEM, Healthy Living, Agriculture, Service, etc.), while another page provides support to 4-H club leaders/volunteers with ways they can keep their clubs interactive and engaged during these uncertain times.

With the changing needs of youth and families throughout the COVID pandemic, interactive workshops have continued to evolve covering a wide variety of topics including science, creative arts, agriculture, health and wellness, citizenship, service, and many more. Workshops were being hosted every Tuesday and Thursdays of each week between March 2020 – August 2020. After August 2020, 4-H professionals began to host interactive workshops that best suited their schedule, still offering them on the 4-H from Home website and utilizing the 4-H from Home email list. Workshops were offered at no cost to families and were originally designed for youth in grades 4th – 8th. Additional interactive workshops were created for youth in grades K-3 based on requests from NJ families. 4-H faculty/staff, volunteers, other extension professionals, and even out-of-state 4-H professionals have offered workshops in their area of expertise.

At the same time newly created short-term virtual 4-H STEP clubs were being tested out through 4-H from Home. These STEP clubs are led by 4-H faculty/staff/volunteers, focused on a specific topic, meet regularly over a series of days/weeks/months. Youth register and participate in any STEP clubs of interest, there is no cost to participate, youth can live anywhere throughout NJ, and they do not need to be enrolled in their local 4-H program to participate. STEP clubs have been offered on various topics including teen leadership, agriculture, STEM, creative arts, animal science, healthy living, cooking, and many more. STEP clubs meet for at least six hours. The length of programming time, topics covered, scheduled meeting dates, club objectives, and youth recognition are created by the STEP club program lead. Program marketing and registration for STEP clubs are the responsibility of 4-H from Home. Once youth are registered the STEP club program leader is responsible for all correspondence, participant tracking, and evaluation.

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

Between March and August of 2020, over 90 1-hour interactive workshops have been offered reaching over 500 unique participants from all 21 counties in New Jersey and youth out of state as well.

Workshop presenters have included: Faculty/Staff from Rutgers Cooperative Extension including members from the departments of 4-H Youth Development, Agriculture and Natural Resources (ANR), and Family and Community Health Sciences (FCHS); volunteers and interns from 4-H, ANR, and FCHS.; and guest professionals from outside of NJ.

Beginning August 2020 department members began coordinating and hosting their own interactive workshops, utilizing the 4-H from Home platform (website/marketing/registration) to recruit program participants. Workshop leads were responsible for collecting program participant data for their sessions. Interactive workshops have continued to focus on many different topics of interest to both youth and families such as: financial literacy; health and wellness like mindfulness and managing stress; COVID-19 and Community Health; creative arts expression including mask making, creating a clown character, virtual improv; learning about different animals including bee's, poultry, rabbits, how animals adapt to winter; food and cooking; and all different science topics including learning from polar scientists, and participating in virtual science challenges.

The NJ 4-H from Home website continues to grow and evolve with the changing needs throughout the state. A page on this website continues to be fluid, changing with the programming needs during different time periods, including Summer (which has included virtual camps and statewide contests) and Rutgers Day (which included virtual live and recorded Rutgers Day Activities coordinated by the NJ 4-H program).

The 4-H from Home website (<http://nj4h.rutgers.edu/4h-from-home/>) has had over 8,000 unique visitors since its creation. There are over 800 active email addresses on the 4-H from Home email list (those who register for an Interactive Workshops and/or STEP Clubs). Additional emails are added upon request of those who find the website and ask to be added via the 4-H

from Home email.

Due to our marketing efforts, 4-H From Home has reached over 80 families not already associated with 4-H, increasing 4-H's relevance for New Jersey families.

4-H from Home Feedback:

"Thank you for all you have done since this Pandemic started. Lacey and I [her mom] are extremely pleased with these 4-H from home presentations, they have been wonderful!!"

"This was awesome! Sarah is trying it by doing it different order of colors. She LOVED your class. Thank you so much! I think she will keep going all afternoon. ? with this experiment. She did end up using an eyedropper/pipette to slowly add the colors. Works great!"

"PS she (program participant) made homemade meatballs the other day, you are quite the inspiration Virginia, she asked me to send you a picture." [pictures were attached to the email.]

"The 4-H Resources for Families page <http://nj4h.rutgers.edu/4h-from-home/family-resources.html> led me to some really cool new activities! This is perfect for families looking for new ideas - THANK YOU!"

The 4-H from Home email also receives pictures from families as participants are either working during their session and/or continue to work after their session.

4-H from Home Replication and Future:

In addition to the 1-hour interactive workshops, over 50 virtual STEP clubs were offered in 2020 and 2021 and reached over 350 youth. Clubs focused on a variety of topics (STEM, Healthy Living, international exchange, etc.). STEP clubs meet virtually multiple times over the course of several weeks and run for a minimum of three hours with some meeting for over 12 hours. STEP clubs provided over 300 hours of 4-H programming to youth around NJ.

Since its inception, 4-H youth development professionals from Maryland, Utah, Delaware, and Illinois have inquired about replicating the program.

We anticipate that 4-H From Home will continue to serve families with both live interactive sessions (workshops/STEP clubs) even after we transition back to in-person programming.

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

NJ 4-H From Home has become a valuable addition to the New Jersey 4-H program throughout the current pandemic and has been able to quickly adapt to the needs of NJ families during these uncertain times. The 4-H from Home website has become a central hub for virtual statewide 4-H program offerings and will continue to play that role in the foreseeable future. NJ 4-H from Home continues to grow adding new interactive workshops, STEP clubs, events/activities, and evolves regularly with the changing needs throughout the state

Developing STEM Identity and College Readiness for Underrepresented Audiences

Project Director

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Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7000122



4-H STEM Explorers

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

Several Rutgers 4-H STEM initiatives, including STEM Explorers in collaboration with the Millhill Child and Family Development Center in Trenton, encourage urban youth from groups underrepresented in STEM to participate in science and research in a series of interactive activities to gain a better understanding of opportunities available in science, engineering, and technology. Part of the 4-H youth development mandate is to prepare and empower our youth to get involved in a career in STEM. Several years ago, a series of national reports sounded alarm bells among youth development specialists about the need to engage our youth in science and technology, across all backgrounds, but especially in our urban communities. The 2006 National Academies report, *Rising Above the Gathering Storm*, highlighted the shortage of highly qualified educators and mentors who can translate and teach science, engineering, technology, and math content and skills. A 2007 report from the National Association of State Universities and Land-Grant Colleges identified science, engineering, technology, and math for youth as a growth area. National 4-H later unveiled SET (Science, Engineering, and Technology), now 4-H Science, as a critical part of its mandate, and Rutgers Cooperative Extension has since been playing an ever-increasing and vital role in creating interest and competency in these areas, especially among those traditionally underrepresented in STEM, including women and racial and ethnic minorities.

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

Mercer County 4-H and the state 4-H STEM office partnered with the Millhill Child and Family Development Center in Trenton to develop a six-week intensive summer STEM program for 70 youth - 24 Trenton middle school students served by Millhill along with 46 new Rutgers 4-H STEM Ambassadors from seven collaborating counties. The partnership received a \$33,000 grant from the Mercer County Youth Services Commission in addition to continued support from Bristol Myers Squibb to support the effort. Mercer County 4-H led the STEM programming, engaging a variety of Rutgers faculty, staff, and students from multiple departments, schools, and campuses. While all programming was delivered through Zoom, each session prioritized hands-on project-based learning with the use of weekly materials kits that were shipped to each participant. The youth participants engaged in activities and discussions with a wide variety of content-rich STEM mentors throughout the summer, including college student counselors, professors, researchers, graduate students, and 4-H Innovation Club teens.

- First week focused on the natural environment (led by 4-H faculty and staff) and included a collaboration with the Rutgers Soil Testing Lab and presentations by an Extension Agriculture and Natural Resources Agent (soils) and 4-H staff (composting).

- Second week, focused on exercise physiology and included a collaboration with Rutgers' faculty from the Department of Kinesiology and Health.

- Third week focused on coding (using micro:bit rovers) led by teens of the Robbinsville Innovation 4-H Club.

- Fourth week focused on robotics (using littleBits inventor kits) led by teens of the Robbinsville Innovation 4-H Club.

- Fifth week focused on data literacy and Antarctica (led by 4-H faculty and staff) as part of an NSF project.

- Sixth week, focused on engineering design (led by 4-H faculty using Rockets to the Rescue kits) and included live virtual tours of the Rutgers Glider Lab (Lichtenwalner) and coastal research with drones along with a panel discussion with four Rutgers Engineering Ambassadors.

The 23 Trenton youth who completed all six weeks received a small stipend for their participation and a Chromebook to eliminate barriers to participation.

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

A total of 70 youth participated in STEM Explorers during the summer of 2021. Of the 23 Trenton youth served by Millhill who completed all six weeks of the STEM programming, 65% are African American, 30% are Latino, and 91% are from a household considered low or very low income. The other 46 youth were new 4-H STEM Ambassadors from urban communities within

seven counties (Atlantic, Essex, Hudson, Mercer, Middlesex, Passaic, and Union). The new STEM Ambassadors chose two of the six weeks to complete along with their online modules, meetings, and subsequent outreach.

The STEM Explorers program is designed to impact the youth participants in three primary areas: STEM Knowledge and Skills, Attitudes toward STEM, and Awareness of STEM Careers. Based on a survey of the youth completing all six weeks of the summer program (% agree or strongly agree): STEM Knowledge and Skills • 92% gained investigative science skills • 92% gained knowledge and exposure to technology • 88% gained science knowledge from the six different STEM topics covered during the program Attitudes toward STEM • 92% are now excited about STEM as a result of the program • 85% believe the activities from the six topics are exciting and fun Awareness of STEM Careers • 100% believe the program made them aware of a variety of careers in STEM • 92% see STEM as a career opportunity. Several of the Trenton students who completed all six weeks reflected on their summer: “The professionals make everything so much more fun instead of boring. The mentors are helping me connect with other people. They even provide you the stuff in a box and gave you a computer. This summer will be the most knowledge-filled summer of my life”; “I really enjoyed the engineering and robotics weeks. It was really amazing that you guys got different students from different programs from Rutgers to come and talk to us.”; “I just really love how hands-on this program has been. I can only imagine how it would be if we were in person. It was really informative to learn about what’s happening with our planet and what is going on in Antarctica with the animals and the fish. This was a great way to save my summer. Thank you!”; “The thing I enjoyed the most this week was getting to see the mini rover move after all those lines of coding and hard work”; “Thanks for giving me this opportunity to be able to explore STEM more thoroughly than we would in school, and allowing me to find new interests.”; “I really liked the experiments. As soon as I got the app on my mom’s phone and my fitness tracker was working, I was so happy and just started walking in circles to get my 10,000 steps.” - Nzuri “I really loved engineering week the best. I love how everything was so hands-on and being able to communicate with others and expanding our knowledge.”; “It is so cool to see robots come to life from a bunch of scraps and parts. I loved this week and plan to keep my rover. This was definitely a memorable experience. I LOVE ROBOTICS!!”

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

A STEM component brings a valuable contribution to a well-rounded education. Science gives learners an in-depth understanding of the world around them. It helps them to become better at research and critical thinking. Technology prepares young people to work in an environment full of high-tech innovations. It has become evident that jobs of the future will require a basic understanding of math and science. Despite these compelling facts, mathematics and science scores on average among U.S. students are lagging behind other developing countries. By exposing students to STEM through this program and giving them opportunities to explore STEM-related concepts, they have a great opportunity to develop a passion for it and hopefully pursue a job in a STEM field.



Data to the Rescue: Penguins Need Our Help

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

This project, Data to the Rescue: Penguins Need Our Help, is an NSF funded project focused on creating replicable ways of bringing polar education to informal learning environments, extending our understanding of how polar education initiatives can be delivered to youth, and designing a professional development model to improve the capacity for researchers to craft meaningful broader impacts. The program is focused on building awareness and understanding of global and local climate change impacts. This effort is part of an NJ 4-H growing investment in STEM education for youth living in rural to urban settings. Geosciences in general and polar sciences specifically are not well represented in STEM programming. The team, with close connections to 4-H in Ohio and nationally, is already expanding the scope of content delivered with the project funding and establishing materials that will last well beyond the scope of funding.

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

Data to the Rescue was developed with a 4-H audience to be used in a Short-term Exploratory Program (STEP) club (previously known as SPIN clubs). It seeks to have youth join them on a science adventure where they will understand how these critically important regions are transforming due to climate change. The program is designed to provide youth with opportunities to explore STEM fields through hands-on exposure to scientific data. The program strives to help youth feel more efficacious about “doing science” by actively integrating science behaviors into their own personal and group identities (e.g. working with scientific data). The team designed this program to • Support leaders - By watching what the youth do and asking questions, the leader helps youth follow their natural curiosity. Leaders help youth gain important skills by encouraging them

to work together and to share ideas and materials. • Be fun, flexible, and educational - The kit is made up of eight sessions, each approximately 45 minutes long. The sessions are designed to be presented in order but can be flexible in both time frame and content presentation. The sessions build on each other, but a child who misses one or more sessions will still enjoy and learn from the activities. The module concludes with a creative expression, called a Data Jam, of youth understanding. • Be modifiable - There is support for ways to make the activities more or less challenging including two levels of the Data Jam activity. The Data Jam component of the resource kits has been the most challenging part of the development process. Through an interactive process, project team members continue to work with the early career researchers who participated in the professional development program in the summer of 2020 to draft a compelling and comprehensible narrative from their data in the resource kits. The team has been working on innovating the Data Jam concept in two key ways: 1) being intentional and transparent in the teacher's guide about how data skills are scaffolded in the kit structure, and 2) expanding the role of arts education and pedagogies in the kit design. The project team, in collaboration with a small production company called Tilapia Films, developed 7 PLP videos for use in the resource kits and also more generally as part of Polar Literacy initiatives. All PLP videos can be accessed at: <https://polar-ice.org/polar-literacy-initiative/> and on our YouTube channel <https://www.youtube.com/user/COSEENOW/videos>. In addition, Tilapia created 8 scientist spotlight videos to highlight the collaborating early-career scientists that are participating in the program. The videos are used with both kit formats and also available as standalone products, for example, to highlight each of the Polar Literacy Principles.

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

The project engages and serves three key audiences including: 1) Out of School time (OST) youth ages 9-13 2) informal educators and 3) polar researchers. Polar scientists participate in professional development (PD) focused on effective science communication skills and work collaboratively with informal educators to design effective OST club programs for underserved and underrepresented youth across four regional nodes (OH, NJ, PA, and CO). The focal point of the project is developing learning environments where youth grapple with real-world polar data, engage in conversation with polar scientists and reflect on connections between the polar regions and local natural systems. Ultimately, the PL project delivers a transferrable model for effective informal STEM learning that builds public engagement with polar science. The project's three key goals are: 1: Understand how youth engagement with polar data influence knowledge of and appreciation for polar systems and data literacy skills (eg. graph reading, sense-making, and reasoning). 2: Describe youth learners' own "connectedness" to a scientific self-identity as a result of engaging with polar scientists in OST programming. 3: Identify and articulate effective strategies for translating polar research and data into OST education programs

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

Despite the devastating impacts of COVID 19, the SEBS/NJAES/RCE team successfully pivoted from the original scope of work to remain productive in a virtual ZOOM environment. Investments were made in virtual and online learning platforms to engage youth in OST programs and have successfully provided professional development for polar scientists.

PLP Kit Implementations with Ohio and NJ 4-H Programs: To date, over 500 youth in grades 3 through 9 have participated in nine programs designed to pilot test the materials and pedagogical practices that have led to current versions of the Data to the Rescue. Analyses of registration data, survey data, artifacts, and observation notes have yielded the following key findings: Participants were relatively diverse with regard to both gender and underrepresented minority (URM) status. Across programs, 44.3% of youth identified as female, and 47.8% identified as URMs. Retention was strong, with the median number of days attended equally to the maximum number of possible days of attendance for five of the seven programs. Across all programs, the majority of youth (61.7%) who participated in at least one session attended all available days of programming. Across programs, youth both demonstrated and self-reported high levels of engagement with science activities and reported statistically significant gains in science identity. Youth who identified as URMs reported lower science identity than youth who did not identify as URMs. Importantly, however, this gap – particularly in perceptions of being "similar to a professional scientist" – decreased from pre- to post-survey. This finding is both exciting and consistent with empirical evidence that science identity can be bolstered among URM youth through strategies including a) showcasing scientists who might not fit traditional stereotypes, b) helping youth see scientists as people to whom they can relate, and c) providing youth with opportunities to practice doing and talking about science. All three strategies were important components of Polar Literacy activities. Gains in fascination with science and valuing of science were smaller than gains in science identity reflecting, perhaps, a "ceiling effect" as youth typically began Polar Literacy programs with high levels of both fascinations and valuing, maintained these high levels over time, and reported on their enjoyment of and appreciation for learning activities. Consistent with this interpretation, youth who began the program with relatively low levels of fascination in science (and, thus, had greater room to grow) reported greater gains in fascination over the week than youth who began the program with relatively high levels of fascination. Importantly, youth who identified as URMs reported greater gains in fascination with science than youth who did not identify as URMs. The development of curricular materials likely contributed to strong

engagement ratings and gains in science identity scores, as evidenced by youths' spontaneous, positive reflections on these elements of program activities (e.g., "Having [scientist's name] here was a lot of fun. I found his work very interesting and learned a lot more about the Arctic.").

Critical Issue

Maintain Viable Agriculture and Aquaculture

New Crops, Natural Products and Agricultural Food Ecosystems

Project Director

James Simon

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1025914



New Crops, Natural Products and Agricultural Food Ecosystems

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

Creating new opportunities for the introduction of new crops, plant products, and to provide new opportunities to growers and those involved in the foods and agricultural sector; and as needed to understand the genetic diversity of undervalued orphan crops and focus on their genetics to breed of crops with enhanced disease resistance, aroma, taste, nutrition and/or for other health and medicinal applications such as the repelling of arthropod pests such as mosquitoes, ticks and bed-bugs. Additionally, we focus on natural product chemistry in plants and in the metabolomics following dietary consumption to identify those bioactive molecules that enhance health and nutrition; and continue to search for new bioactive compounds for applications in the treatment of health and medical disorders.

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

We have created and developed new sweet basils resistant to the fusarium wilt disease; we have created and developed new habanero peppers for the fresh market; we have created and are developing new types of catnip as natural pest repellent agents with the aim that they be as safe and effective as DEET; and we have created and developed two new varieties of oregano for the fresh, spice and nutraceutical market; and working to focus on bioculturally preferred nutrient dense leafy greens. We are working to examine synthetic analogues of dihydromyricetin (DHM) as novel treatments of alcohol use disorder. We serve as partners to Mt. Sinai Medical School in an NIH funded project in which we conduct the bioanalysis and chemistry that seeks to identify natural products in botanical supplements that can positively impact behavioral resilience.

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

The target audience for the new crops research are commercial growers/farmers, seed companies and the allied agricultural industry support farmers. The target audience for the novel bioactive compounds that may serve as new lead proto-drugs include the nutraceutical and dietary supplement industry, the NIH and research community seeking to study botanicals as medicines; and the novel effective natural products that were shown to be effective against arthropod pest are global health foundations, the Department of Defense and others involved in finding effective and safe natural products against those diseases transmitted by mosquitoes, bed bugs and ticks. Those audiences benefited by us sharing with them either new genetic materials, new released varieties, and or participated in trainings and other remote workshops, field visits where they became familiar with the research and findings we discovered and shared with them to use as applicable

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

Our program is a multidisciplinary one that can illustrate through stories and case studies how science can help solve some of their most serious problems and constraints or at least contribute to the solutions the industry needs and in doing so improve health and access to nutrient dense foods and improve income generating opportunities with new crops. Our program when communicated effectively can impart and disseminate lessons learned and provide tools and technologies that they can use.

By creating a greater array of genetic diverse in bioculturally preferred food crops, we can improve the access to, availability of, traditional or indigenous foods crops now universally available. The more basic work in chemistry and bioanalysis is designed to lead to new and novel safe and effective products to improve health and nutrition of families.

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

We hosted several remote workshops under the covid environment and at times were able to host several field days and tours where growers, industry and private sector participated to see the new and improved crops in our greenhouse and fields and lab. We hosted and co-organized two international conferences focused on Traditional Vegetables from Sub-Sahara Africa and on Medicinal Plants. Participated in NIH conferences.

Our results were disseminated using traditional posting on two web-sites (including: : <http://newuseag.rutgers.edu> and <https://rucafe.rutgers.edu>), using Instagram, posting on extension outlets such as the Plant Advisory Bulletin, and in workshops that we hosted with growers, processors, industry and national scientific conferences (with this year mostly remote) and to the research community through peer reviewed research papers.

This coming year, there will be a continued focus on plant genetics and breeding via greenhouse and field trials with some of our materials also being tested by the commercial sector. Continued focus on examining the nutritional and phytochemistry of hibiscus and amaranth while selecting lines good for indoor and outdoor production. Continued work on a wide range of other bioculturally preferred traditional crops originating in other parts of the world. Continued focus in the chemistry and quality control of botanical products used in human clinical trials and the bioanalysis to better understand the bioactive compounds associated with improved behavioral resilience. Focus on processing of the catnip and other extract for pest repellency and the continue development of synthetic analogues of natural products when needed to improve their activity, solubility, effectiveness and/or stability.

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2020. Simon, J.E. and W. Reichert. Catnip Cultivar 'CR9'. US Patent US10,602,702 B2. Date of Patent issue: March 31, 2020.

Closing Out (end date 09/07/2023)

[Industrial Hemp Production, Processing, and Marketing in the U.S.](#)

Project Director

Raul Cabrera

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1025889



Analyzing the agronomic practices, crop quality and genetics for hemp cultivars for New Jersey

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

Until the late 1930s industrial hemp (*Cannabis sativa* L.) was a major agronomic crop in the U.S., but was banned from production for at least seven decades. The 2014 and 2018 Farm Bills reintroduced it as a regulated legal crop, and there is an urgent interest to generate recommendations and best management practices that will allow for the successful production, harvesting and postharvest handling of this crop variants: grain, seed oil, fiber and buds or flowers. We are conducting studies and disseminating information to hemp growers about the agronomic and horticultural management practices and crop quality of hemp cultivars used for flower bud production under intensive field (plasticulture) and greenhouse systems. Among

the production and management practices being evaluated, particular attention is being devoted to: planting date x variety interactions, planting density, fertilization practices, water use and irrigation management, disease and pest management, and postharvest quality (chemical assessment of cannabinoids, terpenes and fatty acid & amino acid profiles, etc.).

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

Agronomic practices: Several floral hemp cultivars were field-grown under fertigated plasticulture management, at densities of ~1,400 plants/acre, in two locations. Two irrigation management treatments were imposed: a “wet” treatment irrigated when soil matric potential (Ψ_m) reached -15 to -25 kPa, and a “dry” treatment irrigated when Ψ_m reached -45 to -55 kPa. Evapotranspiration and water applications were tracked, along with some physiological measurements of crop water status, and plant and flower biomass yields at harvest. Insect and disease pressures and nutrient-related disorders were also recorded.

Preliminary results pointed out to reductions in dry flower yields for plants under “dry” irrigation compared to the “wet” treatments, but without affecting cannabinoid contents/profile. *Septoria* sp. and *Bipolaris* sp. leaf spots, and *Golovinomyces* sp. powdery mildew were the main diseases observed, and we are working on confirming their identity with molecular tools. A preliminary greenhouse experiment was setup to evaluate floral hemp production under soilless substrate cultivation, evaluating container size and suitable fertigation management practices.

Crop quality: A fully functional lab was established on campus to test cannabinoids (THC, CBD, CBG), aromatic terpenes and other quality parameters, and a set-up for small-scale solvent extraction. Cannabinoid analyses were performed several times from field and greenhouse hemp research plots. Sampling done until early September found THC concentrations under the 0.3% THC legal limit, but in later dates most of the evaluated floral hemp cultivars exceeded this limit (ranging from 0.37 to 0.86%). Average CBD concentrations at harvest ranged from 9.0% to 16%. The CBD to THC ratios in harvested flower buds averaged ~20:1 across all cultivars. Results suggest that cultivars with CBD:THC ratios approaching 30:1, and CBG cultivars, should be strongly considered to reduce potential to exceed regulatory THC limits at harvest, and maximize CBD and CBG contents.

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

Results and observations from our preliminary studies, and relevant and practical managements practice arising from these, have been shared in various educational and extension meetings and programs with multiple audiences including potential growers, county agricultural agents, state department of agriculture employees, students and fellow research and extension colleagues. These programs and activities have been made open to all audiences, regardless of race, gender, national origin, etc. Due to Covid-19 regulations, during the fiscal year 2020-2021 these efforts have been mostly virtual/online.

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

Industrial hemp was a major and important crop in the U.S. until the late 1930s, when it was banned from production for at least seven decades. The 2014 and 2018 Farm Bills reintroduced it as a regulated legal crop, and its versatility in different production systems and a myriad of resulting products promise it becoming an economically important staple crop. There is an urgent need and interest in generating knowledge, recommendations and best management practices that allow for the successful production, harvesting and postharvest handling of hemp crop variants: grain, seed oil, fiber and floral organs (buds). Our studies are aimed at generating useful, timely and economically sound information on the best agronomic and horticultural management practices for the production of quality hemp crops used for flower bud production under intensive field (plasticulture) and greenhouse systems.

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

Results and observations from our preliminary studies, and relevant and practical managements practice arising from these, have been shared in various educational and extension meetings and programs with multiple audiences including potential growers, county agricultural agents, state department of agriculture employees, students and fellow research and extension colleagues. These programs and activities have been made open to all audiences, regardless of race, gender, national origin, etc. Due to Covid-19 regulations, during the fiscal year 2020-2021 these efforts have been mostly virtual/online.

During the next reporting period, field and greenhouse experiments will be carried out to evaluate the effects of irrigation & fertilization management on the water and fertilizer use efficiency of floral hemp cultivars. Field evaluation of dual purpose hemp cultivars will be done under more conventional agronomic (no plasticulture) management practices. Laboratory studies will be done on confirming the identity of disease organisms found in field and greenhouse plots with molecular tools. Portable cannabinoid analyzers will be evaluated under field conditions, and contrasted with results from twin samples analyzed with approved laboratory analytical methods.

Journal Publications:

Komar, S., and W.J. Bamka. 2021. An evaluation of two industrial hemp cultivars: Suitability for production, agronomic traits, and performance related to industry and regulatory standards. Journal of the National Association of County Agricultural Agents. 14(1) online. <https://www.nacaa.com/journal/index.php?jid=1222>

Books, chapters and other non-periodical, one-time publications:

Cabrera, R.I. 2020. Some considerations on the intensive horticultural production of industrial hemp, p. 54-57. Proceedings of the 65th New Jersey Annual Vegetable Meeting. Rutgers Cooperative Extension and New Jersey Agricultural Experiment Station.

Simon, J. and Q. Wu. 2020. Sampling services and procedures for the hemp industry, p. 61-62. Proceedings of the 65th New Jersey Annual Vegetable Meeting. Rutgers Cooperative Extension and New Jersey Agricultural Experiment Station.

Control of Foodborne Pathogens During Production and Processing

Project Director

Karl Matthews

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1024994



New technologies to improve the microbial safety of raw products

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

Foodborne illness is a global human health concern. Methods used to improve microbial safety of crops and processed commodities (meat, poultry, fruits, vegetables) that are safe, sustainable, and consumer acceptable are needed. New technologies to improve the microbial safety of raw products will be developed and evaluated.

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

Understanding occurrence and spread of antibiotic resistant bacteria (ARB) on leafy greens is important to mitigating infections associated with ARB. Analysis of lettuce samples collected from local markets revealed the presence of unique ARB bacteria that are associated with food spoilage, but can cause infection in clinical settings. The bacteria was resistant to colistin a "last resort" antibiotic for treatment of infection associated with multi-antibiotic resistant Gram-negative bacteria. Subsequent experiments revealed the genes encoding for colistin resistance carried by the bacteria. Future experiments will determine whether the genes can spread to other Gram-negative bacteria found in food matrices. Research on the use of photosensitizer curcumin is at an early stage. Curcumin is commonly used as a spice and food colorant. The intent is to develop a process combining light and curcumin to inactivate spoilage and pathogenic bacteria on the surface of raw products.

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

Research associated ARB in leafy greens and photosensitizer curcumin have been presented at scientific meetings and used in classroom instruction. Both projects focus on the food microbiome and its impact on human health. Undergraduate students seeking research experience are assisting in all phases of the project from literature review to microbiological analysis to molecular screening. An undergraduate involved in the research is participating in the Louis Stokes Alliance for Minority Participation, a program for underrepresented minority students to pursue and produce high quality work in science, technology, engineering, and mathematical (S.T.E.M.) research

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

The research when completed will support development of strategic approaches to reduce spread of antibiotic resistant bacteria and promote sustainable practices to control spoilage and pathogenic bacteria on raw commodities. Collectively, this will serve to mitigate human illness on a global scale. The information attained from completion of the research will be an important addition to materials used to train and educate workers, consumers, academics, and regulatory agencies.

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

Senior level Ph.D. students are engaged in the project. Importantly they are training several undergraduates in a host of microbiological laboratory techniques and data analysis. This effectively enhances the skill sets of the Ph.D. candidates and the undergraduates. The graduate students have presented the research at departmental seminars and at professional meetings (IFT, IAFP). Weekly laboratory meetings are held with the expectation that each student share what they are working on and the experience(s) they have had.

The PI is working with colleagues in other countries (Thailand, Philippines) that are using some of the data in training sessions for undergraduate and graduate students and local farmers. There is a real need for the public (consumers, farmers, researchers, etc.) to know that antibiotic resistant bacteria are spread through produce and not just foods of animal origin.

This next period we will

1. Conduct additional sampling and analysis of leafy greens for ARB.
2. Continue screening of bacterial isolates for antibiotic susceptibility and antibiotic resistance genes.
3. Determine transfer of resistance genes under a range of conditions.
4. Evaluate efficacy of photosensitizer curcumin for inactivation of *Listeria monocytogenes* on salmon.
5. Evaluate efficacy of photosensitizer curcumin for inactivation of *Listeria monocytogenes* on stainless steel.

[Agritourism in New Jersey](#)

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7002386



Agritourism Training and Risk Management

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

The Rutgers Agritourism Working Group, made up of NJAES/RCE faculty and staff, provides programming for farmers who utilize an agritourism model for direct marketing to customers. New Jersey is the most densely populated state in the nation and farmers have an opportunity to sell directly to the public. In addition to in-state programming, the Rutgers team is cooperating on an agritourism project with 6 other states, led by Vermont. The purpose of this project is to provide training and resources on agritourism safety and liability for approximately 200 farms and service providers.

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

Members of the Rutgers Agritourism Working Group have partnered with other Land Grant Universities in the Northeast to deliver online educational sessions and on-farm evaluations for risk management to agritourism operators. Vermont, New Hampshire, Maine, West Virginia, Pennsylvania, Maryland, and New Jersey are involved in this program. In 2021, a series of 8 webinars were conducted with speakers from 4 different cooperative extension systems. Educators utilized resources developed by the Rutgers working group to conduct on-farm evaluations. Resources can be found at https://sare.rutgers.edu/rdma_introduction.html

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

The target audience is agritourism operators (farmers). Team members conducted on-farm safety assessments for a total of 68 assessments across Vermont, New Hampshire, Maine, West Virginia, Pennsylvania, Maryland, and New Jersey. During the assessments, team members discussed challenges, barriers, and improvements needed regarding safety and liability for agritourism operations.

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

This program is ongoing. However, clientele indicated the following needs/issues that the team is addressing: 81% of respondents were concerned about liability issues, 73% were concerned about managing visitor accessibility, 66% concerned about food safety, and 55% concerned about biosecurity.

Beginning Farmer Training

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7001969



RCE New and Beginner Farmer Program

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

The average age of farmers in New Jersey is approaching 60. It is important to encourage and train the next generation of farmers to produce local food and agricultural goods for the state. Many farmers do not have a next generation that can or will take over the existing farm. As of 2021, there are 9,900 farms in New Jersey on 750,000 acres. With one of the most active farmland preservation programs supported by the residents of New Jersey, there is a large interest in keeping the garden in the garden state. NJAES/RCE faculty and programmatic staff created the RCE New and Beginner Farmer Program to fulfill this need for the next generation of farmers.

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

Phase 1 of 3 of this program was conducted in 2021. A core team of five faculty and staff held weekly online meetings to design and implement the program. Online classes were delivered over 30 weeks, from May through November, for a total of fifteen, two-hour-long online sessions. These sessions were recorded and made available asynchronously through Canvas, a learning management software. Two in-person tours and training sessions on active farms were conducted to provide participants with advice from agricultural and horticultural experts. One educational tour and a separate hands-on planting session were conducted at the NJAES Specialty Crops Research Station in Cream Ridge, NJ. Weekly online "office hours" were held every Thursday throughout the length of the course. These online sessions answered participants' questions and provided a space for participants to ask questions, get feedback on farm plans, and work through issues relating to land and regulations. Three informational fact sheets were written. One fact sheet was published and two others are in the process of being published after peer review. A program website and social media accounts were developed to provide promotional outreach for the program.

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

Participants participated in the program from across the State of New Jersey, with a few coming from New York and Philadelphia. While many were from suburban and rural areas of the state, there are also clusters of students from the more urbanized northeastern portion of the state. The recruitment efforts consisted of a robust multi-channel approach to raise awareness about the existence of the program. Of the 48 registered participants, 25 were male (52%), 22 were female (45%), and one was gender nonconforming. Among participants who provided race/ethnicity information in the pre-course survey, there was a diverse mix of race and ethnic backgrounds, with 12 individuals identifying as White, 1 as African, 3 as Black/African-American, 3 as Southeast Asian, 2 as South Asian, 2 as Indigenous American, and 4 as Hispanic/Latin American.

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

The main survey metrics used to understand the impact were gain in knowledge and gain in skill. 18 of the participants responded to the post-course survey. Since this first phase was a predominantly online education program, the expectation was to see more impact in the gain in knowledge metric. The topics of focus for this assessment were: • Annual vegetable production • Cut flower production • Animal husbandry • Nursery crop production • Fruit production • And beekeeping. The largest knowledge gain was in the area of annual vegetable production, which was a key area of interest for most of the course participants. All participants reported some degree of knowledge increase in this area, with 50% reporting a large increase. Cut-flower production was another topic area that saw significant knowledge gain with all participants reporting some gain, and 70% reporting a moderate gain. In conversations with participants, the program team found that many who had not initially considered cut-flowers as a viable commercial option were now interested in adding this enterprise to their farm plan.

Knowledge Increase by Topic: Internal Survey Data In assessing the increase in skills the program team focused on 4 key areas: • Farm equipment repair and maintenance • Business planning • Business management • And marketing. Training related to farm equipment repair and maintenance was limited by the lack of in-person training this year and will be a larger focus of the next phase. While repair and maintenance were covered in the lectures, these are subjects that are better taught hands-on. Business planning was a recurring theme of the course and most class topics were presented in the context of how they would fit into and improve a participant's farm business plan. 43.75% of respondents reported a moderate increase in business planning skills and 18.75% reported a large increase. Similar increases in skill were reported in the area of business management, which included personnel management, bookkeeping, and related topics. All participants reported an increase in marketing skills, with 56.25% reporting a moderate increase. Marketing is an important and sometimes overlooked topic for new farmers, who are eager to grow produce but have not given much thought to how they will sell it.

Skill Increase by Topic: Internal Survey Data - Additional results were gleaned from open-ended survey questions and conversations with participants. A few highlights from these include: • Pest Control – Many participants were unaware of the requirements around pesticide licensing and the distinction between Organic, Conventional, and Integrated Pest Management systems. Many believed that organic growers either did not use pesticides or did not have to be licensed to apply organic sprays. Many participants commented that they were now aware of the legal requirements and would pursue licensing. Pesticide training manuals were made available to 14 participants at no cost to facilitate the licensing process. • Networking and information – Many participants were not aware of the wealth of resources available to them through the Cooperative Extension Network. They now know that they can turn to RCE when they have questions or need help finding resources. • Farms Purchased – Following the completion of the phase 1 program, two of the participants went on to apply the lesson of the course and purchased farmland, one in upstate New York, and the other in Central New Jersey. Both credited the program with providing them the guidance they needed to ask the right questions and choose the best site for their farm operation.

New Jersey 4-H Animal Science Programs

Project Director

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Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7001228



New Jersey 4-H Equine Program

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

As an increasingly urbanized state, New Jersey offers limited opportunities for young people to learn about agricultural practices and agrarian career choices. There is a disconnect between New Jersey residents and the practical application of science in everyday life, especially topics in Agricultural Sciences. New Jersey youth are becoming disconnected from the land, the interaction of animals and man, and are losing a sense of responsibility and hard work. 4-H Equine programs can help instill those life skills in young people. The New Jersey 4-H Horse Project remains one of the largest projects in the state with over 500 youth enrolled in 2020 -2021. The 4-H year runs from September to August. In this 4 -H project youth study all aspects of the equine industry, animal care and management, anatomy, and physiology, feeds and feeding, breeds and reproduction, genetics, and all styles of riding and equestrian sports. While many of these youth do not have access to a horse, they all have an interest and love for the equine animal. In 2020-2021 there were over 150 registered adult 4-H volunteers in fifteen of the twenty counties who work with these youth to prepare them for equine competitions and life in general. 2020-2021 presented some unique challenges in delivering educational programs due to the Covid- pandemic as the traditional in-person programs were not permitted until May 2021. Several of the State -H Equine programs were delivered in a virtual format and one new program, 4-H Virtual Horse Camps was created.

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

Objectives of the 4-H Equine program included: A) Develop leadership, initiative, self-reliance, public speaking abilities, sportsmanship and other desirable life and workplace skills. B) Experience the pride of owning or leasing a horse or pony and being responsible for its care and management. C) Develop and appreciate horseback riding and equestrian sports as healthy wholesome forms of recreation. D) Learn skills in horsemanship and an understanding of the businesses of raising and training horses. E) Increase knowledge of safety precautions to prevent injury to self, others, and the horse. F) Promote greater love for animals and a humane attitude toward them. G) To be better prepared for citizenship responsibilities through working in groups and supporting community horse projects and activities.

The State 4-H Equine program is comprised of several state events over the course of the year. Two Virtual 4-H Horse camps were held in 2020-2021. The summer camp was four nights covering eight different topics. Youth logged in to a Zoom link and extension faculty and volunteers presented each night. Topics included: hay evaluation, internal parasites, First Aid for your horse, banding and braiding manes, showmanship skills, equine anatomy, quiz bowl questions, and ranch riding. The objectives of the camp were to help participants increase their knowledge and skills in the following subjects: Basic horse care and management (Equine First Aid, Hay Evaluation and Parasites) 2. Preparing for and competing in Horse shows (Banding, Braiding and Clipping, Showmanship and Ranch Riding) 3. Equine terminology and preparation for competitions including Horse Bowl, Hippology, Horse Judging, and Equine Presentations (Equine Anatomy and Kahoots Game). The winter virtual horse camp consisted of preparing youth for the virtual contests to be held in 2021: model horse show, horse bowl, equine art, and horse judging. There were two hours of educational programs for three nights. 30 youth participated in this program. The State 4-H Model Horse Show is available to any 4-H club member regardless of the ownership of a live 4-H project horse. Model horses are plastic models and youth may own one or more brands or models with hundreds of styles and breeds to choose from. In the Model Horse Show, youth display their knowledge of horse breeds, the ability to determine the sex and age of a horse, and what style of riding or work is most common for that breed. Youth in this program learn to identify coat colors and use the appropriate tack on the animal for that style of riding. Some of the youth created their own tack and design appropriate stabling areas and can change their coat colors or position on their model horse. In 2021, this program was virtual, and the format was new and hindered some participation.

The State 4-H Horse Bowl is a quiz bowl type of competition where youth use buzzer boards to answer questions related to physiology, breeding, feeds, nutrition, styles of riding, tack, coat colors, or diseases. This is a highly competitive event in which youth practice and study for many months to prepare. In 2021, this program was successfully held in a virtual format. Youth participants, coaches, and 4-H Staff met weekly to develop their skills and work out any technical issues prior to the contest.

State 4-H Equine Presentations is a public speaking competition where 4-H members research a topic related to horses and present it either individually or as a team. Youth may choose to give formal speeches, individual presentations, or present as a team. In 2021, the youth had to give their speeches using Zoom so that the judges could hear the speech live and ask questions as they would in a regular contest.

The State 4-H Horse Judging Contest is a competition where youth utilize their equine knowledge to place a class of horses similar to the way a professional judge would at a Horse Show. Those competing in judging also use their public speaking skills to justify why they placed a class of horses by giving oral reasons to a judge and receiving a score. In 2021, this was done as a virtual competition using classes available online and giving oral reasons to the judge over Zoom.

Hippology competitors learn to judge horses and give oral reasons as well as exhibit their equine knowledge by solving problems presented in skill-a-thon stations, slides, and quizzes. Again the topics can be a wide variety of topics including tack, feeds, breeds, coat colors, poisonous plants, and more. In 2021, this contest was also done in a virtual platform using a program called Classmarker.

The State 4-H Horse Show Clinic is where youth participants that have access to a horse to ride have the opportunity to showcase all of the skills they have learned during the year. They compete in county qualifying shows and if qualified (by reason of scores and placings) they may represent their county by competing at the State Show. In 2021, the traditional State 4-H Horse Show was not held, but in its place a Horse Show Clinic was held for 25 youth and they had the opportunity to work with horse show judges to improve their skills.

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

Virtual Horse Camp: The summer program had 35 youth from ten different counties participating for two hours of instruction each night. An evaluation was conducted after the event and 15 of the 35 youth completed the evaluation. Results were: 93% rated the event as excellent or very good and it should be done again; 93% reported learning basic horse care skills; 80 % said they felt more prepared for participating in shows

Model Horse Show: Participation in this event was severely affected by the virtual format required in 2021 and only a dozen youth participated. Those youth did however learn new skills in photography and how to present their models to their best advantage in a photo.

Horse Bowl: Sixty Hour (64) youth from twelve New Jersey counties participated in the State Contest in 2021. Because of the pandemic, a virtual format had to be used. Youth practiced for weeks before the event to learn how to “Buzz in” and answer questions in this format. From those in the top 10, a team of 4 youth was prepared for the Eastern National Round-Up competition. Unfortunately, one month before the event one child was unable to participate, so the team did not travel to Kentucky for that competition.

Equine Presentations: Due to the virtual format, participation in this event in 2021 was lower than in previous years. There was 13 youth in the contest from four counties. Of those individuals, one individual presentation and one public speaking competitor did go to Eastern National -H Roundup in Kentucky and placed first and fourth in their contests.

Horse Judging and Hippology: Again because of the pandemic and the virtual format, only twenty-five youth from eight counties participated in this state competition in 2021. Only the NJ hippology team traveled to Kentucky this year.

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

See above.

On-Farm Food Safety

Project Director

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Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7001948



On-Farm Food Safety

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

The fruit and vegetable industry in New Jersey is under increased pressure to improve its food safety practices and to obtain a third-party audit confirming they are improving those practices. With the Food Safety Modernization Act (FSMA) being implemented, all growers with sales over \$25,000 must also meet rigorous federal standards. This requires training and technical assistance to help them understand and comply with the act. The value of utilized fruit and vegetable production in New Jersey is over \$220,000,000, most of which is fresh market production. This requires growers to either obtain a third-party audit if they are wholesale growers or at least be inspected under the Food Safety Modernization Act provisions. Also

impacting the total agricultural sector in 2021 was the Covid-19 pandemic. As state policies shifted and Executive Orders were issued that affected farm businesses, the Rutgers On-Farm Food Safety Team had to assist growers in understanding and complying with these state orders, helping them adapt to the changing situation.

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

The project was delivered through the following methods:

- Presentations at produce industry meetings across the state (30-60 minutes)
- Monthly and weekly newsletter articles (Cultivating Cumberland and Statewide Plant and Pest Advisory – Fruit and Vegetable Editions). During this reporting period, 22 food safety Plant & Pest advisory posts were viewed 1,269 times.
- Factsheet publications
- Website: <http://nj-vegetable-crops-online-resources.rutgers.edu>, <http://plant-pest-advisory.rutgers.edu>, and <http://onfarmfoodsafety.rutgers.edu> where training materials are placed for self-training, new food safety, and agriculture-related Covid-19 information are reported. The Rutgers On-Farm Food Safety YouTube Channel also houses relevant videos for growers as well as new videos and webinars developed by the Rutgers On-Farm Food Safety Team. The website had 11,895 hits in the reporting period from 1,688 users and the YouTube Channel had a total of 240 views.
- Facebook page (<https://www.facebook.com/RutgersOnFarmFoodSafety>) – This Facebook page is used to inform followers of timely food safety information specific to the production of fresh produce. There are 457 followers of the page with 466 likes in the reporting period. The Rutgers Plant and Pest Advisory Food Safety blog posts are also cross-posted onto this page. This Facebook page is used to inform followers of timely food safety information specific to the production of fresh produce. In the reporting period, on-farm food safety Facebook posts had a total reach of 2,134 users.
- In-depth training sessions for growers and buyers (4-6 hours)
- Hands-on training programs
- One-on-one critiques of food safety plans on individual farms (mock/second party audit)
- On-Farm Readiness Reviews (OFRRs) which are one-on-one farm walk-throughs to prepare growers for FSMA inspections. The focus is on good agricultural practices, USDA Third-Party Audit preparedness, and compliance with the Food Safety Modernization Act (FSMA) Produce Rule. Farm visits typically last approximately three hours, with a farm walk-through assessing risk reduction measures.
- 19 Webinar presentations were held for 436 individuals over the reporting period.
- Four educational displays at industry trade shows. In addition to grower outreach, the team also conducts train-the-trainer sessions for extension educators, state inspectors, FDA staff, and industry representatives that do On-Farm Readiness Reviews. Five trainings were held for 95 attendees from 33 states and one territory, and at least 5 professional poster presentations. Four (48 hours) PSA-certified FSMA training sessions were held for 54 individuals. Additionally, 15 other educational programs (~30hrs) were held for 382 people which included 2 GAP Audit classes, private sessions, and public webinars. The audience was diverse in the fact that some growers had not been involved in food safety in the past. Sessions were divided between beginner and advanced growers which allowed the team to better tailor the program to the group. As part of the Produce Safety Alliance training, required by the Food and Drug Administration for the Food Safety Modernization Act, 3 On-Farm Readiness Reviews were completed in collaboration with The New Jersey Department of Agriculture. These farm visits assist growers in assessing their farms' specific food safety risks. Six GAP/Audit farm walk-throughs were also conducted lasting approximately 2 hours each and focusing on the USDA Harmonized GAP standards.

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

The target audiences are fresh fruit and vegetable producers, wholesale buyers and produce cooperatives in New Jersey related to FSMA and third-party audits in addition to beginning growers and those who are planning to start farms. The second target audience was the total agricultural community as related to Covid-19. The following are some examples of participant satisfaction with the Food Safety and OFRR train the trainer programs:

"I really wish I could have taken this class sooner, right after starting to work at the Dept. of Agriculture because I feel I have gained more confidence and knowledge about the things I will talk to farmers about on and off the farm." "This training was one of the best online trainings I've done!" "Overall an excellent course with excellent instructors and excellent material." "This training also provided a solid understanding of the OFRR applicability to inspections and spending time on the distinction that the OFRR is not meant to be an inspection or records review, as I think there is much confusion around this for farmers." "Before the course, I saw no value in OFRRs. I went on a few and they didn't seem to help. Some farmers thought they were a waste of time. Some farmers were given a false impression of what an inspection is. Others felt our outreach didn't know what they were doing. Now that I have taken the course, I really learned that our outreach team just sucks. These OFRRs could be so helpful and mutually beneficial to the regulator and the farmer. The farmer would benefit from "getting a feel" for an inspection and the agency and how compliance and enforcement happens." "I found the egregious conditions slides & the farm scenarios where we role-played as assessors to be the most beneficial aspects of the training. I appreciated the open dialogue during the course which allowed participants to ask questions and have discussions about areas we weren't confident about." "This was a fantastic training. Very rich in content. I know that it will shape how I conduct OFRRs, and I am very grateful for all of the effort that went in to planning and conducting this training remotely." "Most up to date and vast knowledge." "I trust the team to give realistic

guidance and interpretation of an otherwise murky FSMA." "It would have taken me ten audits to learn what I did in a few hours of class and one farm visit." "Farming answers aren't always black and white and regulations aren't clear. The FS Team is a great source of information and support when navigating difficult situations."

A survey conducted asked growers how food safety and OFRR walkthroughs helped them in the following ways: • Helped prepare for FSMA • Improved cleaning/sanitizing • Pointed out flaws in operation • Confirmed our practices were acceptable • Made clear important issues • Let me know we were doing well • Got me in the food safety mood • Beneficial walk to show where we needed to improve. 65 post-training survey responses were received of the 96 state inspectors, FDA staff, extension educators, and industry representatives who attended the 5 On-Farm Readiness Review Trainings: • 54 of the respondents indicated that they were likely to be conducting FSMA Produce Safety Rule inspections on farms. • 47 of the respondents noted that the training had a major or moderate effect on their ability to conduct FSMA PSR inspections. • 39 of the respondents said that they were extremely likely to use the developed walk-around questions used in the training and 21 respondents said they were somewhat likely to use them. • 41 of the respondents were extremely satisfied with the training and 21 of the respondents were somewhat satisfied.

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

Growers were motivated to comply with on-farm food safety principles for two reasons: meeting customer requirements and feeling responsible for producing safe food products. The majority of growers were motivated to implement food safety practices and to obtain certifications required by their customers, especially wholesale retailers. Some growers implemented food safety practices out of a sense of responsibility to ensure product safety and to protect their customers.

Specialty Crops and Food Systems: Exploring Markets, Supply Chains and Policy Dimensions

Project Director

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Accession Number

1024538



Best practices of local food direct marketing and agritourism activities

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

Online grocery shopping continues to positively influence our lifestyle. This has resulted in a dramatic growth in sales and this trend is expected to continue into the foreseeable future. It is important to note that socio-economic and demographic characteristics play a major role in consumer online shopping behavior. Although studies that have investigated the determinants of customers' intentions for online grocery shopping exist in several other contexts, there is the need to identify the key factors that influence consumers' online shopping, especially in the mid-Atlantic region of the U.S. This is critical as this region represents a potentially high growth point for online groceries shopping.

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

The results indicate heterogeneity in the socioeconomic and demographic characteristics of organic produce consumers in their online shopping behavior. Specifically, race, age location, advertisement, consumer's previous purchase of similar products from the Community Supported Agriculture outlets, and trust of what is sold as organic significantly increase the likelihood of being an online consumer of organic produce, while age and the use of pesticides decrease it. Furthermore, product attributes such as packaging, freshness among other quality signs are significant determinants of online shopping behavior for organic food. These findings provide important feedback to retailers in developing better strategies to target specific consumer segments for better online sales. In addition, they can guide the industry in the identification of the key quality signaling attributes to guide online food purchases given the role of trust in the decision-making process.

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

Producers, wholesalers, and retailers. These target segments can serve their clientele better using the findings from this study and enhance their profits.

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

Producers, wholesalers, and retailers. These target segments can serve their clientele better using the findings from this study and enhance their profits.

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

Next period we will conduct additional econometric exercises to predict consumer behavior and disseminate the results to target audiences.

Outreach

Govindasamy, R., S. Arumugam, and R. Brumfield. Marketing Tools for Small Business”, Vegetables Growers Association of New Jersey Annual Convention - Online, New Jersey, February 22, 2021. Govindasamy, R., and J.E. Simon. “Mid-Atlantic Demand for Ethnic Produce, Mid-Atlantic Fruit and Vegetable Convention - Online, Pennsylvania State University, Pennsylvania February 8, 2021.

Publications:

Govindasamy, R., S. Arumugam, G. Gao, M. Hausbeck, A. Wyenandt and J.E. Simon. Downy Mildew Impacts and Control Measures on Cucurbits in the United States. (2021), Journal of American Society of Farm Managers And Rural Appraisers: 78-90.

Govindasamy, R., Kelly, A., Simon, J.E., Van Wyk, E., Weller, S., Ramu, G., and Mbewu, M. Postharvest handling, processing, value, and marketing of African indigenous vegetables: A case study from Zambia. Journal of Medicinally Active Plants (2020), 9(4):209-221.

Sustainable Equine and Animal Agriculture

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Accession Number

7001081



Environmental Impacts of Equine Operations

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

Traditional cool-season grass pastures in temperate regions of the Northeast United States typically experience low productivity in the summer months. This "summer slump" results in increased expense for horse operations associated with costly supplemental feed. Grazing strategies incorporating warm-season grasses, which produce high yields in hot summer months, into traditional systems have shown little economic advantage in cattle. Due to differences in nutritional management goals and drivers of enterprise profitability in equine operations, integrated systems may have greater utility for horse producers. However, little published research exists on the grazing of warm-season grasses by horses. This project investigates the potential for increased pasture productivity through the implementation of integrated, sequentially grazed cool and warm-season horse pasture systems. Three rotational grazing systems: 1. traditional cool-season 2. bermudagrass integrated into cool season, and 3. crabgrass integrated into cool-season are being evaluated under grazing by twelve adult Standardbred horses over a full grazing season. Productivity will be assessed by measuring forage yield and persistence of planted forage varieties. This project is also evaluating the effect of test forage (bermudagrass or crabgrass) and establishment method (inter-seeding or monoculture) on productivity, forage nutritive value, and horse body condition.

Finally, this project will determine if this grazing strategy would provide an economic advantage to horse producers. Costs of establishing and maintaining pasture systems will be compared with supplemental feed expenses. The results of this project will inform equine grazing management on ways to improve the economic sustainability of horse operations in the Northeast US.

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

Pasture management conservation of forage through the application of grazing schemes that allocate time and space available for grazing may lend to facilitating a greater uniformity of forage supply throughout the year by stockpiling both cool- and warm-season pasture plants during times of peak production. Additionally, the incorporation of cool and warm-season annuals to complement perennial pasture may be a useful approach to increasing productivity per acre and extending animal grazing days. An increase in forage productivity per unit of pasture area along with an improvement of uniformity of forage supply throughout the year should also decrease chances of overgrazing which in turn should have positive impacts on soil health. The objectives of this research include: Identifying grazing management schemes that promote uniformity in forage supply across annual grazing cycles and extend the number of available grazing days; Determination of the effects of incorporating warm- and cool-season annuals that complement existing perennial pasture productivity per acre and several horse grazing days; Explore alternative forage species to extend the grazing season; Undertake a survey about equine environmental management that can be given in any of the participating states; Educate agency personnel (USDA-NRCS, County Conservation Districts, etc.) about the horse industry, horse farm management, and recommended practices for horse farms to empower them to work more comfortably and effectively with farm owners; Increase access to environmental stewardship information and recommendations from research for horse farm owners and managers through online content and face-to-face training and demonstrations. This year objectives under 1-3 were completed. Due to COVID, some things had to be altered or shortened. The results have been analyzed and the process of writing journal articles, and meeting abstracts are ongoing. A doctoral dissertation was also completed. In terms of objective #, survey and data collection have been completed. An undergraduate honors project utilized this data and it is currently being re-analyzed and written up into a journal article and possible factsheet. Webinars have been underway with NRCS personnel and other professional agencies utilizing results from this project.

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

The main impact of the work being done in this project is from the BMP survey conducted. The survey provided important information about the farming practices that horse farm owners and managers are using to help protect the environment. If they are not utilizing some of the practices, questions were raised as to why. These results will help NJAES/RCE design education and outreach programs for the necessary target audiences and on the most needed topics so that farmers will be better able to make informed decisions about the BMPs most suitable for their farms. Some results from the survey included: • 84% of the farms utilized an Animal Waste Management Plan • 49% of the farms composted the raw manure while 26% stockpiled it • 56% of the farms had the raw manure hauled away, while 27% spread it on their land • When discussing animal carcass removal 65% of respondents had it hauled away where 21% had it buried on their farm • Other practices utilized to prevent nutrient runoff were equally divided with 13-21% of respondent either picking or dragging paddocks, properly storing feed, locating manure at least 100 feet from the nearest waterway, removing waste feed from hay feeders and feed bunks, preventing rain runoff from entering paddocks, and using roof gutters and vegetative filters to redirect water away from the manure. Other work on pasture forage and rotational grazing have been incorporated into multiple journal articles and factsheets however, change in attitude or action has not been determined as of yet.

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

See above.

[Breeding and germplasm enhancement for New Jersey cranberry and blueberry industries](#)

Project Director

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Accession Number

1019255



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

Farming of native berry crops, e.g., cranberry and blueberry, provides a significant contribution to NJ and US economies. Thus, it is critical to provide blueberry and cranberry growers with varieties that are better suited to current and emerging challenges, including socioeconomic, environmental, and marketing, enabling the economic sustainability of these crops. Our research is focused on developing varieties better adapted to climate change, and with increased disease resistance.

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

Develop blueberry cultivars. Machine harvest of blueberries is increasingly important due to labor shortages and high cost of hand labor. Several advanced selections from our breeding program, with improved machine-harvestability traits (firm berry with small dry scar, uniform ripening, and ease of disarticulation), were propagated further for a large-scale machine harvestable trial. To address a fruit drop problem common in “Draper, we redid the cross (Duke x G751) that gave rise to Draper, and field planted the progeny in 2020 at Variety Farms (a cooperator in Hammonton, NJ). These progeny were planted adjacent to a Draper planting, with the goal of evaluating the population for fruit drop. In addition, several thousand new progeny are being grown out for field planting in 2022. A large interspecific population of blueberry (*Vaccinium corymbosum* x *V. darrowii*) was evaluated for numerous traits including organic acids, volatiles, flavonoids, flowering, fruit and leaf shape and size, with a goal of identifying genetic markers to facilitate future breeding efforts for fruit quality and human health, and for genetic study. Significant differences were found in concentrations and profiles of flavonoids and organic acids, both between the species and among the interspecific blueberry progeny. Due to some recent issues with fruit set in the cultivars Draper and Duke, a greenhouse study was conducted to determine the effect of self (expected in commercial blueberry) versus cross-pollination on developed seeds/berry, fruit set, berry weight and ripening period. A collaborative study continues with Delaware State University to assess heat tolerance in blueberry, a trait significant for climate change adaptation.

Development of fruit rot resistant (FFR) cranberry cultivars. In 2021, 26 cranberry crosses were made among advanced breeding material with unique fruit chemistry, with a goal of enhancing antioxidant levels. In June 2021, a trial was planted at Chatsworth, NJ, consisting of over 800 progeny from third-generation FRR crosses, which combine sources of resistance. Several trials of progeny from previous FRR crosses were screened for FRR by withholding fungicides. The progeny were evaluated for fruit rot and yield, and some progeny had consistently improved FRR with commercially viable yields. Trials of our advanced selections planted at cranberry growers in Washington, Oregon, Wisconsin, and British Columbia were evaluated and samples harvested for yield and fruit quality traits. Samples were also harvested from six elite FRR selections planted in 2019 in grower trials in Chatsworth and Browns Mills, NJ. These grower trials are an excellent test of the varietal potential of our advanced selections. Genetic resistance to fruit rot will allow for reduced and/or alternative fungicide applications, reducing costs for growers, environmental impacts, and human health concerns. We continue to work on the discovery of genes controlling FRR, phytonutrients, stress tolerance, and other fruit quality traits.

Flavonoid Profiles. Cranberry fruit samples were collected from several unique low acid breeding populations for HPLC analysis of four organic acids; with a goal of developing varieties that will reduce the amount of ‘added-sugar’ needed in cranberry products. Fruit from over 800 progeny from an interspecific (*V. darrowii* x *V. corymbosum*) blueberry population were also collected in 2021 for phytochemical analysis. A better understanding of genetic and environmental factors influencing phytochemicals, especially those associated with human health, will provide guidance to our breeding program. Varieties with enhanced phytochemical levels will improve plant performance, and lead to berry products with improved nutritional aspects.

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

Target audience includes research scientists and extension professionals as well as cranberry and blueberry industry, growers, and processors. Cranberry growers have benefited from recently released cranberry varieties with increased yields and fruit quality. Scientists benefited from enhanced knowledge of the genomics of these fruit species, as well as their phytochemistry. Extension professionals benefited by having new information and varieties to offer their clientele.

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

Blueberry varieties with improved machine-harvestability traits and better adapted to a warmer climate will make blueberry production more economically sustainable for growers and more affordable for consumers.

Cranberry varieties with genetic fruit rot resistance will allow for reduced fungicide applications, reducing costs for grower, environmental impacts, and human exposure. Cranberry varieties with reduced acidity should allow for products with higher concentrations of cranberry and reduced 'added sugar', enhancing their health benefits.

Varieties with enhanced phytochemical levels will improve plant performance, and lead to berry products with improved nutritional aspects.

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

This project provided laboratory and field experience training for several undergraduate students, two graduate students, a postdoctoral associate, and technical staff. Students were trained in evaluating plant traits in the field, i.e. fruit quality, percent rot, and yield estimates; fruit chemistry and HPLC analysis, DNA extraction and SSR analysis in the lab; data analysis, and preparation of journal publications. Posters and presentations at scientific meetings were largely virtual in the past year. A weekly lab meeting allowed Vorsa's students and staff to regularly present and discuss their work. One graduate student, Yurah Kim, completed her MS degree on the study of health-related compounds in blueberry, in December 2021.

Due to COVID-19, dissemination of research results was limited in 2021. Papers were presented virtually at the Internat. Vaccinium Symposium. Presentations were made at virtual grower meetings in New Jersey, including American Cranberry Growers (ACGA) Winter Meeting and Summer Field Day, Blueberry Open House, Cranberry Twilight Meeting, and Blueberry Twilight Meetings. Outreach activities included providing cultivar information to numerous blueberry and/or cranberry growers in NJ, MA, WI, OR, WA, including Atlantic Blueberry Co., Variety Farms, Pine Island Cranberry Co., Makepeace Cranberry, Cutler Cranberry, Lee Brothers, J.J. White, and Integrity Propagation. Information on fruit rot breeding is accessible at the following website <https://www.vacciniumcap.org/fruitrot>; and on the low acid cranberry at website <https://www.vacciniumcap.org/lowmalicacid>.

Fong SK, Kawash J, Wang Y, Johnson-Cicalese J, Polashock J, Vorsa N. 2021. A low malic acid trait in cranberry fruit: genetics, molecular mapping and interaction with a citric acid locus. *Tree Genetics & Genomes* 17:4 <https://doi.org/10.1007/s11295-020-01482-8>

Kim Y. 2021. Segregation of Chlorogenic Acids and Flavonol Glycosides in interspecific (*Vaccinium corymbosum* x *V. darrowii*) diploid F2 blueberry population. MS Thesis, Rutgers University.

Canadian Plant Breeders' Rights for CNJ99-9-96 'Haines'®

Canadian Plant Breeders' Rights for CNJ99-52-15 'Welker'®

US Plant Patent for CNJ99-9-25 (PP32,896).

In 2022, we will continue working on our blueberry and cranberry breeding objectives including the evaluation of advanced selections from previous breeding and selection cycles, and our most recent breeding populations. Analyses will include: 1) horticultural traits, e.g., yield, fruit quality, etc., 2) fruit chemistry, e.g., soluble solids (brix), titratable acidity (TA), flavonoids, and organic acids. Crosses will be made in the greenhouse in early spring, seedlings from last year's crosses will be grown out, and previous year's progeny will be field planted for evaluation. Progeny evaluation trials, advanced selection blocks, and grower trials (in NJ, OR, WI, BC) will be evaluated throughout the growing season and fruit samples harvested. Promising selections will be propagated for establishment of future replicated trials. Laboratory evaluation of fruit chemistry and flavonoid profiles will be conducted. Cranberry progeny will be screened for fruit rot resistance. Genetic mapping work and identification of QTL will continue. We will prepare and submit papers concerning flavonols in cranberry and blueberry.

Conservation, Management, Enhancement and Utilization of Plant Genetic Resources

Project Director

Steven Handel

Organization

Rutgers the State University of New Jersey New Brunswick Campus



Can adding the North American woody vine Virginia Creeper stabilize coastal sand dunes in New Jersey?

Final Result

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

We are investigating whether native vine *Parthenocissus quinquefolia* (Virginia creeper) offers ecosystem services and should be propagated for use in back dune stabilization plantings in the Northeast. This was investigated by collecting varieties at the coast and inland, and doing greenhouse and field tests to see which varieties are best adapted to the stressful coastal conditions. Once identified, these genetic varieties of the plant can be made available for coastal restoration and protection.

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

Coastal sand dunes protect lives and property by buffering destructive storm surges. Current standard practices of planting *Ammophila breviligulata* (beachgrass) to stabilize dunes may be enhanced by adding the North American woody vine, *Parthenocissus quinquefolia* (Virginia creeper), which can provide additional wildlife value. *P. quinquefolia* grows in a wide range of habitats.

A series of five greenhouse experiments tested if there are coastal ecotypes of *P. quinquefolia* that are better adapted to coastal sand dunes and will perform better in coastal sand dune restoration. We tested the growth responses of *P. quinquefolia* sampled from inland and coastal habitats in response to common dune stressors: salt spray, sand burial, and germination in sand. Plants grown from both cuttings and seeds were tested with foliar salt spray treatment, but only plants grown from seed were tested in sand burial and germination experiments.

In the salt spray experiments, inland cuttings had more foliar damage than those sampled from coastal areas. Seed grown plants showed the same ecotypic response with coastal plants showing more tolerance to foliar salt spray than inland plants. In both sand burial experiments of gradual and acute treatments, plants from coastal areas also showed increased tolerance to burial. In germination trials, seeds from coastal areas had greater rates of germination when sown into trays of beach sand and standard growing media.

These results show that critical aspects of plant performance in response to dune stressors are related to seed provenance, the genetic resources within this species of native vine. Coastal land managers and conservation agencies should prioritize the selection of coastal ecotypes of *P. quinquefolia* over inland sources to improve ecological restoration success and habitat value. These experiments in field and greenhouse show that cryptic genetic resources are in this species and can be used to improve protection of coastal property and also increase wildlife value of dune restoration activities by the Army Corps of engineers and other, local agencies.

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

The target audiences for this research come from three different communities. First, professional ecologists and botanists can use this research in their teaching and in explaining to the general public the importance of genetic resources in improving protection and ecological services at our nation's coast. Second, the results of these experiments can be used to improve the plans and coastal restoration projects of many agencies charged with helping in this critical area. At a time of rapid sea level rise, improving dune and coastal vegetation will increase erosion control as well as give resources to coastal biodiversity. Third, this research will improve the products of native plant nurseries on the East Coast who need better plant materials to supply to their customers.

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

The broader public needs plants for their properties that can withstand the many environmental stresses of the salty, windy environment where they live. In these ways this research could improve economic values at the coast as well as natural resources. All homes and public lands near the coast are subject to enormous erosion and storm surges. These will increase in coming years with climate change, sea level rise, and increased intensity of storms. Making our coastal landscapes more resistant to the stresses is a critical priority for the many residents and businesses along the seaboard. Identifying plants such as *divine* we have studied, that can help in this way gives a sustainable solution to a regional problem.

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

The research supported by this grant allowed an outstanding graduate student to complete her PhD research. In addition, over the course of this grant we trained four undergraduate majors in ecology and natural resources in field and laboratory techniques. This allowed the students to get intensive experience in plant biology research. One of the students, Eva Popp, received a national award for her achievement from the Botanical Society of America. This Young Botanists Award was only given to 19 students in the United States last spring. The graduate student supervising the field research was awarded the prize for the outstanding oral presentation at the symposium held at Columbia University. The talk was based on the results of her many experiments. All final experimental data are now in hand. These are being written up for professional publications in ecological and coastal journals. The PhD student involved in this work will take her final defense this spring.

We have made presentations of results to three national meetings on ecological restoration of plants: Ecological Society of America annual meeting, 2020, Salt Lake City, UT. "Enhancing coastal sand dunes with a native woody vine: coastal ecotypes of *Parthenocissus quinquefolia* outperform inland ecotypes in salt spray and sand burial greenhouse experiments." (with three university students - A. Gage, E. Popp, and J. Flanders.) Botanical Society of America annual meeting, 2020, Anchorage, AK. "Enhancing coastal sand dunes with a native woody vine: coastal ecotypes of *Parthenocissus quinquefolia* outperform inland ecotypes in salt spray and sand burial greenhouse experiments." (with three university students - A. Gage, E. Popp, and J. Flanders.) Symposium on Conservation of Coastal Resources, Columbia University, NYC.2020. "Ecotypic responses to coastal stressors."

Improving Economic and Environmental Sustainability in Tree-Fruit Production Through Changes in Rootstock Use

Project Director

Megan Muehlbauer

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1014317



Finding innovative ways to produce increased quantities of superior grade apples

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

As consumer demand for high quality apples continues, and viable agricultural land dwindles, there is a need to establish high density apple growing systems. However, trees can only be maintained in these compact growing systems if they are grown on dwarfing rootstocks. The purpose of the NC-140 project is to test, observe, and report on new dwarfing apple rootstocks suited for high density growing systems.

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

Goals/Objectives 1. To evaluate the influence of rootstocks on temperate-zone fruit tree characteristics grown under varying environments and training systems using sustainable management practices.

Major activities completed and/or experiments conducted 2021 was the seventh growing season of both the 2014 Fuji and 2014 Honeycrisp rootstock trials. During the 2021 NC-140 meeting it was decided that data collected from the 2014 Fuji trial was adequate for making final conclusions on which rootstocks (of the rootstocks included in the trial) were best suited for Honeycrisp scion. The 2014 Honeycrisp trial will continue through its original timeline of 2024. Activities completed during the 2021 growing season included significant pruning of both the 2014 Fuji and 2014 Honeycrisp rootstock trials, maintenance sprays as detailed in the Rutgers Tree Fruit Production Guide and data collection.

Data collected Data collected from the 2014 Fuji Rootstock trial included yield per tree, number of apples per tree, circumference of tree 18" above the soil line, width of tree at widest part, height of tree, date of green tip and date of full bloom. Data collected from the 2014 Honeycrisp Rootstock trial included yield per tree, number of apples per tree, circumference of the tree, date of green tip, and date of full bloom.

Summary statistics and discussion of results Data from the 2014 Fuji trial indicated that yields were extremely heavy for the 2021 growing season. This data illustrates that the highest yielding rootstock in 2021 was V.6 although it was not statistically significantly higher, this was also the rootstock with the largest trunk cross sectional area. In contrast, the rootstock with the greatest average yield efficiency was G.202 with 1.6 kg of apples per cm². Data from the 2014 NC-140 Honeycrisp trial illustrates that the highest yielding rootstock in 2021 was G.30, in contrast the rootstock with the largest trunk cross sectional area was V.6. The rootstock with the greatest average yield efficiency was G.11 and M.26 which averaged ~.93 kg of apples per cm².

Key outcomes or other accomplishments realized. The Vineland (V.1, V.5, V.6 and V.7) rootstocks continue to be very vigorous, although not particularly yield efficient in either the Fuji or Honeycrisp trial. The Geneva rootstocks i.e G.11 and G.202 continue to show significant promise as recommended yield efficient rootstocks.

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

Tree fruit growers in New Jersey and throughout the United States continue to benefit from the research results of the NC-140 rootstock trial project. In 2021 due to the continued pandemic limitations, the vast majority of research results have been disseminated to growers via phone calls with Rutgers University Agricultural Agents. As a result >90% of fruit trees planted in New Jersey have made rootstock choices based upon written and verbal recommendations resulting from the New Jersey NC-140 trial results.

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

In the past year approximately 50% of tree fruit growers (~10) in Northern New Jersey have been preparing to plant 1-10 acres of high density apples. Their decisions of which rootstocks to order are a direct result of the outreach of research obtained from the NC-140 apple rootstock trials.

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

Through the course of this project year my research associate Rebecca Magron who assists with data collection has been able to attend the International Fruit Tree Association Conference to further her knowledge of the impact of NC-140 research on the international tree fruit community. I have mentored and trained a G.H. Cook honors student, who assisted in maintenance and data collection of the NC-140 trial this past growing season.

The vast majority of outreach this past year has been through phone calls, E-mails and individual farm visits with growers. During most of these interactions with tree fruit growers I provided an update on the latest findings from the NC-140 trials. In the Spring of 2021 I co-hosted a virtual seminar series titled 'Ask the Expert Tree Fruit Edition'. Where experts in all areas of pomology including rootstock research answered questions and sparked discussion on all aspects of tree fruit production.

This upcoming year I will be involved in analyzing and publishing data that I obtained in 2019 and 2020 on the effect of rootstock on bitterpit incidence in Honeycrisp apples. This project was performed on the 2010 and 2014 Honeycrisp rootstock trials, and will be written as two separate manuscripts. In addition a research plot will begin to be prepared at the Snyder Research Farm (herbicide, soil testing, and fertility amendments). This will be prepared to establish a Hard Cider Apple rootstock trial in 2023.

Publications this period:

J.A. Cline, W. Autio, J. Clements, W. Cowgill, R. Crassweller, T. Einhorn, E. Fahalli, P. Francescatto, E. Hoover, G. Lang, J. Lordan, R. Moran, M. Muehlbauer, S. Musacchi, M. Stasiak, R. Parra Quexada, T. Robinson, S. Sherif, J. Zandstra. 2021. Early Performance of 'Honeycrisp' Apple Trees on Several Size-Controlling Rootstocks in the 2014 NC-140 Rootstock Trial. *Journal of the American Pomological Society*. 75:189-202

Ecology and Control of Annual Weeds in Turfgrass

Project Director

Matthew Elmore

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1013421



Ecology and Control of Annual Weeds in Turfgrass

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

This project investigates low environmental impact alternatives to synthetic herbicides and how they can be used in concert with cultural practices to control weeds that are extremely problematic across the northern United States. To combine these components into an integrated system for weed control, components determined with weed control efficacy or influence on weed invasion will be combined and investigated in various systems for weed control.

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

This research provides a framework for turfgrass managers to change the industry-standard management of a common insect pest, the annual bluegrass weevil. Instead of implementing a strategy designed to provide complete control of the annual bluegrass weevil, turfgrass managers can delay insecticide applications and allow the insect to kill the annual bluegrass, a problematic weed species. Combining this insect approach with an herbicidal one controlled annual bluegrass 80%, compared to <40% control from either strategy alone. Field research continued in 2021 to better determine how this approach could be tweaked on turfgrass areas where infestation of the weed (annual bluegrass) varies. This research was initiated to address stakeholder concerns about how this research applies to turfgrass areas different severity. This second phase of the research project is led by Dr. Albrecht Koppenhofer in Entomology in collaboration with my project. Relating to objective 2, we isolated several strains of bacteria from annual bluegrass seed and are working with them in the laboratory to understand whether they make the weed annual bluegrass more competitive. We have identified 6 strains that may improve the growth of annual bluegrass. We are currently evaluating these isolates in controlled experiments to understand whether they help promote the growth of annual bluegrass.

This project seeks to determine new strategies to control these weeds without relying entirely on synthetic pesticides. One field project led by a graduate student found turfgrass managers can delay insecticide applications and allow an insect (already endemic to turfgrass in the region) to kill the annual bluegrass. Combining this insect approach with a plant growth regulator controlled annual bluegrass 80%, compared to <40% control from either strategy alone. The second project investigated a common cultivation practice called aerification that improves turfgrass growth (especially in highly used turfgrass sites). Many managers of parks and other high use areas avoid this valuable practice during the spring because it is thought to increase crabgrass infestations. Our field research found that it does not increase crabgrass infestations. The results of this work indicate turfgrass managers can use aerification to benefit the growth of the turfgrass in the spring in addition to the previously prescribed fall timing.

A third project seeks to understand whether there are specific bacteria associated with annual bluegrass in the wild that make it grow vigorously. Beneficial bacteria are present within plants, but how they affect weeds is not well understood. The vigorous growth of annual bluegrass, especially in the seedling stage, is one of the reasons it is a problematic weed. We've isolated specific bacterial strains from the annual bluegrass seed. Using laboratory experiments, we are trying to understand whether these bacterial make the annual bluegrass grow more vigorously, possibly by helping the plant acquire nutrients.

This research is designed to provide turfgrass managers with better options to control weeds, in order to maintain the benefits of turfgrass areas. Specifically, options that do not rely entirely on pesticides and can be implemented in a practical and economic way using existing technology. We've developed a strategy whereby turfgrass managers can delay spraying an insecticide and obtain control of a problematic and pervasive weed. We also showed that turfgrass managers who use the

non-chemical practices of aerification in the springtime do not have to be concerned about this practice increasing crabgrass infestations. We are also learning more whether weeds associate with microbes to make them more weedy. By understanding these microbes we may be able use these microbes to improve the growth of desirable plants.

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

The target audience was turfgrass industry professionals and other Extension specialists. The target audience was engaged through extension outreach efforts. These efforts included in-person field day and online seminars hosted by RCE and industry professional trade organizations with a national scope.

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

Turfgrass areas have environmental and societal benefits, especially in urban and suburban areas. Turfgrass areas reduce rain runoff for flood control, prevent soil erosion which maintain soil and improves water quality, reduce ambient temperature in the summer, and sequester carbon from the atmosphere. Turfgrass also provides a functional greenspace for recreation and organized athletic and non-athletic activities. These benefits are reduced if pests such as weeds, insects, or diseases compromise the integrity of the turfgrass. Among weed pests, annual bluegrass and crabgrass are among the most problematic as they are annual weeds which die in the summer and winter, respectively, leaving voids in the turfgrass canopy. Severe infestations can result in bare soil for several months of the year, which erases the benefits of turfgrass.

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

Diehl, K., Elmore, M., Koppenhöfer, A., Murphy, J., & Kostromytska, O. (2022). Annual bluegrass weevil (*Listronotus maculicollis*) and paclobutrazol control annual bluegrass (*Poa annua*) in creeping bentgrass (*Agrostis stolonifera*) fairways. *Weed Technology*, 1-23. doi:10.1017/wet.2021.106

Elmore, M.T. and D.P. Tuck. 2021. Effect of hollow-tine cultivation on crabgrass infestation in cool-season turf. *International Turfgrass Research Journal*. doi: 10.1002/its2.5

[Sustainable and scalable production of food and feed using the aquatic crop plants of the Lemnaceae family.](#)

Project Director

Eric Lam

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1012957



Biomass production using the aquatic plant duckweed

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

To meet the challenge posed by population increase and environmental degradation due to application of large quantities of agricultural chemicals, this project will seek to create a scalable platform for biomass production using the aquatic plant duckweed. Our project's success can unleash this potentially game-changing technology platform for sustainable and continuous biomass production that can create a new sector of crop products, especially in the area of aquaculture.

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

To enable us to create a reliable duckweed production platform in an open system, we need to bring modern advanced biological techniques to the field of duckweed agronomic research as well as to learn how duckweed interact with microbes in their environment. To this end, the two major activities in my laboratory have been 1) the generation of high quality genome sequences for selected species of duckweed in order to better understand their genetics and evolution, and 2) the

characterization of the bacteria population that lives on and inside of duckweed - i.e. the duckweed microbiome. In the present reporting period, we have published the first completed genome sequence - for the smallest genus of duckweed *Wolffia*, which also grows the fastest among flowering plants. The genome sequence enabled us to study how genes are regulated by a daily rhythm compared to other plants to reveal how a fast growing plant may achieve their speed in biomass production by minimizing unnecessary controls and gene number. We also publish a comprehensive study that characterized the bacteria microbiome of duckweed from different field sites as well as reconstructed in the laboratory using aseptically grown plants by reintroduction of bacteria rich wastewater from a municipal water treatment plant in New Jersey. These studies set the stage for more experimentation in the near future to examine the role of different bacteria strains/species in the duckweed microbiome context. Ultimately, knowledge from these research should assist us in keeping duckweed that we want to cultivate more healthy and thus deliver products more reliably with good quality.

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

The target audience during this period is mainly the duckweed research and applications community. This is especially true of the comprehensive review article that we recently published in 2021. The community benefited from our efforts by having access to reference genome information that will enable cutting edge research approaches. Also, description of the microbiome structures in duckweed will also set the stage for improved understanding of what type of bacteria inhibits duckweed and how they compare with the bacteria community associated with other land plants.

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

The broader public may benefit in the future from our project's activities when we begin to reduce our research findings into products in the market and job creation in the society as we built out the foundations for a duckweed-based agricultural platform. This can be in the form of genome-assisted selection of optimal duckweed strains for targeted characteristics in the duckweed crop, or a synthetic microbiome for duckweed that can facilitate reliable cultivation of these plants under a hydroponic cultivation platform that can continuously produce plant biomass in diverse locale and conditions.

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

We will continue our effort in the two major research areas as outlined above: 1) We aim to complete our genome research effort by completing the first *Wolffiella* genome. Together with other genomes that we would be completing in the *Lemna* genus with the labs of Todd Michael and Robert Martienssen, this would complete reference genomes for all five genera in the duckweed family. 2) We will be starting the effort to create synthetic communities with duckweed associate bacteria that we have already isolated to begin the systematic dissection of the duckweed-bacteria ecosystem. This effort should help reveal the molecular basis for beneficial interaction between various bacteria species and duckweeds.

Return of the Lemnaceae: duckweed as a model plant system in the genomics and postgenomics era. Acosta K, Appenroth KJ, Borisjuk L, Edelman M, Heinig U, Jansen MAK, Oyama T, Pasaribu B, Schubert I, Sorrels S, Sree KS, Xu S, Michael TP, Lam E. *Plant Cell*. 2021 Oct 11;33(10):3207-3234. doi: 10.1093/plcell/koab189.

Genome and time-of-day transcriptome of *Wolffia australiana* link morphological minimization with gene loss and less growth control. Michael TP, Ernst E, Hartwick N, Chu P, Bryant D, Gilbert S, Ortleb S, Baggs EL, Sree KS, Appenroth KJ, Fuchs J, Jupe F, Sandoval JP, Krasileva KV, Borisjuk L, Mockler TC, Ecker JR, Martienssen RA, Lam E. *Genome Res*. 2020 Dec 23;31(2):225-38. doi: 10.1101/gr.266429.120.

Duckweed hosts a taxonomically similar bacterial assemblage as the terrestrial leaf microbiome. Acosta K, Xu J, Gilbert S, Denison E, Brinkman T, Lebeis S, Lam E. *PLoS One*. 2020 Feb 6;15(2):e0228560. doi: 10.1371/journal.pone.0228560.

[Aquaculture Development in New Jersey](#)

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number



Barnegat Bay Shellfish Restoration Program

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

The Barnegat Bay ecosystem remains a very stressed system due to a combination of human activities and environmental changes. Shellfish provide many ecosystem services, such as improving water quality by filtering the water, serving as habitat and prey for other species, mitigating erosion by stabilizing shorelines; and helping to restore wild populations through reproduction. Therefore, restoring wild shellfish populations and commercial shellfish aquaculture farming provides many benefits that can improve coastal marine ecosystems' health. Extension education programming is necessary to educate clientele on the status of our coastal marine ecosystems, the important role of shellfish within these ecosystems, and how they can change their behaviors to help improve the health of marine ecosystems via responsible coastal stewardship practices.

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

As part of the Barnegat Bay Shellfish Restoration Program (BBSRP), the Coastal Stewardship course educated stakeholders about the ecology of Barnegat Bay and recommended practices for being responsible stewards of marine resources while focusing on shellfish. The 2021 course consisted of 10 evening classes, as well as two experiential learning field trips. This year's program included a shellfish aquaculture demonstration at land-and-bay-based shellfish hatchery and nursery systems and the Tuckerton Seaport. This program is hosted in collaboration with partners, ReClam the Bay.

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

The primary clientele served by the BBSRP Coastal Stewardship course are members of the general public and prospective commercial shellfish farmers. The 2021 Coastal Stewardship course had 85 registered students and the average course evaluation response (n= respondents) rated the overall program quality as 4.76 and organization as 4.97 (based on a scale of - Poor to -Excellent). The average response was 4.94 out of 5.0 when asked if they were pleased that they participated in the program.

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

100% of Coastal Stewardship course evaluation respondents (n= total) agreed that they had an improved understanding of the issues impacting the health of the Barnegat Bay ecosystem as a result of taking the course. Furthermore, 94% of respondents agreed that they are likely to change their own practices to promote more positive environmental stewardship of our marine ecosystems and 97% agreed that they'd share what they have learned with others. As a result of participating in the Shellfish Gardener course, the registrants committed over 800 hrs of volunteer time to improve the health of the Barnegat Bay ecosystem, which included assisting in growing 600,000 hard clams and 50,000 oysters that were planted in the wild to help restore shellfish populations.



What's the Catch

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

In recognition of National Seafood Month and to support New Jersey's fishing and aquaculture industries during the COVID-19 pandemic, What's the Catch – New Jersey Seafood and Healthy Living was developed and implemented to deliver science-based information on responsible seafood production and the health and nutritional benefits of seafood consumption. Diverse content connected the topics of seafood production with the health and nutritional aspects of seafood to encourage increased consumption and purchasing.

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

A two-part *What's the Catch?* (WTC) program communicated responsible, sustainable methods of local fishing and aquaculture (Part 1) and the health and nutritional benefits of seafood (Part 2). Using the Dietary Guidelines for Americans (DGAs) as a framework, WTC-Part 2 shared recommendations to maximize nutritional knowledge and self-efficacy regarding seafood purchase, preparation, and safe handling. Nutritional qualities of seafood (low saturated fat and sodium levels, lean protein, and Omega-3 content) and safe levels of mercury intake were featured. Guidance for selecting fresh seafood and minimizing food safety risks, along with preparation methods, recipes, and cooking videos, were provided to increase self-efficacy.

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

A total of 44 viewers attended night one and 67 viewers attended night two. Program participants (N=64) were asked to complete a quantitative post-attendance Qualtrics survey. Descriptive statistics assessed usual seafood intake frequency, self-reported knowledge improvements, and the likelihood of behavior change.

Twenty-one participants (33%) completed the survey. Most (66.6%) consume seafood twice weekly or more (meeting the DGAs), yet 57.1% were highly likely to consume more seafood and 33% somewhat likely to increase intake post-program. Nearly 62% of participants were highly likely, and 28.6% somewhat likely, to purchase more local seafood. Most participants strongly or somewhat agreed they had improved understanding of the DGAs (57.1%, 38.1%), mercury (47.6%, 42.9%), nutrition (66.7%, 23.8%), and preparation/purchasing (76.2%, 19.0%) regarding seafood.

Survey respondents also reported increased knowledge relative to recreational and commercial marine fisheries and aquaculture industries. 88.9% agreed they would use or share with others information they learned during the program

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

Program outcomes demonstrate that the broad range of seafood topics presented during WTC encouraged consumption by participants and increase knowledge of NJ seafood production methods. Increased knowledge and self-efficacy through nutrition education likely motivated consumers to partake in healthier behavior.

Sustaining and Enhancing Commercial Fruit and Vegetable Production in New Jersey

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7000820



Apple Maturity Assessment Program

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

In a 2017 survey of 34 fruit growers in New Jersey (representing 12 counties and 2,480 acres) respondents indicated one of the top priorities/needs of fruit growers was the identification and promotion of new apple varieties. This need arises in part because many of the newest apple varieties are no longer available to NJ growers because they are club varieties. Club varieties are patented and trademarked, and the rights to grow and sell them are managed by an exclusive membership of farmers. Most of these clubs do not allow for the inclusion of New Jersey growers. Over the past couple of years, through further conversations with growers, Extension faculty have determined there is a need to provide consistently reliable data on the progression of apple maturity in New Jersey. This data can aid growers in finding the optimal time to pick their crop to ensure it is the highest quality product for their consumers. Similarly, it can guide when to open different portions of Pick Your Own orchards. It also provides growers with a sense of awareness and the ability to compare how their crop maturity is progressing in comparison to other orchards which can help growers pinpoint issues they may have before it is too late to address them.

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

In 2021 a program was started by an RCE Agriculture and Natural Resource Agent to measure and monitor apple maturity progression throughout northern New Jersey. With the assistance of student workers, apple samples were obtained from five orchards each week through the duration of the apple harvest season. Apple samples were brought to the lab at the Snyder Research and Extension Farm where they were tested for maturity. Maturity indices included background color (% red), firmness, soluble solids, and starch index. Data was inputted onto weekly reports that were uploaded to the Rutgers University Apple Maturity Review Website. Growers can access the website as they wish, or sign up to receive e-mail notifications when the weekly report is uploaded.

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

Since the inception of the program in the fall of 2021, the website has been well received as evidenced by the steady website traffic. In addition, all five of the orchards from which apples were sampled weekly indicated that they held off on picking specific varieties until the information was posted on the website regarding maturity. In addition, growers were surveyed in the late winter to determine how useful the website was. A total of 86% of growers who logged onto the apple maturity website (n=9) indicated that it assisted them in deciding on when to begin their apple harvest. Reports include apple maturity metrics (i.e. sugar content and pressure, tasting notes) and recommendations on whether varieties at particular locations are ready to be harvested. Since it was launched it has had 754 views, and 29 subscribers.

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

See above.

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

As the program expands into South Jersey (which is planned for the Fall of 2022) this percentage will likely increase.
<http://www.njapplematurity.rutgers.edu>.



Blueberry and Pollinator IPM

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

New Jersey has over 120 commercial blueberry growers, producing what is the most valuable food crop in the state. Blueberries are a unique agricultural commodity since they are one of only several native foods in commercial production in the US. In New Jersey, most blueberries are grown in the ecologically sensitive 'New Jersey Pinelands,' which are characterized by porous soils with high water tables, which are subject to vertical movement of a number of agricultural chemicals. This area is a source for much of the surface and shallow groundwater found in the southern and central parts of the state and encompasses the Cape May, Rancocas, Great Egg Harbor, Mullica, and the Barnegat Bay watersheds, home to over 2.6 million people. The pest complex on blueberries is extensive, with pests attacking virtually all parts of the plant (e.g., fruit, buds, leaves, roots, stems, flowers) and pest management requiring up to 12 pesticide sprays per year. The vast majority of these sprays are high-risk organophosphate and carbamate materials, which are likely to adversely affect the myriad number of farmworkers present during harvest. At present, the blueberry industry is seeing a per capita increase in consumption of fruit, often by children, which may in part be from the many health benefits derived from the antioxidants contained in the berries. Blueberries have developed into an international sensation, with many countries starting or increasing production. These facts mandate the implementation of pest management strategies that deliver high-quality fruit with minimal insecticide residues. Organophosphates and carbamates have been the cornerstone of insect pest management programs in blueberries for the past 40 years. Insecticide-use data collected by University IPM programs in NJ, MI, and ME indicated that ca. 90% of insecticide applications in these states are with broad-spectrum organophosphate and carbamate insecticides. In recent years, blueberry growers used 3.62 lb a.i. per acre of various insecticide products. With 10,500 acres of blueberries in NJ, this translates to about 39,000 lb a.i. statewide. Most of the a.i. was from organophosphates and carbamates (98.3% or 38,337 lb), with only 1.7% of all insecticide materials classified as reduced-risk. Over 40 different insect and disease pests can attack highbush blueberries, including the new invasive pest, the spotted wing drosophila. Pest

management costs continue to increase. The Food Quality Protection Act has led to restrictions and changes in the types of pesticides that may be used to produce blueberries. Many of the new pesticides are a narrow spectrum, that controls only one or a few pests and must be used with degree day phenology models and other integrated pest management (IPM) practices. As labels for older products are restricted, and newer more expensive products come on the market, production costs have increased. Some blueberry growers can spend up to \$300,000 per year on pesticide materials. The spotted wing drosophila has become the key insect pest in blueberries, is responsible for 80% of insecticide use, and threatens the entire U.S. blueberry industry since it produces an internal maggot in the fruit.

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

An integrated pest management (IPM) program was delivered to commercial blueberry growers. The program employed seasonal field scouts who collected weekly pest management data. The program reached all blueberry growers in New Jersey, but collected farm-specific data on those farms participating in the scouting program. Results of scouting data were summarized in 2 statewide newsletters (The Blueberry Bulletin and The Plant & Pest Advisory-Fruit Edition –a Web Blog format). Results were also transferred to growers with farm visits, seasonal update meetings, a broadcast fax system, and broadcast emails. Data was collected on insect and disease pests as well as fertility levels through soil and plant tissue sampling. Based on the scouting results, pesticide recommendations were made to all growers, within the objectives of the program.

A research/demonstration component demonstrated and refined the use of alternative pest management practices such as the use of trapping methods for determining treatment timings for blueberry maggot. A demonstration program was initiated on 300 acres to show the effectiveness of behavioral control - mating disruption in place of the neonicotinoid insecticide (imidacloprid) to control the Oriental beetle. The trial demonstrated that mating disruption can replace the use of the neonicotinoid insecticide. Growers participated in an IPM program and maintained high fruit quality while minimizing pesticide use. In 2021, this included 40 growers who grew 6000 acres of blueberries, or about 66% of the state acreage and about 75% of the state production. Growers were taught about monitoring and management of spotted wing drosophila. Fruit was surveyed to assess fruit quality and SWD infestation rates. An industry-wide survey was continued on the impacts by SWD on the NJ blueberry industry. A monitoring technique was developed that gave 7 days' warning of spotted wing drosophila (SWD) presence before they are found in commercial fields. A component was started in 2018 to minimize the impacts of pesticides on pollinator health, continued in 2021.

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

Poorly managed fields lost up to 50% of the crop from spotted wing drosophila damage. However, all growers participating in the blueberry IPM program sustained '0' economic losses from this pest. This program was instrumental in protecting the blueberry industry while minimizing conventional OP and carbamate insecticide use. While non-managed fields showed over 100 maggots per qt of berries, no fruit rejections were reported by IPM participants.

Growers cooperated with the program in the use of new detection, monitoring, and sampling methods that reliably predict pest levels. They were educated about novel management methods for a variety of pests in blueberries.

Growers minimized on-farm pest management costs. Some growers spent as much as \$250/A for pesticides while the average IPM participant spent \$150/A. The average grower using IPM practices saved over \$100/A. New pest management practices such as mating disruption and whole-farm GIS-based monitoring were used. Small plot research/demonstration trials for Oriental beetle mating disruption continued to show that the Oriental beetle could be managed with mating disruption in place of a bee-toxic soil applied insecticide.

Fertility monitoring led to recommendations for lower fertilizer use. In 2021, 576 samples were taken for combined monitoring of plant fertility and nematode levels. Soil and plant fertility tests demonstrated that about 75% of fields sampled had sufficient to high levels of soil phosphorous

Recommendations concerning honey bee health resulted in 5 growers starting to apply pesticides at night, delete 1 at bloom fungicide application, and beekeeper removal of hives to clean locations, improving honey bee health and reducing bee losses.

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

Through demonstrations, articles, county reports and other outreach, public awareness on IPM was improved. Articles appeared in 2 newsletters with 42 editions (printed and webversions), with over 2250 subscribers (including mail and web blog subscriptions). Newsletters on the Web recorded 180,7136 views or downloads.

IPM training of students and farm employees created new IPM interns, professionals and researchers. The program trained 6 students and seasonal workers, and 3 farm employee as IPM scouts, enabling the 66% of NJ blueberry acreage to be under IPM practices, and an additional 16% of NJ acreage to be selfscouted.



Bolstering the Vitality and Adaptability of New Jersey Commercial Nursery and Allied Green Industries

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

The nursery and allied green industries of New Jersey represent some of the most economically important agricultural and employment sectors in the state. Thus, cooperation with these stakeholder groups via delivering educational content, commercial recommendations, pesticide recertification opportunities, services such as diagnostics, stakeholder-informed research endeavors, and bridging the gap between regulatory groups and stakeholders, is at the heart of the Rutgers NJAES/RCE Green Industry Working Group's mission. Connection and service to these groups promote prosperous and economically viable nursery and allied green industries. These industries provide employment, community stability, and ecological sustainability throughout NJ and the greater Northeastern / Mid-Atlantic regions of the United States of America. The NJAES/RCE Green Industry Working Group's impacts are divided into two focal areas; however, collectively constitute a single emphasis; bolstering the vitality and adaptability of NJ commercial nursery and allied green industries. This report focuses on cooperation with and service to, the nursery and green industries, and regulatory, academic, and grower groups.

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

Cooperation with and service to the green industry is focused on delivering high quality, contemporary educational materials, being present at important events and conversations, and providing service to these commercial, allied industries, and stakeholder groups during both routine and unexpected situations commonplace to the COVID-19 era. The Rutgers NJAES/RCE Green Industry Working Group has led virtual and in-person seminars, seminar series, programs, twilight sessions and national topic spotlight seminars for grower groups, landscape professionals, arborist, fellow academics, master gardeners, undergraduate students, industry professionals, and regulatory bodies. This working group has also provided educational content for or in cooperation with upwards of 40 different green industry stakeholder groups throughout the country, thus furthering Rutgers's impact regionally, nationally, and internationally. The content of these educational sessions is the product of prior or current research projects, experiential knowledge, or stakeholder engaged requests, thus leading to grassroots development of future program development. During the COVID-19 pandemic, Rutgers Master Gardeners also began efforts to streamline and centralize educational content into virtual series, where many of the content sessions were taught by working group members. State regulatory agencies such as the New Jersey Department of Environmental Protection (NJDEP) have been engaged to streamline virtual pesticide recertification session standard operating procedures and the deployment of said credits. The working group also engaged the NJ Department of Agriculture (NJDOA), especially the Nursery Inspection and Certification department to work more cooperatively on pest timing, movement of invasive organisms, and overall promote cohesiveness in this area. On a more local and regional level, members of the working group regularly interact with county and the state Boards of Agriculture, in addition to the New Jersey Agricultural Experiment Station Board of Managers to engage other regulatory groups such as the NJ State Agriculture Development Committee on constantly evolving farmland preservation and soil disturbance issues. Groups such as the NJ Audubon Society and the Natural Resources Conservation Service (USDA-NRCS) have also been engaged heavily in the recent year. These relationships provide much needed feedback for future stakeholder-led educational programming. In short, a variety of methods have been utilized by the NJAES/RCE Green Industry Working Group to promote educational programming and services to multiple facets of the nursery and allied green industries in New Jersey.

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

The primary target audience is comprised of the commercial nursery, ornamental, greenhouse growers, and allied industries that purchase, maintain, and promote their goods, i.e. the allied green industries. The primary target is at the local level, but efforts are felt regionally and nationally. The commercial production industries can be generalized into containerized and in-ground nursery stock, greenhouse-produced ornamentals, ecosystem restorative, or native plant nurseries and seed producers, and turf producers. The allied green industries include nursery stock re-wholesalers (to landscape professionals,

or large retail stores), garden centers, landscape and arboriculture professionals, and industry groups that supply the consumables required for the green industry to operate. Academic, industry, regulatory, municipal, and grower associations are also targeted, however, this should be viewed cooperatively, as to promote cohesion within this dynamic industry. There has been a steady increase in cooperation and acceptance of Rutgers educational programming in the green industry. This cooperative experience has led to numerous stakeholder-led research endeavors including developing educational content for commercial native plant production, easing the use of growing degree-days for pest management, and developing local Phytophthora (root disease) recommendations in conifer and nursery stock production, to name a few. In 2021, the working group initiated the first Nursery and Ornamental sessions at the NJ Agricultural Convention and Trade Show (ACTS). Nursery/Ornamental Program Track I and II: State Agricultural Convention (63 participants, 35 survey responses) • 97% of respondents found the materials presented to be of value and timely. • 91% of respondents indicated that they would attend the Nursery/Ornamental Sessions at the State Agricultural Convention next year. Other quotes that broadly typify this positive reaction by our collective stakeholder groups include New Jersey Department of Agriculture, in reference to recent collaborations – “That’s terrific. I’ll be sure to share with the rest of our inspectors. Very helpful, keep up the great work and thank you for including us in your updates!” representative from the Woodsedge Tree Farm and the NJ Christmas Tree Growers Association – “Thanks so much for attending the NJ Christmas Tree Growers Assoc. twilight meeting at our farm last evening. Participation by Rutgers Cooperative Extension personnel really adds to our meetings. Thanks for your offer to participate in our activities in the future. We look forward to working with you.” Executive Director of the NJ Landscape Contractors Association. - “I want to thank you for the great call we had yesterday morning. I am super excited to be working with you very smart and down to earth folks and think we’ll put together an amazing educational program! Thanks again!” (in reference to The Northeast Green Industry Showcase) Executive Director NJ Nursery and Landscape Association - “This makes me so happy! Knowing that the educational choices we provide are encouraging people to consider native species, etc. means that the work we are doing is...well, working! I try to provide information and education that is appropriate for all types of views, but my own passion lies in considering our ecosystem first. I can’t wait to hear about your research.”

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

The NJAES/RCE Green Industry Working Group members provided 135 educational sessions over 330 hours to over 10,200 participants, with the cooperation of over 40 academic, grower, regulatory, and industry groups throughout the nursery and allied green industries.

Of the presentations, some quantitative data was collected. Below includes excerpts of presentations during this period:

Using Growing Degree-Day Models to Prepare for the Future (60 participants, 16 survey responses) • 100% indicated that they found the presentation valuable. Grower Comment: I will “Use as a supplement to current scouting program”

Growing Mums for Fall Markets (35 participants, 5 survey responses) • 100% indicated that they will make changes in their personal or business activities based on this presentation. Grower Comment: This presentation will help “improve my mum production.”

African Marigolds for Fall Markets (30 participants, 4 survey responses) • 75% indicated that they will make changes in their personal or business activities based on this presentation. Comment: “We are a supplier to growers, so just helpsto know their goals and concerns, to perhaps address or suggest additional ideas.”

Sustainable Landscape Plants for Your IPM Program (50 participants, 15 survey responses) • 73% indicated that they will make changes in their personal or business activities based on this presentation. Growers indicated that they learned “some good information about native plants and where they can be used and a “better understanding of some native plants” and that they plan to use this information by “using some plants in future work and educating others on the same,” “incorporating more natives into my landscape designs,” and “including a couple of shrubs in our catalog.”

Principles and Applications of Plant Health Products: Winter 2021 (36 participants, 31 survey responses). Note this program series includes four 1.5 hour classes on sustainable turfgrass management for industry professionals (1. Intro to Plant Hormones, 2. Plant Growth Regulators, 3. Biostimulants, 4. Implementing a Plant Health Program). • 100% of respondents indicated that the information learned in this program was useful. Participants commented that they gained knowledge in: • What and how plant health products are effectively used in turfgrass. • Knowing what products to use and when on our turf. • Good information for someone who’s never worked with pesticides • Learning about growth regulators • Learning about the different ways to manage your turf through different methods was very useful • Understanding how plant hormones work and affect the plants was the most useful part of this section for me.

Ecological Landscaping (40 participants, 7 survey responses) • 100% indicated that they will make changes in their personal or business activities based on this presentation. Participants commented: “I would love a follow-up presentation that discusses ornamental grasses”; “It was excellent and useful we could have had more time.”, “Great assembly of native plants that I can

incorporate into my garden”; “I am making improvements to my yard and want to focus on native species.”; “It gave me many good ideas for my gardens and my friends' gardens I will share the slides and information”; “As a Master Gardener, I will use the information in volunteer activities.” Participants indicated that they would use this information by: using the database of native plants (NWF database), visiting nurseries that stock native plants, plant echinacea, etc. Future programming suggestions included: • I'm interested in the ways that parking lots can be made more biodiverse/pollinator-friendly. • Native ornamental grasses. • Downtown and city street landscaping and green infrastructure Nursery/Ornamental Program Track I and II: State Agricultural Convention (63 participants, 35 survey responses) 97% of respondents indicated that they learned new information from this program. 77% of respondents indicated that the information they learned will result in decreased chemical use. 83% of respondents indicated that the information they learned would result in increased profits. Services and funds generated: 1. Rutgers Plant Diagnostic Laboratory (PDL) faculty and staff captured 104% of the laboratory's operating costs. The PDL has been providing essential diagnostic services to the nursery and green industries of NJ and the region for over two decades. Not only does this laboratory offer diagnostics, but they also provide detailed recommendation data that is critical to producers, professionals, and academics alike. 2. An ANR programmatic staff member has led the statewide nursery, greenhouse, and landscape Integrated Pest Management Scouting Program, where he makes upwards of 90 on-farm visits, provides scouting services and generates cost savings for the program valued at \$10,655 over the federal reporting period.



Evaluation of Apple Rootstocks to Maximize High Quality Apple Production in New Jersey

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

Apples as with many perennial crops, are clonally propagated. The most common way in which this is done is by grafting the cultivar (scion) of interest onto a rootstock. Rootstocks have been bred to provide many benefits to growers, including control of scion vigor, thereby allowing for high density orchards with greater yield potential. In addition these rootstocks can have a profound effect on other scion characteristics including yield, fruit size, tree vigor, and in the case of certain varieties, nutrient disorders. In a 2017 survey of 34 fruit growers in New Jersey (representing 12 counties and 2,480 acres), respondents indicated they have strong interest (2nd highest priority) in continued research to trial and provide recommendations for novel improved apple rootstocks.

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

NC-140 program is a national effort to trial new apple rootstocks at research farms throughout the country and ultimately provide sound recommendations to growers. The Agriculture and Natural Resources Agent in Hunterdon County manages, maintains, and evaluates three rootstock trials at the Rutgers University Snyder Research and Extension Farm in Pittstown, New Jersey. This effort includes a 9-year old 'Honeycrisp' rootstock trial with 31 rootstocks, a 5-year-old 'Honeycrisp' trial with 16 rootstocks, and a 5-year-old Axtex Fuji® trial with 15 rootstocks. The data collected from all of these trials include yield, fruit size, tree vigor, and disease susceptibility. In addition to obtaining formal data for research publications, these New Jersey research plots have served as teaching tools for commercial high-density apple cultivation for several Rutgers Master Gardener pruning workshops in 2018, and 2020, as well as a twilight meeting for apple growers, and a number of other group tours of the Snyder Farm. Data from these trials has been compiled and published in three articles in grower publications. New Jersey data has been collated with that of collaborators throughout the country and published as two Peer-Reviewed Journal articles. The trials help growers to visualize the effect of each rootstock on commonly grown cultivars providing them critical information to choose which rootstocks to grow on their farms.

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

The 2014 'Honeycrisp' and 2014 Aztec Fuji® Rootstock trials were featured as part of the tour during the May 2019 North Jersey tree fruit grower's twilight meeting held at the Rutgers Snyder Research and Extension Farm. During the tour, information was presented on the fruit set, vigor, disease incidence, and growth habits of the trees in these studies. Subsequently, growers were surveyed (n=24) to determine how impactful it was for them to see these trials in person. • 96% of respondents indicated it was valuable to see the NC-140 rootstock trials in the field • 92% of respondents indicated they would make future decisions on rootstocks for their farms based on the field tour Tree fruit growers throughout New Jersey were surveyed in March 2022. A

total of 7 growers indicated they used information from RCE (phone calls, E-mails, and publications) in deciding which rootstocks to purchase for their apple trees. As a result of this apple rootstock programming, growers planted 5,825 trees with optimal rootstocks for their location.

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

See above.

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

A secondary project is being planned and is described as the following:

To date little to no research has been done to identify rootstocks that are best suited to be grafted to commonly grown hard cider apple varieties. As part of a national collaborative effort with the NC-140 Regional Rootstock Trial a hard cider rootstock trial will be established in 2023 at the Rutgers University, Snyder Research and Extension Farm. The purpose of the trial will be to examine the influence of rootstocks on hard cider apple fruit production and juice/cider quality. The variety 'Porters Perfecton' will be grafted in triplicate onto 10 different rootstocks (G.11, G.41, G.202, G.210, G.213, G. 214, G.890, G.935, G.969 and B.10). Spacing will be 15' between rows and 4.5' between trees in a randomized complete block design. A significant amount of data will be collected from this trial including vigor (tree circumference), yield, yield efficiency, fruit size, sugars, titratable acidity and pH. Data collected from this trial will be collected with that of collaborators and published and it will also be published in New Jersey grower magazines. In addition, it will serve as a teaching tool for grower twilight meetings in the future.



Hemp Research and Extension Programming

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

The 2018 Farm Bill and passage of the NJ Hemp Farming Act has made the production of Hemp (Cannabissativa) legal. Hemp has not been produced commercially in the US for over 75 years. The current interest is in crop centers on CBD production, in addition to fiber and grain production. Currently, few extension personnel throughout the country have worked with the crop because of its legal status and now must learn to produce hemp under modern agricultural production systems.

The NJAES Hemp program is among the first licensed hemp producers in the State of New Jersey. This has allowed NJAES to conduct some of the very first research trials on-field production of hemp for CBD in New Jersey. The NJDA has issued permits and authorized NJ producers to begin cultivation starting with the 2020 growing season. Producers were proceeding without the use of any current New Jersey-specific research or guidance developed. Using historically available production information and newly acquired data from surrounding states may be of some use to NJ agriculture; however, it fails to provide highly valuable state-specific data to help ensure that NJ hemp farmers can produce hemp viably and sustainably in a market they have entered late. A continued delay in providing reliable production practice and a variety of data places NJ producers at a disadvantage when compared to producers in competing locations with access to state-specific information.

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

Recognizing the delay is harmful to a developing NJ hemp industry, Rutgers has allowed hemp field research to commence in 2020 and continue through the 2021 field season. The field trials have provided valuable information to enable the NJAES/RCE faculty to produce a NJ Hemp Production Guide supported by state SARE funding. Five educational programs were organized by NJAES/RCE faculty/staff regarding hemp production and attended by 468 individuals. In addition, RCE faculty provided more than thirteen presentations and served as panelists on three separate hemp programs. More than 750 people have been reached through these various events.

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

Participant surveys were used to assess the effectiveness and usefulness of the Hemp Educational sessions planned and organized for existing and potential hemp producers. Surveys were given to participants at several production workshops held during 2020/2021. Participants were asked to rate their knowledge before and after the sessions on a variety of topics including production practices, pest management, regulatory compliance, hemp testing, and marketing. Highlights of the survey indicate: 93% indicated information from the program, 'very much to somewhat' assisted their hemp farming plans; 78% indicated they were 'very to somewhat likely' to change production or marketing plans based on information presented; 85% indicated the program 'very much to somewhat' assisted them regarding the decision to produce hemp; 57% were 'very likely' to incorporate information from the sessions into their hemp production plans.

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

The Agriculture and Natural Resources Agent in Burlington serves as a technical advisor to Bergen County Community College regarding the development of courses in hemp production as well as a technical advisor for a multi-state SARE grant exploring sustainable hemp production across the Northeast.

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

Note: Next year (2021-2022) the Program Initiative title will be revised to "Sustaining and Enhancing Commercial Agriculture Production" to include other specialty crops/herbs, such as hemp.

Academic materials produced through the programming include:

Published Journal Article: Komar, S., Bamka, W.J. 2021. An Evaluation of Two Industrial Hemp Cultivars: Suitability for Production, Agronomic Traits, and Performance Related to Industry and Regulatory Standards. Journal of the National Association of County Agricultural Agents. 14(1) online.<https://www.nacaa.com/journal/index.php?jid=>

Published Abstract: S. Komar and W. Bamka 2021. An Evaluation of Industrial Hemp (*Cannabis sativa* L.) Cultivars: Suitability for Production in New Jersey. Northeast Plant, Pest, and Soils

Conference Proceedings:

Bamka, W. 2021 - Rutgers First Hemp Trials: Observations and Future Direction. Proceedings of the New Jersey Annual Vegetable Meeting. P. 81. S. Komar, W. Bamka, N. Rajmohan, A. Wyenandt, R. Buckley, T. Gianfagna, J. Simon, and R. Cabrera. 2021.

Hemp Production in New Jersey: Challenges and Opportunities. Proceedings of the New Jersey Annual Vegetable Meeting. P. 84. Bamka, W. and S. Komar. 2020.

History and Background of Industrial Hemp Production. Proceedings of the New Jersey Annual Vegetable Meeting. p. 16. Komar, S. and Bamka, W. 2020.

Hemp Agronomy: Introduction to Pest Management, Fertility and Cultural Practices. Proceedings of the New Jersey Annual Vegetable Meeting. pp. 17-18. Bamka, W. and S. Komar. 2020.

Current Industrial Hemp Research in the Northeast. Proceedings of the New Jersey Annual Vegetable Meeting. p. 19. Komar, S. and Bamka, W. 2020.

Marketing Hemp. Proceedings of the New Jersey Annual Vegetable Meeting. pp. 63-64.

Fact Sheets and Resources Developed:

Bamka, W. and S. Komar. 2019. Introduction to Industrial Hemp-Basic Production Agronomy. NJAES Fact Sheet FS. <https://njaes.rutgers.edu/fs/> Fact sheet has 1,268 page views as of March 2021.

Bamka, W., R. Cabrera, S. Komar, and B. Schilling, 2019 (updated 2020). Industrial Hemp Production in New Jersey: Frequently Asked Questions. NJAES Fact Sheet FS. <https://njaes.rutgers.edu/fs/> Fact sheet has 8,055 views as of March 2021.

Bamka, W.J., S.J. Komar, M. Infante-Casella, K. Brown. 2021 (In preparation) New Jersey Hemp Field Production Guide. USDA SARE funded publication.



Innovations in Agriculture

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

New Jersey's agricultural sector contributes over \$2.1 billion to the economy and supports over 31,000 jobs, representing significant value to the state. While land prices and property taxes are high in NJ, the high population density and proximity to urban areas provide growers with markets that might not exist in more rural areas. Furthermore, the rich cultural diversity of NJ residents offers agricultural producers an opportunity to market ethnic and specialty crops to meet the needs of all people. Specific needs in central NJ were assessed by visiting farms and having direct conversations with growers, as well as with organizations such as the Monmouth County Board of Agriculture and Grown in Monmouth. Based on these interactions, an information session was held to facilitate a discussion with 80 'Grown in Monmouth' members regarding the role that Rutgers Cooperative Extension could serve in helping to support the agricultural community. Common themes that emerged across the various agricultural commodity groups that exist in Monmouth County were the need to generate greater profits per acre, interest in growing specialty crops, direct marketing opportunities, and the importance of training new and beginner farmers. The efforts to meet these needs coalesced into an Agricultural Innovations Program.

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

The Agricultural Innovations Program is designed to meet the evolving needs of growers in Monmouth County and Central New Jersey by providing educational opportunities, field demonstrations, and farmer to farmer networking focused on new crops, sustainable growing practices, creative marketing, and training for beginner farmers. An annual event was hosted virtually. Forty-two attendees heard presentations given by 7 different agricultural educators and professionals. The talks focused on current information and updates on IPM, growing degree day modes, weed control, pesticide safety, and new crops and market opportunities. Growers received the following pesticide credits for completing the program: Core: 1, 1A: 4, 10: 3, PP2: 4. Rutgers Specialty Crop Research and Extension Center - Rutgers Cooperative Extension of Monmouth County has taken an active role in leading and collaborating on several projects at the Cream Ridge Experiment Station. Digital photographs and video documentation are occurring throughout the growing season to provide growers with high-quality educational materials that can be delivered online. Two in-person tours were hosted at the Cream Ridge Experiment Station this year highlighting the agricultural innovation projects. The first tour was hosted as a twilight meeting that welcomed 35 growers to the farm and the second tour involved 15 beginner farmers as part of the RU Ready to Farm program.

Growing Baby Ginger in Moveable High Tunnels: Extending the growing season can provide growers with new markets and new crops while building resilience in our agricultural sector. This project documented production practices for growing baby ginger (var. Peruvian Yellow) in Central New Jersey, at the Cream Ridge Specialty Crop Experiment Station using moveable high tunnels. Videos were recorded and posted on the NJAES YouTube channel and two tours were hosted at the farm, one for beginner farmers and one for experienced growers.

Sunflowers for Cut Flower Production: In response to inquiries from several growers regarding recommendations for cut flower sunflower production and to develop educational materials instructing new growers on how to successfully grow this crop, sunflower trials were initiated at the research farm this year. Ten different varieties bred for cut flower production were planted on 1/6 acre using small-scale seeding equipment. Sustainable soil management practices including cover cropping in the spring and fall were also included in this project. The growing practices were documented and recorded for the development of a video and fact sheet and tours of the plots were given to two different groups. Upon harvest, over 1,000 sunflowers were donated to 13 different local charity organizations, including soup kitchens and nursing homes throughout Monmouth County, with assistance from the Monmouth County Master Gardeners. Each bucket of sunflowers donated also included information about research from Rutgers University documenting the impacts of cut flowers on improving mental health and a QR code linking back to information about the resources available through Rutgers Cooperative Extension.

Native Grass Trials: Over 50 different taxa of ornamental grasses were established at the research farm, with the majority being native species, to evaluate their performance in Central NJ and to welcome nursery growers, landscape professionals, and home gardeners to learn about how these low input plants might be incorporated into more gardens and landscapes. Documentation gained from this demonstration is being used to develop fact sheets and presentations for 2022.

All America Selections (AAS) Ornamental Plant Evaluation Program This project involved evaluating four cultivars for this national program and growing five cultivars for an Introduction Garden that helps to introduce horticultural professionals to the award winners that have been released in the last two years. Growers were able to observe firsthand and learn about these ornamental plants that have demonstrated high-quality performance with minimal inputs throughout our region. Further connections were made with other participants in the national AAS program.

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

The target audience for this program includes established and beginning professional growers as well as home gardeners in Monmouth County and throughout the state of New Jersey. Feedback from the Monmouth County Board of Agriculture, the Monmouth County Commissioners, Grown in Monmouth, home gardeners, and individual local growers has been positive. Specific feedback related to the Agricultural Innovations Programming is included below:

Central Jersey Vegetable Growers Meeting (Virtual): 3.5 hours, 42 Participants, 10 survey responses. • 100% of participants rated the overall quality of the 2021 Central Jersey Vegetable Growers Program as Good or Excellent. Cream Ridge IPM Research Updates (Virtual): (42 Participants, 9 survey responses) • 100 % of participants rated the overall program content and presentation as Good or Excellent Soil Organisms, Their Functions & How to Increase Beneficial Microbes in the Soil (Virtual): 0.5 hours (35 participants, 20 survey responses) • 100 % of participants rated the overall program content and presentation as Good or Excellent • “RCE faculty member did an excellent job of explaining the roles of the organisms in the soil and how they impact plant growth.” Growing Hazelnuts in NJ (65 participants, 5 survey responses) • 100 % of participants rated the overall program content and presentation as Good or Excellent.

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

March 24, 2021: Central Jersey Vegetable Growers Meeting (Virtual): 3.5 hours, 42 Participants End of Program Evaluation (n=10) • 100% reported gaining knowledge from the 2021 Central Jersey Vegetable Growers Program. • 90% indicated that the information gained from the 2021 Central Jersey Vegetable Growers Program will help them achieve economic gain on the farm through increased profits or reduced costs. • 70% indicated that the information gained from the 2021 Central Jersey Vegetable Growers Program will help them to reduce pesticide use on the farm. Cream Ridge IPM Research Updates (42 Participants, 9 survey responses) • 100% indicated they plan to use or share what they learned • 75% indicated they will make changes in their personal or business activities based on this presentation. Growing Hazelnuts in NJ (65 participants, 5 survey responses) • 100% indicated they plan to use or share what they learned • 60% indicated they will make changes in their personal or business activities based on this presentation.



Pesticide Safety Education Program (PSEP)

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

Currently in New Jersey there are 15,000+ certified applicators registered with the New Jersey Department of Environmental Protection (NJDEP). Of these, approximately 3,000 are private applicators. To remain certified New Jersey law requires that private and commercial applicators accumulate at least 12 hours of recertification training divided between CORE (4) and CATEGORY (8) classifications during a five-year period.

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

The PSEP is the designated Extension program within Rutgers University for New Jersey that serves as a liaison with the USEPA and the NJDEP, providing a focal point of New Jersey pest management and pesticide safety outreach. This program serves a wide diversity of stakeholders, providing a logical trusted connection between pesticide regulators and the regulated community. The Rutgers PSEP program is a gateway to Rutgers NJAES research and extension programming; as well as university Extension PSEP programs and resources nationwide. Through the program, we continue to educate directly and indirectly, by producing training resources for, providing training to, and/or assisting with training by county agents, associations, state regulatory agencies, university specialists, registrants, Master Gardeners, health professionals, non-English trainers, and schools. Extension faculty and staff provide objective, science-based support to state and federal regulators who must increasingly assess proposed pesticide safety-related laws, and amendments and sunset provisions to existing laws.

Furthermore, the program provides the opportunity for individuals to meet certification/recertification requirements for licensing under [NJAC 7:30.](#), as well as resource development for applicators seeking certification in minor categories of pesticide use, and for other under-served audiences.

The program currently utilizes 24 different manuals to provide the initial training to both private and commercial applicators. Since pesticide information and technology are constantly changing, various manuals have required both major and minor revisions on a regular basis to maintain the competency level of applicators.

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

Approximately 5,000 applicators were recertified by this program in 2021. In addition, New Jersey initially certifies an average of 2,000 commercial applicators each year and requires initial training in CORE and CATEGORY materials. New Jersey also registered approximately 2,000 commercial pesticide operators. The program this year offered initial CORE training sessions for commercial operators and applicators and provided training to school employees and master gardeners so they understand the proper use of pesticides and the issues surrounding their use.

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

As a result of the program, several thousand private pesticide applicators, and commercial pesticide applicators and operators were provided with basic information that allowed them to conduct their jobs in a safe manner. In addition, information and training provided by this program gave growers and other applicators the skill set necessary to successfully complete their state pesticide licensing exams. In doing so, the application of pesticide in the state is a safer operation that is being done in a manner that does not create a hazard to applicators, workers, or the general public.

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

Program Initiator: George Hamilton, Extension Specialist



Upland Fruit (Tree Fruit and Grape) IPM Delivery

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

NJ peach production is valued at just under \$30 million and apples at \$28.5 million. The industry in southern counties is heavily oriented towards wholesale markets and peach production, while the industry in northern counties is heavily dependent on direct markets and apple production. Retail market fruit production in northern counties is valued at approx. \$15-18 million. New Jersey fruit growers produce commodities are susceptible to more than two dozen arthropods and disease pests. Management of this pest complex can cost producers up to \$500 or more per acre. Some large NJ growers may spend up to \$350,000 on pesticides alone. Fertilizers also represent a major cost impact. Growers can experience depressed prices from foreign and west coast competition, often leading to deficits in the farming operation. Production costs are high due to labor, fertilizer and energy costs, and pesticide costs. Pest management costs have increased due to label restrictions on old products and the introduction of newer more expensive pesticides. The Food Quality Protection Act has led to restrictions and changes in the types of pesticides that may be used to produce many fruits. Many of the new pesticides are a narrow spectrum, that controls only one or a few pests and must be used with degree day phenology models and other integrated pest management (IPM) practices. While customers continue to demand high-quality clean fruit, they are also aware of pesticide use and want assurance of safe food with little to no pesticide residues. An IPM delivery program continues to be delivered to commercial growers, statewide.

The New Jersey wine grape industry has doubled since 2002, with at least 50 wineries and over 100 vineyards. NJ is 5th in the U.S. in wine production, producing 1.7 million gal. of wine, valued between \$40-\$50 million. Since there has been no IPM programming for grapes and little baseline data, many grape growers tend to either overuse pesticides or not adequately control pests. Therefore a pilot IPM program was expanded in 2020 to focus on pest surveys, grape berry moth timing, spotted drosophila and sour rot, and now spotted lanternfly. These new invasive species are now driving grower pest management concerns and pesticide use.

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

An integrated pest (IPM) and crop management (ICM) program was delivered to commercial fruit growers who produced apples, peaches, nectarines, cranberries, and grapes. The program reached both primary and secondary

Secondary

participants attend extension update meetings, and receive other IPM/ICM information through personal visits, fax broadcasts,

articles, newsletters, and the Internet. Primary participants are those growers who access all the above information and participate in a field scouting program. While some primary participants do self-scouting, the majority contribute funding through acreage participation fees which fund seasonal field scouts, travel, supplies, and laboratory costs. Weekly field scouting forms the program core and data source for newsletter articles, and from which pest management recommendations

were made, with nutrition and nematode management included at specific times of the season. Organized grower meeting contact reached a total of 980 audience members, while on-farm consultations totaled 2,224 visits. The Plant and Pest Advisory blog post included 22 articles with 79,618 reads. Acreage impacted by primary participants totaled 80% of all state tree fruit acreage. Over 95% of total state tree fruit acreage was impacted by the program.

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

The program demonstrated reduced risk methods that included the use of mating disruption and ground cover management as

tools to replace insecticide use for Oriental fruit moth, tarnished plant bug and stink bugs, and two species of peachtree borers.

Degree-day pest phenology models were updated, and proper use was advised to growers. Demonstrations were conducted on

commercial farms to encourage the use of alternative practices. Alternative practices include the use of mating disruption and reduced-risk pesticides. In southern counties, where the bulk of commercial peaches are produced, 75% of growers used alternative,

'reduced risk' insecticides, and 80% of growers used reduced risk fungicides. In total, program participants reduced pesticide use by 26-80% compared to standard spray schedules, depending on the practices used. Other IPM practices included grower use of degree day based pest models, reducing insecticide use by 40% compared to standard calendar spray methods.

In laboratory tests completed in 2020 as part of the fertility component, over 75% of areas sampled were shown to have sufficient

to excessive phosphorous levels, which led to decreased phosphorous use on those sites. The invasive insect, brown marmorated stink bug (BMSB) has set pest management programs back 30-40 years. Demonstrations showed that growers could treat field edges while using mating disruption and ground cover management to reduce insecticide use by up to 75% compared to most commercial practices now being used for BMSB. Grape growers reduced sour rot incidence with the use of fungicides combined with SWD monitoring. Spotted lanternfly outbreaks were prevented in 3 vineyards after detection efforts

led to treatments that prevented grapevine loss.

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

These programs reduce the adverse impacts of pest control on human health and the environment, while managing pests effectively.

Project Director

Lori White

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1024738



The impacts of pyrethroid pesticides and plastic chemical components in living organisms and at what exposure levels

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

This project addresses the biological effects of different types of plastics and their associated chemical additives on eukaryotic organisms using the zebrafish model to interrogate toxic responses. Both size and composition of the micro- and nano- plastic fragments are being assessed for physical and biochemical effects.

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

The studies we are conducting involve chemicals that are used in high quantities, have known toxic effects, and have been detected in wildlife and humans both here in the United States and around the world. Every person and animal is likely to have been exposed to both pyrethroid pesticides and plastic chemical components. This work will provide information on their impacts in living organisms and at what exposure levels.

We completed a series of experiments examining different plastics and their effect on developing zebrafish. The plastics were ranked for toxicity from least to most toxic and identified growth, craniofacial changes and cardiovascular effects. These findings were recently published (Moreno and Cooper 2021 DOI:10.3934/environsci.2021014). This research reinforces the important concept of structure activity relationships when it comes to biological effects observed in eukaryotic organisms. This research allowed us to target organ specific genes that will be further investigated in our next series of experiments. This research is key to assessing risk to aquatic organisms based on the class of plastics present in any water body. It also demonstrates that these organ systems are sensitive to these plastics and could indicate effects that could be observed in natural populations.

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

The target audience were researchers interested in biological impacts of micro and nano plastics on finfish and possibly translate to higher vertebrates. The zebrafish is being used to identify toxic effects that are conserved across lower and higher vertebrates. This is also important for the determining which plastics may be phased out due to potential adverse effects and which ones show little biological activity.

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

Plastic contamination has and continues to be a major issue for the environment and organisms that are exposed to breakdown products from plastic waste. Unfortunately, people are aware of macro plastic waste (bottles, bags, cosmetics) but few people realize the presence of small plastic particles in receiving waters because they are not visible to the naked eye. However, the number of plastic particles and fibers may be equal to the number of zooplankton or phytoplankton in the water. The idea of out of site out of mind can be deceiving when there is an impact on the base of the foodweb supporting important fisheries or recreation species. It is realized that plastics will continue to be an important component of our lives, hopefully with reduced usage volumes. Our research demonstrated very different adverse effects with specific plastics while others were virtually nontoxic. This finding will likely result in certain plastic chemical classes and manufacturing methods being phased out. This will also have an impact on recycling by limiting the most toxic plastics from being manufactured and used.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to

communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Ms. Gina Moreno is the graduate student in Environmental Sciences who has been conducting this research for her Ph.D. degree and is in her final year. In addition, to Ms. Moreno there have been 4 undergraduates who have played major roles in maintaining the fish husbandry unit while acquiring experience based research credits required for graduation. Each of the undergraduates are required to conduct mini projects and write research papers each semester.

As stated above the next series of experiments will examine gene expression to see if the plastics alter normal gene expression and correlate with lesion occurrence in specific organs. The studies will be limited to 3 plastic classes which have low, moderate and high toxic effects on the developing zebrafish. Since we are looking at the zebrafish from several hours post fertilization through the yolk-sac larval stage we can observe alteration in normal embryonic expression of genes that can be compared to higher vertebrates including human embryonic development. These comparisons rely on the homology of physiological and biochemical pathways across species.

G. Moreno and K.R. Cooper (2021) .Morphometric effects of various weathered and virgin/pure microplastics on sac fry zebrafish (*Danio rerio*) June 2021AIMS Environmental Science 8(3):204-220 DOI:10.3934/environsci.2021014

Continued and Improved Sustainability of Marine Fisheries

Project Director

Kathleen Howell

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

7001082



Introductory Fisheries Science for Stakeholder (IFISSH)

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

New Jersey's marine fishing industries provide significant socio-economic benefits to the state, including the production of local, high-quality seafood, supporting the tourism industry, providing employment opportunities, and serving as key elements of the social and cultural fabric of coastal communities. In 2018, New Jersey's commercial fishing and seafood industries had an estimated \$3.55 billion total economic impact and provided over 49,000 jobs. Concurrently, New Jersey's recreational fishing industry had an estimated additional \$1.27 billion total economic impact in 2018 and involved over 14,000 jobs and approximately 750,000 anglers. Given the value of New Jersey's commercial and recreational marine fishing industries, it is critical that appropriate fishery management regulations are in place to ensure the long-term sustainability of both marine fishery resources and the industries that rely on these resources. Fisheries management has become increasingly complex in terms of the content of management plans and the fisheries science considered in the development of these plans, and this science is not easily understood by most stakeholders. Extension programming is needed to help meet the needs of stakeholders of New Jersey's marine fisheries as they relate to fisheries science, stock assessment, and fisheries management so that they are prepared to get involved with and make progress on related issues, including the responsible stewardship of marine fishery resources.

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

The Introductory Fisheries Science for Stakeholders (IFISSH) curriculum was developed and first implemented in 2018. The curriculum was implemented again in 2021 to serve a diversity of clientele, including recreational and commercial fishermen, interested members of the general public, and also paraprofessionals interested in fisheries science. The objective of the IFISSH curriculum is to educate stakeholders of New Jersey's marine fisheries on the science, management, and responsible stewardship of fishery resources so that they are better prepared to make progress on and get involved with issues impacting their industries. In 2021, the IFISSH curriculum was delivered via webinar during the COVID19 pandemic. There were a total of ten 2.5-hour evening classes from mid-February through late April. Seventeen different lecturers delivered presentations on their respective areas of expertise, which ranged from fisheries biology, climate change, oceanography, stock assessment, and fisheries management.

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

A total of 110 people registered for the IFISSH course in 2021. The primary clientele served included recreational and commercial fishermen, the general public, and paraprofessionals involved in fisheries science or a related field . Based on course evaluation responses (n= individuals), the average rating of the overall course quality was 4.71 and 4.79 was the average rating for overall course organization (based on a scale of -Poor to -Excellent). When asked if they Strongly Disagree (score = 1) or Strongly Agree (score = 5) with the statement that “I am pleased that I participated in the program”, the average response was 4.6. The average response was 4.64 when asked how strongly they agree that “The information presented was valuable”.

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

The IFISSH course produced a significant increase in knowledge in topics related to fisheries science and management based on the average response when students (n= evaluation respondents) were asked about their level of knowledge before taking the course (4.7) and after taking the course (7.89) (scale of 1- Low to -High). The average response was 4.4 out of 5.0 when students were asked if they plan to use or share with others what they learned.

Water Management and Quality for Specialty Crop Production and Health

Project Director

Raul Cabrera

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1024300



The chemical composition/quality of alternative water resources, and their potential effects on their plants/crops

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

The production of ornamental crops and maintenance of landscape plantings are associated with the use of large amounts of irrigation water and fertilizers. Dwindling availability of good quality water sources and environmental impact concerns call for (good-quality) water conservation through improved irrigation and fertilization management practices, and a judicious use of alternative irrigation water sources We are conducting studies and disseminating information to ornamental plant growers and landscape managers about the chemistry of alternative irrigation water resources and their potential effects on plants, along with suitable practices to successfully manage them. These activities include best management irrigation & fertilization practices that minimize the environmental impact of nursery, greenhouse and landscape activities (i.e. reduced pollution).

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

Addressed during this period:

Water quality of irrigation sources: An online tool to estimate costs and benefits of installing a water recycling system in commercial nurseries was developed and validated with data from previously published data from nurseries and greenhouses with actual recycling systems. A grower can input data on an existing nursery operation and the online tool returns an initial “regulatory risk score” based on the user’s drought and pollution risk, and then, using a partial budget approach, it returns a net present value of investing on a water recycling system, upfront capital cost, and expected change in annual cash flow. Simulations of this computer tool pointed that capital cost and profit vary significantly with the precise method used to size the runoff water recapture pond. Furthermore, it found a common result of negative net present values of investing in water recycling, leading to the “policy” conclusion that incentives from federal agencies or nonprofit organizations are required/justified to install recycling systems on grounds of social costs and benefits (reduced environmental impacts of water pollution).

Soilless culture and nutrient management: A study was established to re-assess the response and relationships of rose crop nitrogen (N) status (expressed in both leaf weight and area basis) on cut flower productivity and quality. Peach Avalanche® rose plants (own-rooted and grafted on 'Natal Briar' rootstock) were fertigated with complete nutrient solutions (based on a modified 0.5X Hoagland solution) differing in total N concentration: 2, 4, 6, 8, 10 and 12 mM. Nitrogen was applied with a 12% ammonium fraction, using sulfate salts as substitute for nitrate salts in the lower N treatments, thus producing iso-equivalent solutions with electrical conductivities averaging 1.74 dS/m. After four flowering flushes, no statistical differences in flower yield parameters were detected. While chlorosis symptoms started to be noticeable in the foliage of plants receiving the lowest N concentrations, leaf tissue analyses, expressed on a dry weight basis, revealed similar N concentrations and a progressing manganese (Mn) deficiency (< 30 mg/kg), along with relatively low concentrations of iron (Fe). Micronutrient levels in the nutrient solutions were increased to 1.25X Hoagland solution concentrations and the study will be monitored for another four flowering flushes. Expression of leaf N status on an area basis showed a weak relationship with leaf chlorophyll levels. Further results are needed to assess the potential usefulness of expressing leaf nutrient concentrations on a leaf area basis to correlate with flower yields and/or to aid in the diagnosis of incipient nutrient deficiencies/disorders.

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

Results from our studies, and relevant and practical managements practice arising from these, have been shared in various conferences, seminars, workshops and extension educational programs with multiple audiences including nursery and greenhouse growers and employees, county agricultural agents, master gardeners, landscape and tree care maintenance contractors and personnel. These technical and educational programs have included largely Caucasian (white) and Hispanic population groups, and have included presentations in both English and Spanish languages. It should be noted that all these programs and activities are always open to all people regardless of race, gender, national origin, etc. These educational and extension outreach efforts have included laboratory instruction, workshops, seminars, extension and outreach teaching – and during the fiscal year 2021 these have been mostly virtual/online, with a few (when permitted) in-person venues.

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

The production of ornamental crops and maintenance of landscape plantings use large amounts of irrigation water and fertilizers. For instance, as much as one half of urban potable water in many cities across the country is devoted for outdoor (landscape) irrigation. Ornamental nursery and greenhouse crops use water volumes and fertilizer applications that can be one order of magnitude higher, but have at best a 50% use efficiency, compared to most other food and fiber crops, and thus have a tremendous pollution potential. Economically-sound irrigation and fertilization practices are needed for these ornamental crops and landscape plantings to ensure the sustainability of their future in farming settings and the ecosystem services they provide in urban environments. We conduct studies, and disseminate information, to ornamental plant growers and landscape managers about best irrigation and fertilization managements practices that sustain their activities and minimize wasteful use of good quality water sources and reduce pollution of their surrounding rural and urban environments.

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

During the next period, experiments will be carried out to evaluate the effects of irrigation & fertilization management and container size (volume) on the water and fertilizer use efficiency of select nursery and greenhouse crops, with a special interest in quantifying the water footprint of ornamental crops and landscape plant species. These activities will include the use of traditional and alternative irrigation water sources.

Journal Publications:

González-García, Y., G. Cadenas-Pliego, A.G. Alpuche-Solís, R.I. Cabrera and A. Juárez-Maldonado. 2021. Carbon nanotubes decrease the negative impact of *Alternaria solani* in a tomato crop. *Nanomaterials*. 11, 1080.

<https://doi.org/10.3390/nano11051080>

Uresti-Porras, J.G., M. Cabrera-De-la-Fuente, A. Benavides-Mendoza, A. Sandoval-Rangel, A. Zermeño-Gonzalez, R.I. Cabrera and H. Ortega-Ortíz. 2021. Foliar application of zinc oxide nanoparticles and grafting improves the productivity of bell pepper (*Capsicum annuum* L.) grown in a NFT system. *Notulae Botanicae Horti Agrobotanici* 49(2): 12327.

<https://doi.org/10.15835/nbha49212327>

López-Vargas, E.R. Y. González-García, M. Pérez-Álvarez, G. Cadenas-Pliego, S. González-Morales, A. Benavides-Mendoza, R.I. Cabrera and A. Juárez-Maldonado. 2020. Seed priming with carbon nanomaterials modify the germination, growth and antioxidant status of tomato seedlings. *Agronomy* 2020, 10, 639; <https://doi.org/10.3390/agronomy10050639>

Books, chapters and other non-periodical, one-time publications:

Cabrera, R.I. 2021. Irrigation and nutrition management, p. 224-257 (Chapter 3). In: J. Faust and J. Dole (eds.) *Cut Flowers and Foliages*, Crop Production Science in Horticulture Book Series, CABI, Wallingford, UK.

Management and Policy Challenges in a Water-Scarce World

Project Director

Karen O'Neill

Organization

Rutgers the State University of New Jersey New Brunswick Campus

Accession Number

1021001



Assessing adaptation to coastal climate change and river floodplains

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

Management of water resources in non-arid states includes concerns about the legacy of industrial development and contamination, the under-funding of facilities like sewage treatment plants, and a lack of coordination between people making decisions about land development and information the effects of development on water quality. This project will analyze political and legal arrangements in New Jersey that contribute to these problems.

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

1. Major activities include completion of the first round of research on government spending for water quality improvements in the Delaware River Basin, on contract to the William Penn Foundation. The Foundation granted the co-PIs a second round of funding of \$305,000 in October 2021.
2. a) Financial data were collected on the amount and purpose of funding from governments at the local, state, and national levels for projects to improve water quality in the Basin. b) Other data were collected from interviews and surveys of experts in water and conservation. Interview questions concerned their knowledge and perceptions of the availability of funding and about equity in funding.
3. a) Agencies varied greatly in providing information about projects they funded. There are few regulatory requirements to ensure reporting to the public, and information is provided in different ways within and across levels of government. We tabulated nearly \$900 million of relevant projects within six years within the Delaware River Basin. Of these, by far the largest share of reported funding for expenditures is from state governments, nearly two-thirds of the total. b) Experts reported knowledge of general funding trends for the agencies they interacted with the most (e.g., rural land conservationists were familiar with funding for farms). They had little information about overall funding across agencies but expressed interest in the data we collected. Some expressed beliefs that funding was inequitable in some fashion, sending most funding to some upstream, rural Basin regions and providing little funding for areas with high populations of poor or ethnic minorities.
4. a) Key scholarly accomplishments include producing a new dataset of patterns of funding, and information about funding, in a large Basin in the United States. This is the first study of a large Basin that we know of, and it will contribute to a small group of studies of water and land conservation funding in this country. Patterns for distributing funds in the Basin are patchy and not predictable by simple metrics. For example, only some programs prioritize protecting land with highly intact ecosystem functions. B) Analysis of the interviews provides a baseline for awareness and perceptions of funding and funding equity. We will retest awareness and perceptions in the second phase, after experts have been able to use the information in our report.

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

The key target audience for this phase of research was the select group of experts on our Expert Panel and the staff and board members of the William Penn Foundation, the major private funding of water conservation in the Basin. The Foundation commissioned this study as one of its many evaluation and expert reports to guide its own funding. Their aim is to identify how government is funding water quality improvements so they can maximize their own charitable contributions and contribute to policy discussions (e.g., by providing or encouraging matching funds and by providing technical assistance to nongovernmental organizations). Within this project, we had the intellectual freedom to develop our own research questions. We chose to direct much of our attention to studying the distribution of funds and perceptions about funding equity. Participants from the Foundation and the Expert Panel were appreciative of this information. Other interviewees were curious about the project as well, and many asked for further information as the project proceeds.

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

Voters in the Delaware River Basin have approved land and water conservation funding at the state level, and many voters in many jurisdictions have approved additional funding from their counties and municipalities. Funding for farm conservation and best practices is one of the largest categories of spending, even for a Basin with large sections of urbanized land. State and local funding exceed federal funding for this Basin. It is helpful for residents and farm owners to learn which agencies are providing funds, for what purposes, and what locations. The primary users of information from this project will be charitable foundations in the region, as well as local governments and nongovernmental organizations that seek government conservation funding and matching funds.

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

a) The first phase of the project aimed to provide a basic methodology for collecting information about government funding that can be replicated through future projects funded by the William Penn Foundation. Our team began the second phase near the end of this reporting period, further developing the methodology. We informed members of the Foundation staff and the Expert Panel on these methods. Several graduate students received training as they helped collect and analyze these information.

b) The study of interviewees is intended in part to broaden knowledge of funding among Basin experts. An undergraduate research assistant began training in coding software and learned about scholarly literature review for this portion of the project.

Phase 2 of the William Penn Foundation was funded, with the aim of further improving the methodology for gathering information about government funding for water quality improvements in the Delaware River Basin. For this second phase, we intend to fill in missing information from government funders. We will also interview many of the first round of experts and a new round of experts, intending to assess whether they have changed their perceptions of equity in funding based in part on our first project report.

Outreach activities:

Government Expenditures to Protect and Improve Water Quality in the Delaware River Basin, 9th Annual Delaware River Watershed Forum, Sept 30 2021: presentation by project co-PIs, Karen O'Neill and Daniel Van Abs and several project stakeholders to the annual conference of conservationists interested in improving water quality in the Basin. We will use this forum for follow-up reporting in 2022.

Understanding Government Expenditures to Protect and Restore Water Quality in the Delaware River Basin, American Water Resources Association, Mid-Atlantic Conference, September 22, 2021: presentation by project co-PIs to association primarily serving water services providers and water resources managers.

Using Scale to Understand Coastal Climate Adaptation: A Global Comparison, Rural Sociological Society, June 15, 2021, Karen M. O'Neill, Heather Fenyk, and Shannon Caplan: study of global comparison of retreat strategies and geographic theories of scale.

Interview with evaluation researchers Redstone Strategy Group commenting on the William Penn Foundation's Watershed Wide portfolio within the Delaware River Watershed program, March 4, 2021: interviews of project co-PIs.

Project Director

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Organization

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Accession Number

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Copper as a treatment for *Staphylococcus aureus*

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

Staphylococcus aureus is a major cause of bovine mastitis. Many *S. aureus* strains are resistant to commonly prescribed antibiotics. We are investigating new ways of preventing and treating *S. aureus* infections using widely available compounds.

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

To combat antibiotic resistance, we need to develop new prevention and therapeutic approaches. Copper (Cu) has shown promise as an antimicrobial compound; however, questions remain about how Cu enters cells, kills microorganisms, and how microorganisms prevent intoxication by Cu. We spent most of last year examining how copper an under appreciated antimicrobial kills *Staphylococcus aureus*. We generated a *S. aureus* strain that lacked the ability to detoxify copper, which is toxic to cells. We discovered by copper enters *S. aureus* cells and the processes effected by intracellular copper. We have presented data showing that a dysfunctional MntABC Mn transporter results in decreased cellular Cu accumulation. We also demonstrate that cytosolic Cu accumulation inhibits *S. aureus* FeS enzymes.

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

Staphylococcus aureus is a major cause of bovine mastitis—a disease that results in decreased milk yield and costs the dairy industry billions of dollars each year. *S. aureus* infections are also the leading cause of human infectious disease related death in the USA. Therefore, the research conducted by my group impacts the health and pocketbooks of all Americans. The findings from our research are of great interest to the public, scientists studying infection biology, research extension specialists attempting to prevent bovine mastitis, and physicians treating *S. aureus* infections.

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

The results generated by our research group could be used to treat or prevent infections caused by *Staphylococcus aureus*. Such a discovery could have major impacts on human and animal health.

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

The funds provided by this project have allowed me to purchase supplies for the training of one Ph.D. student and one postdoctoral scholar. These funds have also allowed my students to generate data that has resulted in publications, which facilitated public awareness resulting requested speaking engagements and poster presentations. The experiences that I have gained by training these students and the manuscripts that we authored have also greatly helped my professional development.

We have published eight peer-reviewed manuscripts in top journals this year and we have more manuscripts in revision. A number of these studies were partially funded by the NIH, and therefore, they are open access, so the public can easily read about our findings. Four of the papers directly related to the work that was funded by this NIFA project and the project is cited in the acknowledgements. The graduate student and postdoctoral researcher have presented their findings at scientific meetings. I have also presented the results from the work funded by the NIFA project in lectures to graduate students and faculty at Rutgers University.

This upcoming year we plan to focus our attention on determining how copper, an antimicrobial metal, prevents that growth of *S. aureus*. We will also focus our work on determining how Cu treatment results in cell death. A second goal is to better understand the mechanism(s) of Cu-dependent biofilm formation. Biofilms are a pre-requisite for *S. aureus* infections and biofilm-associated cells are considered the etiologic agents of recurrent *Staphylococcus aureus* infections.

Publications:

Patel J.S., Norambuena J., Al-Temeemi H., Perryman A.L., Wang X., Occi J., Russo R., Park S., Zimmerman M., Ho H.P., Perlin D.S., Dartois V., Connell N., Ekins S., Kumar P., Boyd J.M.*, Freundlich J.S.* Bayesian Modeling and Intrabacterial Metabolism Applied to Drug-Resistant *Staphylococcus aureus*. *ACS Infection Disease*. 8/2021 PMID: 34342426. doi: 10.1021/acsinfecdis.1c00265.

Ferrer-González E., Huh H., Al-Tameemi H.M., Boyd J.M., Lee S.H., and Pilch D.S., Impact of FtsZ Inhibition on the Localization of the Penicillin Binding Proteins in Methicillin-Resistant *Staphylococcus aureus*. *Journal of Bacteriology*. 7/2021 PMID: 34031040.

Juttukonda L.J., Beavers W.N., Horning K.J., Unsihuay D., Horvath D.J., Kim K., Weiss A., Pishchany G., Al-Tameemi H., Boyd J.M., Sulikowski G., Bowman E.B., and Skaar E.P. A small molecule modulator of metal homeostasis is toxic to Gram-positive pathogens. *mBio*. 10/2020 PMID: 33109764. doi: 10.1128/mBio.02555-20.

Al-Tameemi H., Beavers W.N., Norambuena-Morales J., Skaar E., Boyd J.M. *Staphylococcus aureus* lacking a functional MntABC manganese import system have increased resistance to copper. *Molecular Microbiology*. 4/2021 PMID: 33034093. doi: 10.1111/mmi.14623.

Type

Projects / Programs without a Critical Issue

Not Provided

Projects / Programs

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