

Maryland (University of Maryland Eastern Shore) Annual Report - FY2021

Report Status: Approved as of 07/08/2022

Contributing Organizations

University of Maryland Eastern Shore

Executive Summary

Overview

In the past, the University of Maryland College Park and the University of Maryland Eastern Shore (UMES) submitted the Report of Accomplishment jointly. The cooperative relationship in research and extension established over many years will continue but each institution will report their accomplishments separately. This is the second report submitted solely by the UMES Agricultural Experiment Station and Extension Program. Over the past year, UMES work focused on four thematic clusters: Agriculture and food with a food security focus; Natural resources and environmental sustainability; Human health and development; and Products to market. Within these themes we specifically addressed five critical issues as follows: Climate change; Environmental stewardship; Family and community resiliency; Food and agriculture; Human health, nutrition and wellness; and Safe, secure and abundant food supply. The progress made to address each issue is provided in the ensuing section.

Critical Issue: Climate Change (CP)

See University of Maryland College Park Report of Accomplishments

Critical Issue: Climate Change - UMES

The overall goal of one project was to characterize climatic vulnerabilities of Delmarva's agriculture by better understanding how extreme weather and flooding impacted production in the region. This was accomplished by investigating the perceptions of extreme weather risks and adaptive capacity among small and limited-resource farmers in the region. Historical data collected from various meteorological stations in Delmarva indicated fluctuating patterns in temperature and rainfall with the warmest temperature in June, July, and August; and the highest rainfall ranging from May to September. More than half of surveyed farmers believe that climate change is occurring. A logit model revealed that age and education, acceptance of climate change practices, and observed changes in climate by farmers over the past 5-10 years positively influenced their perceptions of climate change. On the other hand, factors such as age and farm size did not significantly influence their perceptions of climate change. Farmers also perceived extreme weather, high incidence of pests and diseases as major threats to agriculture. In order to mitigate the incidence of climate change, farmers utilized the following as adaptation strategies: they avoided planting in the flooded areas of the farm, grew selective crops, practiced soil conservation techniques, and bought crop insurance.

Another project focused on the development of a cost-effective activated gypsum amendment that reduced ammonia emission from poultry litter bedding. Ammonia emissions from poultry production houses might affect climate change and worker health. There is also a need to improve soil health attributes including, biological, chemical and physical qualities, increased water infiltration, and reduced transport of dissolved phosphorous, pathogens and other contaminants to surface waters, when using poultry litter as a cheap source of fertilizer. The need to develop a more cost-effective product that will reduce ammonia emissions from poultry litter bedding is of interest. Lab bench-top incubator trials showed that gypsum-rich poultry bedding litter could serve to improve soil health, as well as, release less available-P when added to the soil as compared to traditional poultry litter bedding material. Further research with various materials under different poultry house pen situations is underway with the goal of finding a product that would reduce ammonia emissions at lower cost.

Another project focused on developing environmentally sustainable alternative management practices for two key insect pests, the green stinkbug (GSB) *Chinavia halaris*, a native pest, and the brown marmorated stinkbugs (BMSB), *Halyomorpha halys*, an invasive pest. Both are known pests to many vegetable and field crops. There are limited studies on the effect of entomopathogens on adult stinkbug mortality. Most pathogenic microbes are not effective against stinkbugs due to the stinky chemicals' antimicrobial activity (Trans-2-octenal and trans-2-decenal). Field-collected fungi were tested against adult and nymph stinkbugs using dip and spray bioassays.

Moreover, the potency of the stinky chemicals tested against the field-collected fungi. The field collected fungi were identified using molecular techniques as *Beauveria bassiana* AL strain and *B. bassiana* Pink strain. Dip bioassay results showed that the mortality rate of adult GSB and BMSB treated with pink and AL strains was high compared with controls, 92%, and 70%, respectively. The mortality rate of adult BMSB treated with AL strains was higher than the control, and the mortality rate was 58%. Spray bioassay results showed that the mortality rate of adult GSB treated with Pink and AL strains was high compared with controls, 35%, and 51%, respectively. Evidence of mycosis was recorded in cadavers of both GSB and BMSB, and identified as *B. bassiana*. The in-vitro assay showed that the stinky chemical failed to inhibit AL strain growth in the media, but it significantly inhibited Pink strains' growth. Both the strains showed a pathogenic effect on adult and nymph stinkbugs and reduced their population by at least 50% within three days. Interestingly, the fluorescent imaging revealed that the fungus is endophytic in soybean and corn plants, suggesting increases in its environmental persistence. The findings are in preparation to be submitted to the journal of pest management sciences. Not much progress has been made on kudzu bug in the field due to the seasonal availability of kudzu bugs in the Delmarva region.

Critical Issue: Environmental Stewardship (CP)

See University of Maryland College Park Report of Accomplishments

Critical Issue: Environmental Stewardship - UMES

One project focussed on the evaluation of soil health building practices, and how these impact soil quality and yield of specialty crops grown on the Delmarva Peninsula. Managing for soil health, and improved soil function, is based mainly on maintaining and providing suitable habitats for soil organisms. Tillage, fertilizers, pesticides, and other management practices can improve and/or damage soil health if not applied or performed correctly. Chemical fertilizers and other agricultural chemicals can kill and/or impair soil microorganisms, resulting in reduced soil respiration and soil health, which can reduce crop health and crop yields. While COVID related issues impacted this project, field experiments were conducted at two separate locations with two different soil types during the 2021 growing season. The field studies were conducted to 1) to evaluate the application of sustainable fertilizers on the growth and development of broccoli (spring & fall study) and okra and 2) to evaluate the application of sustainable fertilizers on soil health. Soil biological activity, CO₂ release, yield, and chlorophyll content was collected and analyzed.

- Both broccoli studies experienced many abiotic and biotic factors that negatively affected the outcome of each study. No yield data was collected for the spring study and the fall study was terminated early due to disease damage and crop losses. There was no significant differences in chlorophyll content, soil biological activity, and CO₂ release (lbs/acre) among treatments. However, there was a significant difference in CO₂ (mg) release as affected by sustainable fertilizers in the spring study at each sample day. For the spring study, the poultry litter leachate + molasses (PLL+Mol) treatment had the highest percent increase in soil biological activity and CO₂ release (lbs/acre).
- Yield and chlorophyll content in the okra studies varied among location and treatments. There was a significant difference in the total CO₂ release, average CO₂ release, and CO₂ release at each sample day in the Field 1 study. For the Field 2 study, there was no significant difference in total CO₂ release, average CO₂ release, and CO₂ release at each sample day except sample day 5. When comparing the two okra field studies, the average and total CO₂ release was significantly higher in the PLL+Mol treatment.
- Based on the results of these studies, it was concluded that sustainable fertilizers, such as PLL+Mol and vermicompost tea + fish emulsion + Mol, can potentially improve soil health. The results of these studies showed that sustainable fertilizers can produce similar yields and higher CO₂ release when compared to the chemical fertilizer treatment.

Critical Issue: Family & Community Resiliency (CP)

See University of Maryland College Park Report of Accomplishments

Critical Issue: Family & Community Resiliency - UMES

UMES Extension educators and specialists relied on the program planning and evaluation (PPE) practices and followed a systematic process whereby activities were identified and brought to fruition to change people's lives through improvement of social, economic, environmental, and civic conditions. Conceptually, PPE involved multiple steps, including identifying/assessing problems using situation analysis tools, managing required resources, defining and implementing projects and activities, creating output that led to desired outcomes, and evaluating the impacts. The goal of PPE was to change the target groups' living conditions (social, economic,

environmental, and civic conditions). Also, minimizing the existing knowledge gap in program planning and evaluation and facilitating stakeholders to prepare needs, facts, and figures-based plans to optimize the benefits to the target groups by achieving the desired results.

A novel approach in the development of Agritourism educational activities in Maryland. Small and medium ranchers/woodlot owners/farmers in the State of Maryland are increasingly dependent on agritourism as a source of additional income to maintain their landholdings. Most of these landholdings and farms cannot meet modern farm management demands in cost, technology, labor, and efficiency. The goal is to assist agritourism entrepreneurs in maximizing their social and economic capacities and thus contribute to local community welfare and development in counties within the state. As an initial step, a comprehensive study was completed with the goal of providing an overview of the typology and spatial distribution of agritourism services within the 24 counties in the state of Maryland. It evaluated the cost of access to transportation and explored the consumer characteristics of agritourism locations. Using the results from the study and additional user survey data, UMES Extension will establish a comprehensive agri-tourism extension education program.

Additionally, UMES Extension continued its collaboration with UMES to deliver the Agriculture Law Education Initiative (ALEI) to Maryland's producers. ALEI's broad mission is to raise awareness of the various legal concerns that affect Maryland's producers' agriculture businesses and to educate them about how the laws impact their operations. A critical component of ALEI's mission is to educate and advance the understanding of laws and policies that apply to, and affect the food system. The ALEI partnership reaches Maryland's agricultural community through in-person trainings, publications, webinars, and formal classroom education.

Critical Issue: Food and Agriculture (CP)

See University of Maryland College Park Report of Accomplishments

Critical Issue: Food and Agriculture - UMES

Several projects were implemented to address this critical issue with a specific focus on specialty crops especially in small scale production systems:

Organic specialty crop management on Delmarva for optimized plant development and pest control was the focus of one project. Limited resource farmers desire to produce more organic specialty crops to fulfill consumer's needs. However, they require more information on production techniques including pest management, and availability of affordable and acceptable organic management inputs to meet national organic program (NOP) guidelines. Alternative and complementary approaches, such as intercropping were examined to determine their suitability as a means to control pests in organic specialty crop such as tomato. Research was conducted to assess insect repellent effects of intercropping tomatoes with lemon grass, in organic culture. While the COVID pandemic impacted this work, a field study was conducted in the 2021 growing season. Data were collected and analyzed from the organic site as well as a non-organic site.

A second component of the organic production research assessed crop development and economics of organic ginger produced from rhizome seed pieces and seedling propagation. Three different types of ginger propagation materials were tested in a high tunnel. These materials were in different stages of development and from different weights of rhizome. Following nutrient recommendations for growing ginger, two OMRI approved fertilizers, Nature Safe and Phytamin Fish Emulsion, were tested. They were applied to the high tunnel site in split applications after soil preparation. All seedlings and sets were started in the greenhouse from existing organic rhizome stock materials in May and maintained organically until harvest in December, following the first frost. Data were recorded for plant growth, chlorophyll fluorescence, chlorophyll content, yield characteristics and nutrient contents. A greenhouse study was conducted to assess the morphological and physiological development of the ginger transplants in containers while using one of the OMRI approved fertilizers from the high tunnel study.

A survey in 2020 to identify arthropod pests of hemp in the Eastern Shore of Maryland found that Corn Earworm (CEW), *Helicoverpa zea*, emerged as a key insect pest in our region. The CEW feeds primarily on hemp flowers and tunnels into the floral structure, causing plant tissue wilting. Hemp enters its reproductive stage from late August through late September, when daylight in the Eastern Shore of Maryland is less than 14 h. at that time, alternate CEW host plants (corn and soybean) may not be at a stage congenial to CEW oviposition, and this leads to the heavy infestation of hemp plants by CEW. Therefore, in order to improve pest management for hemp production in the Delmarva Region, a study was conducted to characterize corn earworm population dynamics. Data were collected starting early in July through the first week of October in 2020 and 2021. Pheromone trap catches of corn earworm moths were used to predict larval infestations in hemp. Heliothis mesh traps baited with corn earworm pheromone were installed in three locations on the Eastern Shore of Maryland. The traps were emptied weekly, and the moths were counted. In both sampling years and all locations, the population CEW moths increased from late July through early September, after which their number decreased dramatically. However, the number of

larvae increased significantly starting early in September until harvest and caused considerable damage to the hemp flowers. Research findings were disseminated to other researchers, Extension personnel, and hemp growers in the Delmarva region. Three industrial hemp field tours were conducted on the UMES research farm at different growth stages of hemp. On average, 38 growers attended the tour and learned about insects, pests, and diseases affecting hemp during vegetative and flowering growth stages.

Support for small scale production systems is a specific focus for UMES Extension. According to the 2017 Census of Agriculture, the number of farms in Maryland totaled 12,429. Approximately 80% of these farms are classified as small farms with sales of \$100,000 or less. Despite the growing interest among diverse populations who want to enter farming on a small-scale, farmers continue to face numerous challenges. In November 2020, the UMES Extension's Small Farm Program organized its 17th annual Small Farm Conference. The main objective of this two-day virtual event was to equip farmers and landowners in Maryland and along the Delmarva Peninsula with tools and strategies to increase farm profitability and promote farm sustainability. Simultaneously, UMES Extension utilized this event to build, revise, and expand program and outreach activities to appeal to and address individual as well as community needs, emerging problems, and concerns of target groups focusing on limited-resource, new and beginning, and the underserved farmers. The annual conference is making a huge impact in helping new and underserved farmers achieve their dream of farm ownership. The UMES Research, Education and Extension Farm has played an important role in connecting socially disadvantaged and veteran farmers/landowners to agriculture service providers and USDA resources. The *Around the Bay Farmers Alliance* (ATBFA) was established as a safe place for farmers to voice their concerns, support each other, and find solutions to their problems. The ATBFA have created a platform, bringing the two groups of farmers together so knowledge can be transferred. In response to the increasing interest in growing *Specialty Herbs* among farmer clientele and landowners over the past couple years, UMES Small Farm team has expanded the specialty herb garden at our extension demonstration farm to educate and train Maryland citizens and interested farmers, gardeners on the cultivation and harvesting practices of growing both culinary and medicinal herbs. Row crops and specialty crops both face abiotic and biotic stresses like soil salinity, drought, nutrient imbalance, indigenous pest and pathogens resistance, and herbicide resistance. Small, women, veterans, socially disadvantaged, and minority farmers mainly focus on specialty crop cultivation on the Delmarva Peninsula. Year-round hands-on training for fruit and vegetable cultivation is also limited on the Delmarva Peninsula, which is responsible for the lack of knowledge among local small growers for specialty crop cultivation. The geographical location of the Delmarva Peninsula near the center of dense urban populations such as New York, New Jersey, Washington, D.C., and Baltimore provide avenues to supply fresh fruits and vegetables at premium price to increase income at the farm. In addition, cultivation of specialty crops in combination with row crops also cause crop diversification, increase local economy, and rejuvenate the lost fruit and vegetable industry.

Small ruminants, chicken broilers and honeybee keeping complement the income of small farmers on Delmarva. Honeybee keepers have enhanced their knowledge and skills of managing and handling honeybees through the workshops, in-person consultations and counseling, and demonstration events. The hands-on opportunity offered during the demonstrations about maintaining a healthy bee colony and minimizing winter losses have considerably strengthened their knowledge and skills. Finally, UMES Extension specialists developed a coordinated approach in poultry applied research, training, and extension programs as well as the public and private sectors to identify priorities and needs of the poultry industry and facilitate approaches to address those needs. Some of the challenges include broiler health, processing and food safety, environment, profitability, and broiler welfare.

Critical Issue: Human Health, Nutrition, & Wellness - UMES

One project under this critical issue focused on Personal Protective Equipment (PPE) for pesticide operators. The work focused specifically on decontamination studies and standards development. Cotton/polyester garments are typically worn when applying pesticides. Decontamination studies, or washing of the garments, are important to determine pesticide residues in reusable cotton/polyester garments that have or have-not repellent finish. Travel restrictions due to the pandemic required major changes in the planned activities for laboratory and field decontamination studies. To enable completion of the decontamination work, a week of training and methodology development was organized with the BASF Operator Exposure (OPEX) team in Germany. This allowed researchers from UMES and IAC Brazil to build upon the expertise of BASF OPEX team to address the issues with laboratory studies. The researchers also received training in extraction and analysis of garment from field studies. UMES was responsible for the development of documents and coordination with colleagues in Brazil, France, and Germany. As a result of the revised plans, we will be able to meet the goals and objectives for the decontamination study. Interlaboratory tests for revision of the spray method used for evaluation of whole body garments as PPE were conducted in 2019 to address interlaboratory variability. The decision was made in December 2019 to conduct the next interlaboratory test with the revised methodology. This study was delayed due to the pandemic. As Convener of ISO WG3 committee on protection against chemicals, and as researcher with the colleagues from Brazil, I was actively involved in the planning of the interlaboratory study and analysis of the test data. Coordination of the interlaboratory study during the pandemic required additional planning and development of documents that enabled us to proceed with interlaboratory testing, discussions. The interlaboratory tests were completed in Fall 2021. Data analysis is ongoing.

Critical Issue: Human Health, Nutrition, & Wellness (CP)

See University of Maryland College Park Report of Accomplishments

Critical Issue: Renewable Energy Resources (UMD College Park)

UMES has nothing to report under this Critical Issue for this fiscal year.

Critical Issue: Renewable Energy Resources - UMES

Both the University of Maryland College Park (CP) and University of Maryland Eastern Shore (UMES) box for Renewable Resources was labeled UMES. We are not sure which of the two boxes is ours.

See University of Maryland College Park Report of Accomplishments

Critical Issue: Safe, Secure, Abundant Food Supply (CP)

See University of Maryland College Park Report of Accomplishments

Critical Issue: Safe, Secure, Abundant Food Supply - UMES

A project to determine the prevalence and antimicrobial resistance of Salmonella in organic and non-organic chickens revealed no difference in the presence of Salmonella between both products. Salmonella is a pathogenic bacterium that is responsible for salmonellosis. Salmonellosis is one of the most common and widely distributed foodborne diseases in the world. Multidrug resistance of Salmonella is becoming a global public health crisis. Salmonella is common in poultry and spread to humans by contaminated meat. A few studies were conducted on the prevalence and antimicrobial resistance of Salmonella in retail chicken. However, adequate information is not available about the prevalence and antimicrobial resistance of Salmonella in organic and non-organic chickens at retail stores on Delmarva peninsula. The overall goal of this study is to address this data gap. Antimicrobial susceptibility testing was completed and the results were analyzed. The recovered Salmonella isolates were serotyped and DNA was extracted from each confirmed Salmonella isolate recovered from chicken to investigate virulence properties.

The project improving food safety of fresh produce and associated water quality on the Delmarva Peninsula strengthens collaborative research efforts between University of Maryland Eastern Shore (UMES), the USDA-ARS, and selected Land Grant Universities on national priority issues of Food Safety of fresh produce and associated Water Quality. This project attempts to strengthen UMES capacity in food safety, organic agriculture, and water quality areas. First, this project is evaluating the microbial water quality of various agriculture water sources in the Delmarva Peninsula. In addition, this project evaluates the food safety impacts of cover-crop and animal grazing in fresh produce systems with an aim to improve cover crop adoption, crop-livestock integration, and soil health. Thirty *E. coli* and *Listeria* biosensors were received in October 2021. The protocol for this work is still under development in collaboration with our colleagues at Clemson University and Iowa State University. Research and application will start in early 2022 and throughout the incoming years. To determine the whole genome sequencing and antimicrobial resistance of Salmonella and *Listeria monocytogenes* isolated from alternative irrigation water sources on Maryland's Eastern Shore, select water samples were analyzed for genotypic and phenotypic characteristics by whole genome sequencing and antimicrobial susceptibility testing.

The project on development of *Aronia Mitchurinii* as a specialty crop alternative for the Delmarva Region completed (1) the cultural management study and second year of observation for ripening of Aronia and (2) the thermal decomposition study and resin extraction. This project is focused on developing cultural management and best processing practices for the super-fruit and specialty crop *Aronia mitchurinii*. Cultural management includes the role of nitrogen, Azomite, and organic vs. traditional growing on the yield and antioxidants content of Aronia berries. It has been observed that some fruits rich in anthocyanins have different peaks of ripening: one is when the content of anthocyanins is the highest, and the other when the content of soluble sugars (brix) is the highest. To check if this observation is relevant to Aronia and to provide farmers with the optimal harvesting days for pharmaceutical applications (when anthocyanins are the highest) and for food-related applications (when brix is the highest), we collected samples of Aronia berries at different stages of ripening, analyzed brix and antioxidants, and plotted it vs. calendar and vs. temperature days. It has been calculated that many of the antioxidants can decompose under elevated temperatures while food products are produced and pasteurized. To preserve as many antioxidants as possible from Aronia during the processing, we conducted thermal decomposition experiments. The antioxidant content was analyzed as a function of temperature and time during the heating process for Aronia juice. Finally, Aronia can produce a palatable juice when being juiced at low temperatures. The pulp is bitter due to the very high tannins content yet contains many antioxidants. By developing the technology of extracting antioxidants from the pulp by resin extraction, we created additional applications for the berry, such as immune boost to other plants, natural colorants, pharmaceuticals, and an antifouling agent. We have completed analyzing Aronia for cultural management research. So far, we have compared five years of observations. We have found that 3 g/bush/year of nitrogen treatment is the optimal quantity amount for both organic and traditional growing. Having too much or too little

nitrogen causes a loss in the berry's antioxidant content while having too little nitrogen also influences berries' yield. Traditionally grown berries are higher in antioxidants content than organically grown berries. At the same time, the addition of Azomite has minor to no effect on the yield and nutraceutical content. We have monitored the third year of ripening of Aronia and determined the timing for the peak of antioxidants and the peak of sugars. The first two years produced two peaks of ripening that were pretty similar year to year. However, the third year of observation, when the number of temperature days was significantly higher, both peaks happened almost at the same time. We plan to continue this observation for several more years. We are plotting the results not only as a function of temperature days but also a calendar day. We have completed the evaluation of four types of polymeric resins to isolate powdered antioxidants from Aronia. For the last two years of the observation, we have added the values of total polyphenols and total flavonoids, along with the data for total anthocyanins content. We have come up with the best conditions and best resins for extraction. We have completed experiments for the thermal decomposition of Aronia juice. Temperatures in the range between 80 to 120 deg C were covered as a function of heating time. At 80 deg.C, even after 2 hours of heating, less than 10% of antioxidants had decomposed, whereas at 120 deg. C. already after the first five minutes of heating, more than 50 % of antioxidants had decomposed. After also analyzing polyphenols and flavonoids, we were able to develop a plausible mechanism of decomposition. Finally, two graduate students have obtained the required experimental data and started working on their thesis papers. Additionally, we are preparing four papers for publication and have conducted several presentations at national and regional conferences.

The UMES Extension Food Safety Program addresses the food safety issues, such as worker training, personal hygiene, and pathogen cross-contamination, at various levels in our community by helping farmers, food processors and food service keep our food supply safe. The UMES' 4-H STEM reaches out to all potential and prospective clientele across Maryland to strengthen the positive experience and life-changing tools that UMES Extension offers to future generations: environmental science literacy, career readiness, robotics, physics, etc.

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

No updates.

Highlighted Results by Project or Program

Critical Issue

Climate Change - UMES

Closing Out (end date 09/07/2023)

[Extreme weather, sea level rise, and climate change: understanding impacts and adaptation strategies for small farmers in the DelMarVa](#)

Project Director



Progress Report primarily covering survey of DelMaVa Farmers

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

The overall goal of this work is to characterize DelMarVa agriculture's climatic vulnerabilities by better understanding how extreme weather and flooding impact production in the region. This will be accomplished through three research objectives:

1. Identify the physical weather hazards, socio-economic conditions, and production characteristics associated with the greatest observed agricultural losses in the region;
2. Investigate the perceptions of extreme weather risks and adaptive capacity among small and limited-resource farmers in the region; and
3. Analyze variation in impacts across different farm types and production systems by synthesizing results across objectives 1 and 2 in order to suggest research priorities and potential adaptive actions.

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 major activities, especially for the objective 2, focused on a survey of DelMarVa farmers, who provided needed data to the project's objectives. While objectives 1 and 3 will be accomplished in the next six months, objective 2 results are described as follows. Historical data collected from various meteorological stations in Delmarva indicated fluctuation patterns in temperature and rainfall with the warmest temperature in June, July, and August; and the highest rainfall ranging from May to September. More than half of surveyed farmers believe that climate change is occurring. A logit model revealed that farmers' age and education, farmers' acceptance of climate change practices, and observed changes in climate by farmers over the past 5-10 years positively influenced farmers' perceptions of climate change. On the other hand, factors such as age and farm size did not significantly influence Delmarva farmers' perceptions of climate change. Farmers also perceive extreme weather, high incidence of pests and diseases as major threats to agriculture in the Delmarva Peninsula. In order to mitigate the incidence of climate change, Delmarva farmers utilize the following as adaptation strategies: they avoid planting in the flooded areas of the farm, grow selective crops, practice soil conservation techniques, and buy crop insurance.

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

Though a few number of small farmers have been introduced to the findings of this study through individual interactions between the farmers and the researchers, a larger portion of the target audience will be introduced to the results of this project using the University of Maryland Eastern Shore's extension seminars/workshops, fact sheets, and extension bulletins.

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

While some research findings have been published as a Master Thesis and others presented at the professional symposia, current and upcoming results of this project, especially from the objectives 1 and 3 will be disseminated through various medias including extension publications and peer-reviewed journal articles.

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 encountered problems with objective 2. Rather than conducting focus-groups of small farmers, we revised our initial plan due to public health restrictions associated with the COVID-19 pandemic. A survey (online, mailed, and limited face-to-face) of farmers was conducted instead. The UMES Institutional Review Board (IRB) reviewed and approved the survey questionnaire. Objective 1 is being accomplished by conducting a statistical analysis of agricultural losses from extreme weather contained within the Spatial Hazard Events and Losses Database for the United States (SHELDUS).

The two UMES' M.S. students working on the project were also involved in the small farm outreach programs organized by the UMES Extension. They graduated in fall 2021 and will be presenting their research in April 2022 at the Association of Research Directors in Atlanta, GA where they will be also interacting with their fellow students and attending other professional training opportunities. Chitubila, S. and S. Tubene, 2021. *Investigating the Influence of Mediated Climate Change Communication on Farmers' Climate Change Adaptation Strategies in the Delaware, Maryland, and Virginia Peninsula*. Abstract submitted to ARD. April 2-4, 2022 Symposium. Atlanta, GA.

Aduiteye, E. and S. Tubene, 2021. *Assessing Farmers' Perceptions of Climate Change and the Potentials for Climate Change Adaptation in Delaware, Maryland, and Virginia Peninsula*. Abstract submitted to ARD. April 2-4, 2022 Symposium. Atlanta, GA.

A Virginia Tech PhD student has been responsible for preliminary machine learning and statistical modeling of the SHELDUS loss records. She will be lead author on a peer-reviewed research manuscript we expect to submit in Summer 2022 and will present the work at several professional conferences.

[Developing a Cost Effective Activated Gypsum Amendment that Reduces Ammonia Emission from Poultry Litter Bedding](#)

Project Director

ARTHUR ALLEN

Organization

University of Maryland Eastern Shore

Accession Number

1015460



Gypsum-Laced Amendment Lowers Ammonia Levels in Poultry houses, Improves soil Health and Fights Climate Change

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

The issue addressed by this project is the harmful effects of ammonia emissions from poultry production houses on climate change and health issues on industry workers. There is also a need to improve soil health biological, chemical and physical qualities, increase soil water infiltration, and reduce the transport of dissolved phosphorous, pathogens and other contaminants to surface waters, when using poultry litter as a cheap source of fertilizer. The need to develop a more cost-effective product for producers that will reduce ammonia emissions from poultry litter bedding is always popular.

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 wanted to develop a material that would be less expensive for poultry producers to adopt. So, we tried different approaches until we achieved the desired results. This involved experimenting with various materials under different poultry house pen situations until we were satisfied with our final product that would reduce ammonia emissions at lower cost. This involved several planning sessions where we made modifications when warranted. We were convinced that our lab bench-top incubator trials would show that gypsum-rich poultry bedding litter could serve to improve soil health, as well as, release less available-P when added to the soil as compared to traditional poultry litter bedding material.

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

The targeted audiences (poultry producers) benefited through our development of a lower cost product that reduces the ammonia levels in poultry houses which improves the performance of the birds, as well as, reduce the serious health effects of ammonia on industry workers. This includes thousands of poultry houses on the Delmarva Peninsula, in Arkansas, and Alabama.

Farmers benefited from the use of the bedding litter when applied to soils, as it is a rich source of nitrogen, phosphorus, sulfur and other nutrients. The gypsum-laced byproduct produced also improves soil health biological, chemical and physical features. Further, less available phosphorus is released when gypsum-laced bedding material is applied to soil due to the presence of gypsum which binds with phosphorus to form calcium sulfate, which is not very soluble.

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

Protecting natural resources, reducing climate change, and utilizing a problematic waste product (gypsum drywall) as a source material to reduce the harmful effects of ammonia emissions from poultry production surely benefits the broader audience. Ammonia escaping from thousands of poultry housed on Delmarva, and in Arkansas, and Alabama significantly contributes to climate change. The gypsum-based developed product from this project reduces the adverse effects ammonia emissions have on Climate Change as it is trapped in the bedding litter, thus does not escape to the atmosphere. This is certainly a feature of this project that affects the broader public.

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

We had to make some adjustments especially where moisture was concerned. This was a rather significant adjustments with materials selected for the project since it was significant relative to trapping of ammonia in association with gypsum as a main treatment ingredient. A flock of chickens was managed in poultry experimental pens, where we adjusted moisture contents of the litter to commercial house levels in order to achieve the desired results of trapping ammonia in the bedding litter.

Two undergraduate students and a lab technician were trained on how to initiate and conduct pen and benchtop studies. Results from this project have been disseminated at two professional mainstream meetings as oral and poster presentations at 1890 ARD Research Symposium, American Society of Agronomy and Soil Science Society of America international annual meetings. Publications have also been generated by USA Gypsum for their use who provided funding for this project. UMES provided poultry pens and personnel support.

Refereed publications have been delayed due to patent issues, but probably will be forthcoming once these issues are resolved. We plan to continue with field trials which have been delayed due to COVID, and unsuitable field conditions due to abnormal rainfall events. These trials will be a follow-up of bench studies to demonstrate soil health improvements and lower additions of available phosphorus to soil when bedding is added.

Critical Issue

Family & Community Resiliency - UMES

[Community and Economic Development-Strengthening clientele's knowledge and skills to change their lives by upgrading their socio-economic, environmental and civic conditions](#)

Project Director

Enrique Escobar

Organization

University of Maryland Eastern Shore

Accession Number

7001938



Agriculture Law Education Initiative

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

In 2011, the Maryland legislature directed the University System of Maryland to marshal its resources to help preserve Maryland's family farms by helping farmers understand and address the legal issues associated with farming, including regulatory compliance and other public policies that comprise what is known as agriculture law. The Agricultural Law Education Initiative (ALEI) provides instruction on farm estate planning, generational succession planning, land purchase

transactions, legal and institutional risks associated with farm operations, food safety compliance requirements and other topics. ALEI educates the agricultural community on aspects of agricultural law through Extension outreach programs. Extension outreach activities of ALEI members include traditional publications and presentations and multimedia, including online outreach through videos, blog posts, and webinars. ALEI-UMES Specialists also work with the Maryland State Bar Association to educate Maryland attorneys on agricultural issues to aid them in working with farm clients and the farm community with a continually-updated legal services directory of attorneys with expertise in agricultural law.

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.

Maryland's producers are the clientele served by the efforts of UMES Extension specialist and the entire ALEI team. ALEI's broad mission is to raise awareness of the various legal concerns that affect Maryland's producers' agriculture businesses and to educate them about how the laws impact their operations. A critical component of ALEI's mission is to educate and advance the understanding of laws and policies that apply to and affect the food system. The ALEI partnership reaches Maryland's agricultural community through in-person trainings, publications, webinars, and formal classroom education. In conjunction with experts from throughout the University System of Maryland, state and federal agencies, and private service providers, ALEI provides education and resources to hundreds of Maryland farmers each year.

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

The UMES ALEI Extension specialist provides resources to explain agricultural law as it evolves to keep pace with the changing realities of farmers and the agricultural industry in the 21st century. The field is not limited to one area of the law, but covers many areas of law. In the early 20th century, agricultural law might have been limited to commercial, estates and trust, property, tax, and labor laws. But, as agriculture evolved in the 21st century, agricultural law has grown to include patent, trade, administrative, technology, and the growing field of food law. The UMES ALEI Extension specialist educates the Eastern Shore, Maryland, national and international agricultural communities on aspects of agricultural law through outreach programs, including traditional publications and presentations as well as multimedia, online outreach through videos, blog posts, and webinars. The UMES ALEI Extension specialist works with the Maryland State Bar Association to educate Maryland attorneys on agricultural issues to aid them in working with farm clients, and the UMES ALEI Extension specialist works with the American Bar Association to educate attorneys worldwide on food and agricultural issues.

Program Area Summaries

Agricultural Property Management and Land Use Law

With nearly one-half of farmland in Maryland being leased, there are a variety of issues that can arise between tenants and landowners. ALEI helps to strengthen leasing relationships for maximum benefit to farmers and landowners through creating resources on agricultural leasing in Maryland including a variety of sample and fillable leases for different operations. ALEI also has developed resources for farmers and landowners to implement conservation practices on leased land. A key element of my work is to help farmers and landowners identify both areas of liability and legal resources available to help strengthen their operations. ALEI provides resources on Maryland's Right to Farm Law, which provides legal protections to Maryland farmers who are compliant with the law. We also partner with organizations that offer resources to strengthen rural communities.

Topics Addressed:

- Agricultural Leasing

- Conservation Practices on Leased Land

- Local Planning and Zoning

- Neighbor Relations

- Right -to- farm

Environmental Compliance and Natural Resource Management

Agriculture and the environment are inextricably linked. Because farmers' livelihoods are dependent on the health of environmental resources such as soil and water, farmers are naturally stewards of the land. When the environment is degraded, farmers are often the first to feel the negative impacts on their businesses. The UMES ALEI Extension specialist provides education on the network of natural resource protection laws that intersect with agriculture, helping to strengthen both farming and environmental quality. My goal is to provide educational resources so that Maryland farmers are empowered to make management decisions with regard to their business and how it may impact the surrounding environment. The UMES ALEI Extension specialist helps farmers stay on top of laws that may affect their business practices and seek to engage the non-agricultural community. This way, controversies stemming from misinformation or lack of information can be avoided, keeping both agriculture and the environment strong.

Topics Addressed:

- Nutrient and Pesticide/Insecticide Regulatory Compliance

- CERCLA Reporting

- Agriculture Water Law in Maryland

- Intersection of Agricultural and Environmental Law

Farm Viability

The viability of the farming economy is important to both the agricultural and non-agricultural community. One of my goals is to help the agricultural community anticipate and address issues that challenge the viability of the state's agricultural economy. Key issues addressed in the area of farm viability include Agritourism and Estate Planning and Farm Succession. Agritourism refers to people visiting an agricultural operation for recreational purposes. Some common agritourist operations include Christmas tree farms, vineyards and wineries, microbreweries and distilleries. The UMES ALEI Extension specialist helps Maryland farmers learn about opportunities available, relevant regulations, and legal issues that should be considered when starting an agritourism business. Estate Planning and Farm Succession refers to how a farm owner can transfer assets and responsibilities in different situations including the death of relatives, changes in family structure, or passing the farm on to a new generation. While this can be a difficult topic for families to explore, the failure to address this topic can result in confusion, conflict, and even legal action, which can threaten the viability of an operation and stress family and business ties.

Topics Addressed:

- Agritourism Risk Management

- Trade

- Estate Planning and Farm Succession

Food Safety Education for Maryland Farmers

The UMES ALEI Extension specialist educates farmers on food safety liability, Maryland Good Agricultural and Handling Practices, and the Food Safety Modernization Act (FSMA). In an effort to eliminate misunderstanding, the UMES ALEI Extension specialist teaches farmers about civil and criminal liability stemming from foodborne illness outbreaks and the associated defenses that may be asserted in such cases. The UMES ALEI Extension specialist advocates for proactively planning for food safety and food recalls. The goal of preventive food safety planning is to identify and address risks to

strengthen individual farming operations and, by extension, the entire agricultural food network.

Topics Addressed:

- Food Safety Modernization Act

- Food Safety Liability

- Food Recalls

Labor and Employee Management Laws for Maryland Farmers

Farm labor and labor relations are important issues for those who own and manage farm operations. It is important for those who manage farm operations to be aware of laws and regulations that pertain to their employees. For example, new laws and regulations pertaining to the minimum wage and paid leave will also apply to farmers. Farm labor includes fulltime and seasonal workers and interns as well. The UMES ALEI Extension specialist provides resources on state and federal labor laws to help Maryland farm operators come into and remain in compliance. The UMES ALEI Extension specialist also collaborates with other stakeholders to provide training on important management topics and how to identify and avoid areas of legal risk.

Topics Addressed:

- Foreign labor

- Workers Compensation

- Wage and Labor Laws

Legal Risk Management for Maryland Farmers

It is important for all business owners to manage any potential legal risk to their operation. Those who own farm operations can be subject to labor, personal injury, nuisance, and other civil claims. It is important for farm operators to be aware of areas of liability so that they can take action to protect themselves. The UMES ALEI Extension specialist helps Maryland farmers protect themselves through developing publications and curriculums around a wide range of issues for different operations. The UMES ALEI Extension specialist has developed resources on Maryland's Right to Farm Law, liability related to owning livestock and other farm animals, fencing laws and more. Legal action can be timely, expensive, and damaging to individual operations and the community at large. The UMES ALEI Extension specialist works to help Maryland farmers better manage legal risks to support the success of individual farm operations and Maryland's farm economy.

Topics Addressed:

- Agricultural Liability

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

The broader public benefits from ALEI's activities through having more resilient farming operations, agricultural industries and agricultural communities, both urban and rural. Educating producers and industry support service providers as well as regulatory agencies and policy makers about the impacts, rights and responsibilities of the laws that impact farming families

and farm operations helps Maryland maintain the state's largest industry, feed Marylanders and increase the availability of locally-grown, fresh produce, reduce environmental damage caused by agriculture, maintain open space for wildlife and recreation.

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 most significant challenge is fatigue on the part of our clientele. They are overwhelmed with programming, especially programs delivered online. They have less time to attend programs at all because many of them are still dealing with the effects COVID had on their business, including now a shortage of labor. They are asking for more practical approaches to helping them navigate the legal landscape for their farms. ALEI and my Extension colleagues are focusing on developing more interactive online tools and products for self-learning as well as more templates and more opportunities to engage directly with private service providers like attorneys who can directly counsel clients.



Agritourism

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

A novel approach in the development of Agritourism educational activities in Maryland. Small and medium-ranchers/woodlot owners/farmers in the State of Maryland are increasingly dependent on agritourism as a source of additional income to maintain their landholdings. Most of these landholdings and farms cannot meet modern farm management demands in cost, technology, labor, and efficiency. UMES Extension conducted a study (White Paper) to prepare baseline information and guidance to launch education and training programs about agritourism. The study collected data from agritourism facilities through internet searches and direct inquiries. This process will involve the corroboration of academic publications, direct source information, government sources, private organizations, non-governmental organizations, and USDA's databases.

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 White Paper (*Maryland Agritourism: A Baseline Profile*) provides baseline information and guidance to UMES Extension specialists and educators offering education and training to agritourism farmers. Many farmers cannot solely decide, incorporate, and effectively manage farm recreational activities alongside their core farm production routine. The goal is to assist agritourism entrepreneurs in maximizing their social and economic capacities and thus contribute to local community welfare and development in counties within the state. The publication provides an overview of the typology and spatial distribution of agritourism services within the 24 counties in the state of Maryland. It evaluates the cost of access to transportation and explores the consumer characteristics of agritourism locations. The study collected data for 485 agritourism facilities through an internet search and direct inquiries. This process involved corroboration with academic publications, direct source information, federal and state government sources, private organizations, non-governmental organizations (NGOs), and United States Department of Agriculture (USDA) databases. The descriptive methods adopted in the study involved spatial mapping and distance analysis.

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

The findings in this White Paper stress the need for educational support for agritourism management and development. The support system can potentially leverage the advantages inherent in the widespread diversification to agritourism among small- and medium-income farm enterprises. Extension education provides an effective platform to enhance the progress and sustainability of agritourism businesses in the state of Maryland. This report will be succeeded by a survey. The survey will identify the requirements of agritourism stakeholders, including consumers, operators, extension services, and program managers, to test farm, and farmer, assumptions, especially assumptions about the place-based characteristics so far gleaned from this baseline assessment.

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

Agritourism is a consumer-focused type of agricultural operation. It is structured as an additional income-generating platform to augment the economic viability of a farm. Agritourism typically involves participation in a farm activity or operation, leisure, education, and active involvement. Agritourism centers in Maryland include wineries, creameries, craft breweries, petting zoos, U-pick, horseback riding, corn maze, hayrides, farm festivals, and other activities. The economic, social, and cultural activities involved in agritourism offer significant opportunities and implications for rural America. The Maryland General Assembly passed House Bill 252 (March 19, 2018) to provide a framework for the characterization of agritourism in the state. The bill provides a model definition of agritourism as an activity conducted on a farm offered to the general public or guests for education, recreation, or active involvement in farm operations. Local county authorities have adopted the model in their land use management laws and regulations.

Critical Issue

Food and Agriculture - UMES

Improving pest management for hemp production in the Delmarva Region

Project Director

Simon Zebelo

Organization

University of Maryland Eastern Shore

Accession Number

1025945



Corn Earworm Population Dynamics in Hemp Fields in the Delmarva Region

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

In 2020 a survey was conducted to identify arthropod pests of hemp in the Eastern Shore of Maryland. We found out that hemp serves as a host for a wide range of arthropods such as cannabis aphid, hemp russet mite, spotted cucumber beetles, leafhoppers, unidentified caterpillars, stinkbugs, and corn earworms. Even though most of the insects' pests were regularly found in the hemp fields, their injury potential remains unclear. However, Corn Earworm (CEW), *Helicoverpa zea*, emerged as a key insect pest in Maryland Eastern Shore. The CEW feeds primarily on hemp flowers and tunnels into the floral structure, causing plant tissue wilting.

Moreover, the population dynamics of CEW moths were studied in three different locations on the Eastern Shore of Maryland. The CEW infests hemp at the flowering stage. Notwithstanding, hemp enters its reproductive stage from late August through late September, during which there is less than 14 h of daylight in the Eastern Shore of Maryland. This timing coincides when alternate CEW host plants (corn and soybean) may not be at a stage congenial to CEW oviposition, and this leads to the heavy infestation of hemp plants by CEW.

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

Objective 1. Determine the key insect pests and beneficial arthropods in Virginia, Maryland, and Delaware hemp fields.

In 2021 a survey was conducted in four hemp fields to identify insect pests and beneficial arthropods in the Eastern Shore of Maryland. We found out that hemp serves as a host for a wide range of arthropods such as cannabis aphid, hemp russet mite, spotted cucumber beetles, leafhoppers, unidentified caterpillars, stinkbugs, and corn earworms. Even though most of the insects' pests were regularly found in the hemp fields, their injury potential remains unclear. However, Corn earworm (CEW), *Helicoverpa zea*, emerged as a key insect pest in Maryland Eastern Shore. The CEW feeds primarily on hemp flowers and tunnels into the floral structure, causing plant tissue wilting.

In addition to insects pests, some beneficial arthropods, such as praying mantis, ladybird beetles, lacewing, and predatory stinkbugs recorded in hemp plants.

Objective 2. Determine if pheromone trap catches of corn earworm moths can help predict larval infestations in hemp.

Heliothis mesh traps baited with corn earworm pheromone were installed in three locations on the Eastern Shore of Maryland. The traps were emptied, and the moths were counted weekly. Starting early in July through the first week of October in 2020 and 2021. The population dynamics of CEW moths were studied in three different locations on the Eastern Shore of Maryland. The CEW infests hemp at the flowering stage. Hemp enters its reproductive stage from late August through late September, during which there is less than 14 h of daylight in the Eastern Shore of Maryland. In both sampling years and locations, Starting late July through early September, the population CEW moths increased, but their number decreased dramatically after early September. However, the number of larvae increased significantly starting early in September until harvest and caused considerable damage to the hemp flowers. This timing (late August/early September) coincides when alternate CEW host plants (corn and soybean) may not be at a stage congenial to CEW oviposition, and this leads to the heavy infestation of hemp plants by CEW.

Objective 3. Disseminate research findings to other researchers, Extension personnel, and hemp growers in the Delmarva region.

Three industrial hemp field tours were conducted at hemp's different growth stages. On average, 38 growers attended the tour and learned about insects, pests, and diseases affecting hemp during vegetative and flowering growth stages.

We have published one peer-reviewed article entitled " Pest Management Needs and Limitations for Corn Earworm (Lepidoptera: Noctuidae), an Emergent Key Pest of Hemp in the United States" in the Journal of Integrated Pest Management, <https://doi.org/10.1093/jipm/pmab030>

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

This project provided information about the key insect pests of hemp in the Eastern Shore of Maryland and their possible biological and chemical control methods. Hemp growers will become more efficient at identifying insect herbivores and their symptoms and at solving pest issues.

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

This information regarding hemp insect pests will help develop pest management strategies. As a result, this study might lead to 1) a significant increase in the number of hemp farmers, 2) increased economic stability for hemp farmers, 3) a significant number of hemp farmers will fully embrace UMES's IPM program, 4) UMES's Hemp IPM program will become a model for other states and will be adopted regionally 5) profits increase notably in hemp due to reduce pest number, and control cost and 6) less fear of production failures due to IPM tools.

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.

Everything is going well, the only challenge is the provision of the hemp variety. Growers don't grow the same variety every year, forcing us to work with different varieties.

[Development of an Annual Plasticulture System for the Asian Ethnic Crop 'Bitter Gourd' \(Momordica charantia L.\)](#)

Project Director

Naveen Kumar Dixit

Organization

University of Maryland Eastern Shore

Accession Number

1023130



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

The current research work provided information on the cultivation practices of novel crop 'Bitter Gourd' on the Delmarva Peninsula. No information was previously available to local vegetable growers about the source of seeds, sowing timing, seedling preparation, morphology and reproductive characteristics. Similarly, little is known about the fertilizer and irrigation doses for bitter gourd cultivation. In addition, information has not been available for any indigenous diseases and respective management strategies.

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.

Plasticulture cultivation technology was developed for novel crops 'Bitter Gourd' (Momordica charantia L.) at UMES. In addition, a simple and easy-to-construct trellis was also developed for bitter gourd. Varietal differences were observed in yield outcome. India Hybrid showed higher yield (5.6 Kg/Plant) in comparison to Mini Hybrid-225 (3.85 Kg/Plant). Similarly, fruit size was larger in India Hybrid in comparison to Mini Hybrid-225. Postharvest life at room temperature was higher in India Hybrid (9 days) than Mini Hybrid-225 (7 days). Both the varieties were susceptible to Target leaf spot, but did not cause economic damage. Based on field demonstration and online workshops, one of the disabled veteran women farmer grew (0.5-acre) bitter gourd crop in the Princess Anne area and sold the crop in local farmer markets. She is planning to grow more Asian Indian vegetables as these vegetables are in demand and easy to grow on the Eastern Shore. In fact, the Asian vegetable program introduced these crops on the Eastern shore of MD. We also produced 2-YouTube (<https://www.youtube.com/watch?v=NtlfPhOZZi8>) videos on cooking these vegetables with the help of local community members. These videos have been seen 117-times since August, 2021. Farmers requested information on the local sources of seeds for these crops across MD and VA. One local grocery store owner showed interest in buying these vegetables from local growers. This program is still new and more potential impacts will be visible in the near future.

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

Local farmers and stakeholders participated in online and face-to-face workshops on bitter gourd cultivation at UMES research plots. Growers learned multiple aspects of bitter gourd cultivation practice from seed sowing to crop harvest and postharvest storage and transport. Farmers learned about suitable sowing conditions, raised bed dimensions, irrigation and fertilizer application throughout the growing season, and identification of common diseases. Growers also learned the importance of trellis use in bitter gourd cultivation, which promotes higher yield and prevents fruit decay and splitting. Growers also learned how to cook bitter gourd and share it with consumers to promote the sale of bitter gourd in local farmer markets.

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

Bitter gourd is mainly imported from South American countries and this distant transport of bitter gourd causes decline in the quality and shelf life of bitter gourd. The current work provided multiple benefits and opportunities to producers, consumers, and local grocery stores. Local farmers started growing bitter gourd in the Princess Anne area and grocery store owners showed interest in purchase of bitter gourd from the local growers. Consumers from different ethnicities purchased bitter gourd in local farmer markets and were satisfied by the aroma, quality, freshness, and longer shelf life. Bumper crop harvest enabled farmers to look for a wholesale market for the bitter gourd crop.

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.

For the past two years, 1 field demonstration, 7-workshops, 2 pre-/post workshop surveys, 2-conference presentations, participation in 1-local soil summit, 10- email consultations, 10-popular media events including 1 TV program, and newspaper publication were produced for extension outreach with this research work. One research article will be published on bitter gourd cultivation during the next reporting period.

[Agriculture & Natural Resources/Small Farms-Delivering programs to socially disadvantaged farmers to successfully operate farms, informing them about USDA agriculture programs](#)

Project Director

Enrique Escobar

Organization

University of Maryland Eastern Shore

Accession Number

7000179



Alternative Agricultural Production: Growing Ethnic Crops

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

Demographics on the Delmarva Peninsula are becoming more diverse, resulting in increasing demands for locally grown ethnic crops that simultaneously affecting food insecurity. With this demand economic opportunities arises for small farmers. To capitalize on this opportunity, limited resource, socially disadvantage farmers, and landowners have expressed their interest in growing ethnic/specialty crops that are common among the immigrant populations within the region, however, they lack the prerequisite knowledge. As economic opportunities arise for farmers the demand on soils to supply essential nutrients to this production will also increase.

In response to this trend, UMES Extension has incorporated, and educational track centered on **Alternative Agriculture** with the focus on crop diversification, providing farmers with research-based information and training. Diversification can be accomplished by adding a new crop species or different variety, or by changing the cropping system currently in use. Since crop diversity is recognized as one of the most feasible, cost-effective, and rational ways of developing a resilient agricultural cropping system. This program aims to satisfy the demand for locally grown ethnic/specialty crops that will improve food security, it will improve farm income, hence improve the standard of living for the farmers, and overtime it will improve soil properties.

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 major activities were developed for this program with the farmers request in mind. Hence, farmer's involvement was critical for the success of the program. Therefore, the program has created a farmer centered platform which enable them to have an active part. These goals could not be achieved without the farmers. Several activities were performed through collaboration with farmers, these include:

- Interest meeting to build rapport with the farmers and respond to their needs encourage farmers involvement was conducted.
- Research data on ethnic/specialty crops was made public, farmers get first on knowledge of production, harvesting, and marketing which helps them to make meaningful decisions on what crops to grow.
- Farmers was offered technical training through workshops, field demonstration, on-farm training.
- Farmers were link to potential buyers (i.e., 4 P's Foods, Dreaming Out Loud, and Maryland Food Bank) some of the largest fresh produce buyers in the state, which helps them in to make the decision to diversify their crop offerings.

- Farmers play an important contribution to community events (i.e., Jamaica Night at the Washington Inn and Salon ethnic foods showcase) to showcase and educate the consumers about ethnic crop.
- Farmers were supported and accompanied at farmers market to introduce their new crops
- Farmers were provided with factsheets and research-based information about the ethnic crops they were growing and were able disseminate the information to their consumers.
- Farmers were educated on production practices, harvest techniques, post-harvesting techniques, storage, and marketing of ethnic crops (Callaloo, okra, jute leaves, water leaves, cassava leaves, Scotch bonnet peppers
- Farmers were educated on the value-added potential of these crops and were able to create value-added products, hibiscus wine, sorrel drink, scotch bonnet crush, and jerk seasoning.
- Educating limited-resource and socially disadvantage farmers and rancher on ways to their farm income and standard of living by way of crop diversification and USDA programs

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

This program was beneficial to limited resource, socially disadvantage, new and beginning farmers, landowners, veterans, and ranchers because it provided them with the resources on growing ethnic/specialty crops, which includes technical support, education, and first-hand training.

For this reporting period, specialists and educators have trained in excess of four hundred persons, including farmers, agricultural service providers, and stakeholders (i.e., restaurateurs, wholesalers, and retailers specializes in ethnic crops). While there is no physical evidence as of yet on the soil change, farmers within the program are cognizance of the importance of soil health and they have also introduced sustainable production practices which also adds value to their products.

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

Research have shown that 23% of the population within the Washington Metropolitan Area (the whole District of Columbia, along with various districts within Maryland and Virginia) are immigrants and 14% of native-born has at least one immigrant parent which tells us how diverse the population is. With this diversity, the demand for food diversity increases, which means diverse cultures with different food needs. If this 23% of immigrants are not getting the food they preferred, food security declines. Hence the broader public benefited in several ways:

1. Improve food security
2. Availability of fresh food for consumers (improved nutrition)
3. Economy increases/revenue for the small family farm
4. Improved environment (reduction of chemical fertilizers and pesticides run off in the Chesapeake Bay)
5. Improved food safety (reduce the risk of contaminated imports)
6. Provides food enthusiasts with choice

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.

Major Changes

- Program expansion: we have farmers in different states such as Pennsylvania and New York reaching out to UMES Extension specialists and educators for technical support on growing hibiscus. Presently, we are not just collaborating with farmers within the region.

- Virtual meetings: due to COVID-19 in-person meetings have declined and we have retired to meeting virtually

Challenges Encountered: the problems do not directly relate to the program but indirectly linked. UMES Extension specialists and educators, train farmers to grow traditional and ethnic crops, providing them with the necessary programs and outreach. However, marketing of their produce is a challenge. The greater market for ethnic crops is located within the Washington Metropolitan region whereas most of the farmers reside on the Eastern Shore which makes it difficult for farmers due to transportation limitations. Another marketing problem that plagues the farmers, not just for ethnic crop producers but all small farmers, the constant competition with larger suppliers. It is exceedingly difficult for small growers to compete resulting in operation losses and discouragement.

Opportunities for Training and Professional Development: As mentioned above the program is tailored to satisfy the farmers' needs therefore, whenever a need arises, we would provide solutions through training. For example, the problem with marketing, Dr. Theresa Nartea was called in to educate the farmers. Referrals were made for farmers to be trained for the Farm to School program to help with marketing. Additional training and development programs for farmers is made available through USDA programs and we help

Dissemination information: information was transferred through workshop, demonstration, on-farm training, media (newspaper, television, website, Facebook) factsheets, and social gathering. August of 2021, UMES Extension collaborated with the Washington Inn Hotel and Tavern highlighting the ethnic crops and educating the community of their benefits and taste.

Plans for Next Reporting Period

The initial plan for this program was to identify crops that can be grown alternately or that has a high-value, therefore, for the past years we have been focusing on edible crops and has gathered researched based information on twelve of them and we will be introducing others as well inedible crops.

For the next reporting period, UMES Extension specialists and educators will be:

- Collaboration with the Maryland Institute College of Art on the indigo project.
 - The goal is to conduct applied research on two varieties of indigo to evaluate yield and ink potential.

 - Educating farmers on growing and harvesting practices. Presently, five farmers already shown interest. Farmers in this project is provided with seeds and secured market.

- Evaluate the yield production of growing ethnic crops (callaloo and jute) in high tunnels

- Collaboration with the Maryland Food Bank in buying ethnic crops from producers. UMES Extension specialists and educators will provide ethnic crop as introduction to three pantries as part of their pilot project

- Evaluating two varieties of grain amaranth for ease of growth, yield potential, and identify possibly markets as well as establishing niche markets,
- Organize workshops and training on applied researched crops (indigo, amaranth, and other crops)
- Collaboration with Virginia State University on market opportunities for small farmers with Aramark and Sysco, two of the largest fresh food suppliers within the State.



UMES annual Small Farm Conference – Positioning Small Farms for Success

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

According to the 2017 Census of Agriculture, the number of farms in Maryland totaled 12,429. Approximately 80% of these farms are classified as small farms with sales of \$100,000 or less. Yet, despite the growing interest among diverse populations who want to enter into farming on a small-scale, farmers continue to face numerous challenges such as: rising production costs, insufficient farm business management skills, and other uncontrollable factors (economic effects of COVID-19, environmental, etc..) that make it difficult to make a profit. Consequently, there is a strong need to improve farmers access to resources that will put them in a better position to own and operate a farm business successfully.

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.

UMES Extension is committed to keeping our stakeholders abreast of agricultural trends and making sure producers have access to timely information, resources, and strategies that can improve their farm businesses.

In November 2020, the UMES Extension's Small Farm Program organized its 17th annual Small Farm Conference. The main objective of this two-day event is to equip farmers and landowners in Maryland and along the Delmarva Peninsula with tools and strategies to increase farm profitability and promote farm sustainability. Simultaneously, UMES Extension utilized this event to build, revise, and expand program and outreach activities to appeal to and address individual as well as community needs, emerging problems, and concerns of target groups focusing on limited-resource, new and beginning, and the underserved farmers.

As part of the two-day program, UMES Extension offered a variety of virtual seminars, training sessions, and in-person farm demonstrations/tours. More importantly, farmers had an opportunity to participate in virtual round-table discussions with representatives from USDA, the Maryland Department of Agriculture, agricultural businesses and various non-profit organizations to learn about farm programs and services available to farmers and/or farm landowners.

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

Over 100 registered for the virtual sessions on Saturday. Some of the most popular topics were “Bio-Dynamic Farming Principles and Advantages,” “Financial Planning and Management Strategies in Uncertain Times,” and “Development of African Caribbean Specialty Crops.” The virtual aspect of the conference made it possible to attract participants from as far away as Nigeria. Sessions were also available for up to 30 days after the event to allow conference registrants to go back and view sessions that they would have typically missed in a traditional face-to-face event.

Overall, participants found the workshops and sessions centered on alternative crop opportunities, farm business management, and sustainable farming systems to extremely informative and relevant to their interests, needs, and expectations. For many of the sessions, participants indicated their level of knowledge had increased and plan to utilize the information and/or training received to their respective farm operations or endeavors.

The conference is making a huge impact in helping new and underserved farmers achieve their dream of farm ownership. The venue has played an important role in connecting socially disadvantaged and veteran farmers/landowners to agriculture service providers and resources.

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

As expected, the synergy generated from the small farm conference resulted in UMES Extension to reconnect with farmers that had not attended a UMES sponsored event since the beginning of 2020. The farm conference along with the winter virtual webinars offered also opened the door for a new crop of socially disadvantaged farmers and/or aspiring farmers that may not have attended our conference or UMES sponsored events under normal circumstances due to distance or other factors.

In addition, by introducing and educate conference attendees on alternative crop opportunities along with new farm management practices, we have witnessed an increase in the number of farmers diversifying their operations by incorporating specialty/ethnic crops such as: Jamaican callaloo, ginger, scotch bonnet peppers, herbs, and more to their crop offerings. Growing new crops have also opened new market outlets for these farmers which in turn has increased their bottom line. It is anticipated that this growing trend of agricultural diversification will continue as a result of UMES programing efforts.

Critical Issue

Human Health, Nutrition, & Wellness - UMES

Family Nutrition and Health – Importance of food safety, nutrition, and health programs to ensure adequate nutrition and reduce foodborne illnesses

Project Director

Enrique Escobar

Organization

University of Maryland Eastern Shore

Accession Number

7001933



Family & Consumer Sciences (FCS) Program: Developing Communities Where People Work Together for a Healthier Life-Culture of Health Initiative

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

The tri-county area of the Lower Eastern Shore of Maryland is characterized not only by a high prevalence of obese children and adolescents, but also by an evidence of severe poverty, and the socioeconomic status of potential participating families. The Lower Shore of Maryland is also becoming a melting pot of diversity, and we must provide sustainable adult and youth programming to meet the needs of the entire community. Minority population (race alone or in combination with one or more other races) vary by County. Based on our previous initiatives, strategic goals, and objectives we agree to continue to promote health equity and culture of health (physical, mental, environmental, and socio-economic health) in the Tri-County area through the existing partnerships.

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 UMES-FCS Program initiated strong relationships with community leaders to implement engagement processes that bring together citizens in informed decision-making for their community. In collaboration with the multi-sector health council developed in selected communities: Princess Anne-Eden (Somerset County); Fruitland (Wicomico County); and Pocomoke (Worcester County), implemented “Healthy Street –Healthy Me” and “Make Fruits Available to All” projects. In 2021 The UMES-FCS Program team was able to conduct indirect teaching and engagement activities including social networking, mental health, and healthy lifestyle knowledge and skills, food access, harvesting and food safety. During the pandemic, the team worked together to engage youth, adults, community to actively help their community members facing the challenges related to the pandemic. The UMES-FCS Program team, governmental organizations, government agencies, and churches worked together to help families to put food on their tables through Food drives. Families were not able to get together for parenting and financial management due to pandemic.

During the fiscal year 2021, educators in collaboration with partners in the Tri-county area of the lower Eastern Shore of Maryland provided approximately 215 youth and 50 adult direct contacts; and 5,245 youth and 8,976 adults indirect contacts were made through teaching and community engagement activities.

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

The FCS program focused on Adults and young adults from diverse income background emphasizing a cross sector collaboration: Youth and adults were able to conduct the maintenance of six mini-fruits orchards, develop 3 community group therapy gardens, and participate in social events to help improve the relationships between parents and children. The partnerships in each community increased – In each community, collaboration among local community partners included city government, chambers, businesses, nonprofits, farmers, schools, Universities, community economic development, etc. was observed. Approximately 215 youth and 50 adult direct contacts; and 5,245 youth and 8,976 adults indirect contacts were made through teaching and community engagement activities. These activities indicated that local strong relationships among community local stakeholders and strong partnerships between youth and adults increased the culture of health in the community. Together community members faced the challenges related to the pandemic. Community engagement is essential.

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

The partnership between projects, the initiation of a coalition building, multi-health sector, a decision-making process, partnerships between youth and adults, may help increase the culture of health in our communities. Community engagement is an important step for sustainability.

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 2021 fiscal year because of the challenges faced during the pandemic, it was difficult to continue with the social gathering and the related activities. In addition, it was difficult for families to have food on the table. In collaboration with other organizations the UMES FCS program organized food distribution activities in the Tri-County area in response to the lack of food access faced by the target population during the pandemic. These activities helped to increase the number of indirect contacts among adults and youth.

Critical Issue

Safe, Secure, Abundant Food Supply - UMES

Closing Out (end date 09/07/2023)

Prevalence and Antimicrobial Resistance of Salmonella in Organic and Non-Organic Chickens

Project Director

Salina Parveen

Organization

University of Maryland Eastern Shore

Accession Number

7001073



Antimicrobial resistance - Progress report

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

Salmonella is a pathogenic bacterium that is responsible for salmonellosis. Salmonellosis is one of the most common and widely distributed foodborne diseases in the world. Multidrug resistance of *Salmonella* is becoming a global public health crisis. *Salmonella* is common in

poultry and spread to humans by contaminated meat. A few studies were conducted on the prevalence and antimicrobial resistance of *Salmonella* in retail chicken. However,

adequate information is not available about the prevalence and antimicrobial resistance of *Salmonella* in organic and non-organic chickens at retail stores on Delmarva. The overall goal of this study is to address this data gap through following five specific objectives

1. To determine the prevalence of *Salmonella* in organic and non-organic chickens.
2. To serotype *Salmonella* isolates recovered from organic and non-organic chickens.
3. To investigate antimicrobial resistance profiles for these isolates.
4. To explore the virulence properties of *Salmonella* isolated from organic and non-organic chickens.
5. To develop outreach and extension programs for control of *Salmonella* in organic and non-organic chickens.

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. Antimicrobial susceptibility testing was completed and the results were analyzed.
2. Recovered *Salmonella* isolates were serotyped.
3. DNA was extracted from each confirmed *Salmonella* isolate recovered from chicken to investigate virulence properties.

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

Findings of this project were shared with the students of advanced food microbiology, food microbiology laboratory, and seminar in food science and technology courses at the University of Maryland Eastern Shore; the poultry industry; and regulatory agencies through classroom discussion, personal communication, outreach and extension activities. Furthermore, a few presentations were made at national meetings and one manuscript was submitted to a peer reviewed journal.

The investigators anticipate that the project will motivate minority graduate and undergraduate students to pursue higher education in molecular biology, food microbiology, and food safety as well as careers in these disciplines in academia, industry, and federal and state agencies.

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

The findings of this study will provide valuable information about the prevalence of *Salmonella* in organic and non-organic chicken in the Delmarva region. The results of this study will also shed light on the use of antimicrobial agents to control *Salmonella* in chicken. In addition, this study will define the antibiotic resistant profiles and virulence properties of *Salmonella* recovered from two groups of chickens on Delmarva. The findings will alert government authorities, food manufacturers, retailers, healthcare providers, researchers, and consumers to protect the community from *Salmonella* infections.

[Agricultural Communications - Facilitates informative linkages between agriculture specialists and clientele, reaching stakeholders via multiple platforms](#)

Project Director

Enrique Escobar

Organization

University of Maryland Eastern Shore

Accession Number

7002252



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

A team with specialized knowledge in the agricultural communications is dedicated to communicating the language of science and transferring technology from scientists to consumers according to their needs and interests. Broadly, it addresses all subject areas related to the agriculture and allied disciplines, such as food, feed, fiber, fuel (F4), natural resource management, 4-H and youth development, community economic development, and others relevant to keep our stakeholders informed about the three pillars of a land grant university mission: teaching, research, and Extension. Farmers, youth and citizens are aware of new programs, webinars, workshops, field days and many other activities for information and fulfillment of their personal activities. Simultaneously, the Communication team facilitates developing web-based materials and maintaining the websites with updated information as an 'e-repository' to provide access to all, locally and globally.

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 UMES Extension Communications team published the School of Agricultural and Natural Sciences (SANS) monthly science digest magazine, UMES Extension connection newsletter, thematic and programmatic brochures, factsheets, flyers, pamphlets, booklets, tech notes, and periodical reports. The periodic publications maintain a critical link between UMES Extension and its clients because also lists the coming events sponsored by UMES Extension, registration procedures and deadlines.

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

UMES Extension clients benefit from Ag Communications' compilations of resources, publications, news, events, plus the Maryland Extension Network. Communications specialist link clients with resources, subject matter experts, create a bank of photographs and videos for further training and reporting.

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

Ag Communications team members wrote about activities happening, analyze, and promoted the activities of UMES Extension educators and specialists. The Ag Communication team also took care of media requests for information creating marketing materials to publicize general information about USDA Programs for the farming clients, food producers, agricultural associations, and other agricultural organizations.

[Development of Aronia Mitchurinii as a specialty crop alternative for the Delmarva Region.](#)

Project Director

Vicki Volkis

Organization

University of Maryland Eastern Shore

Accession Number

1016197



Completed (1) The Cultural Management Study and Second Year of Observation for Ripening of Aronia and (2) Thermal Decomposition Study and Resin Extraction

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

This project is focused on developing cultural management and best processing practices for the super-fruit and specialty crop Aronia mitchurinii. Componentss of cultural management include the role of nitrogen, Azomite, and organic vs. traditional practices on the yield and antioxidant content of Aronia berries. It has been observed that some anthocyanin rich fruits have di?erent ripening peaks: one when the content of anthocyanins is highest, and the other when the content of soluble sugars (brix) is highest. To check if this observation is relevant to Aronia and to provide farmers with the optimal harvesting days for pharmaceutical applications (when anthocyanins are the highest), and for food-related applications (when brix is the highest), we collected samples of Aronia berries at di?erent stages of ripening and analyzed them for brix and

antioxidant content. The data were then plotted vs. calendar and vs. temperature days. It has been observed that many antioxidants can decompose under elevated temperatures while food products are produced and pasteurized. To preserve as many antioxidants as possible from Aronia during processing, we conducted thermal decomposition experiments. The antioxidant content was analyzed as a function of temperature and time during the heating process for Aronia juice. The pulp is bitter due to the very high tannin content yet contains many antioxidants. By developing the technology of extracting antioxidants from the pulp by resin extraction, we created additional applications for the berry, such as immune bust to other plants, natural colorants, pharmaceuticals, and an antifouling agent. The other goal of this program is the training of students. This project supports one graduate student; another graduate student, who was supported using funds from a different source, participated in the research for this project.

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 completed analyzing five year data on the impacts of cultural management on Aronia. We found that 3 g/bush/year of nitrogen treatment is the optimal quantity amount for both organic and traditional growing. Having too much or too little nitrogen causes a loss in the berry's antioxidant content while having too little nitrogen also influences yield. Traditionally grown berries are higher in antioxidant content than organically grown berries. At the same time, the addition of Azomite had a minor to no effect on the yield and nutraceutical content.

We have monitored the third year of ripening of Aronia and determined the timing for the peak of antioxidants and the peak of sugars. The first two years produced two peaks of ripening that were similar to each other. However, during the third year of observations when the number of temperature days was significantly higher, both peaks happened almost at the same time. We plan to continue these observations for several more years.

We have completed the evaluation of four types of polymeric resins used to isolate powdered antioxidants from Aronia. Based on data collected over two years, we have identified the most suitable resins and best conditions for extraction of antioxidants.

We have completed experiments for the thermal decomposition of Aronia juice at temperatures ranging between 80 to 120 deg C.. At 80 deg. C, even after 2 hours of heating, less than 10% of antioxidants had decomposed. However at 120 deg. C. during the first five minutes of heating, more than 50 % of antioxidants had decomposed. After analyzing polyphenols and flavonoids, we were able to develop a plausible mechanism of decomposition.

Finally, two graduate students have obtained the required experimental data and started working on their thesis papers. Additionally, we are preparing four papers for publication and have conducted several presentations at national and regional conferences.

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

- o Two graduate students have obtained data and started preparing their thesis papers

- o The research community has attended several presentations made by students.

- o Farmer communities were exposed to the project via presentations during UMES Agriculture demonstration days and at the UMES Small Farms conference.

- o The project provided an experiential training opportunity for a group of undergraduate students.

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

- o The Aronia project has been highlighted several times in local press and UMES publications. These sources are accessible to all local communities.

- o Local communities and farmers have learnt about the project during agriculture demonstration days at the UMES farm and during the Annual Small Farm Conference. In addition, during our summer programs, students presented results at

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.

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 2021 fiscal year, we submitted a no-cost extension request because the students' ability to attend school in person and work in the lab was heavily affected by COVID. They needed additional time to finish their work, write their thesis, and submit papers. The request was granted. Now the end date of the project is April 30, 2022.

In the 2022 fiscal year, we plan to:

- Graduate two graduate students

- Prepare and send out four papers

- Make a presentation during Small Farms Conference

- Make a presentation at ABRCMS national meeting

- Submit a final report for the project

- Write a proposal where a similar approach will be applied to additional specialty crops.

- Submit a proposal to expand the Aronia approach to some other specialty crops.

- Prepare and submit the final report

- Patent the power drink from Aronia berries.

Below is a list of submitted papers and presentations, made during the 2021 fiscal year:

Submitted papers

1. The Impact of insect herbivory in the level of cannabinoids in CBD hemp Varieties. Brando Jackson, Lenneisha Gilbert, Tigist Tolosa, Shelly Ann Henry¹, Victoria V Volkis, Simon Zebelo *. Submitted to BMC Plant Biology 2021

2. ANDREW G. RISTVEY, SUDEEP MATHEW, BLESSING AROH² AND VICTORIA VOLKIS . Effect of organic nitrogen rate on fruit yield, brix, and other quality parameters in two cultivars of Aronia. Submitted to Journal of Horticultural Science and Biotechnology 2021

Presentation in oral or poster format:

1. V. Volkis. Value-Added Crops Beyond Agriculture and Food: The Science on the Edge of Phytochemistry and Polymers: Nature's Gifts for Medical Textile, Antifouling Protection, Pest Control, and Medical Supplements. Invited talk at Delaware State University. Mar 2021.
2. Probing Extracts from Aronia and Holy Basil as Potential Antifouling Agents. Teemer Barry¹ Carson Cohen¹, Baruch S. Volkis¹, Paulinus Chigbu¹, Victoria V. Volkis^{1*} 2020 ABRCMS Virtual Experience
3. Developing an All-Natural Organic Power Drink from Aronia Berries. Ayanna E. Lynn¹, Jordan R. Brooks¹, Itohan R. Eromosele¹, Andrew G. Ristvey², Victoria V. Volkis^{1*} 2020 ABRCMS Virtual
4. Developing a portable device for gauging ripeness in fruits using quantitative determination of anthocyanin and sugar content. Destiny T. Parker¹, Melanie Y. Staszewski^{1*}, Monica Elavarthi^{1**}, Breann V. Hrechka¹, Andrew G. Ristvey², Victoria V. Volkis¹ 2020 ABRCMS Virtual
5. Teemer Barry, Carson Cohen, Victoria V. Volkis*. Probing Essential Oil Extracts from Aronia mitschurinii, hemp, and Holy Basil as Potential Antifouling Agents. Department of Natural Sciences, University of Maryland, Eastern Shore, Princess, Anne, MD 21853. 2020 Conference of the Northeast Regional Honors Council (NRHC) in Albany, NY, 2020.
6. Probing Extracts from Aronia and Holy Basil as Potential Antifouling Agents. Teemer Barry¹ , Carson Cohen¹, Baruch S. Volkis¹, Paulinus Chigbu¹, Victoria V. Volkis^{1*} 2020 ABRCMS Virtual Experience
7. Developing an All-Natural Organic Power Drink from Aronia Berries. Ayanna E. Lynn¹, Jordan R. Brooks¹, Itohan R. Eromosele¹, Andrew G. Ristvey², Victoria V. Volkis^{1*} 2020 ABRCMS Virtual
8. Developing a portable device for gauging ripeness in fruits using quantitative determination of anthocyanin and sugar content. Destiny T. Parker¹, Melanie Y. Staszewski^{1*}, Monica Elavarthi^{1**}, Breann V. Hrechka¹, Andrew G. Ristvey², Victoria V. Volkis¹ 2020 ABRCMS Virtual
9. Developing a Portable Device for Gauging Ripeness in Fruits Rich by Anthocyanins and Sugars. Ezra Cable, Destiny T. Parker¹, Melanie Y. Staszewski^{1*}, Monica Elavarthi^{1**}, Breann V. Hrechka¹, Andrew G. Ristvey², Victoria V. Volkis¹ ICSS conference, April 2021

Type

Projects / Programs

Projects / Programs without a Critical Issue

2

[NC170: Personal Protective Technologies for Current and Emerging Occupational and Environmental Hazards](#)

Project Director

Anugrah Shaw

Organization

University of Maryland Eastern Shore



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

Cotton/polyester garments are typically worn when applying pesticides. Decontamination studies are important to determine pesticide residues in reusable cotton/polyester garments with and without repellent finish.

Methodology studies, including interlaboratory studies are required for standards development.

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

Objective 1: Travel restrictions due to the pandemic required major changes in the planned activities for laboratory and field decontamination studies. To enable completion of the decontamination work, request for made to the colleagues to organize week of training and methodology development with BASF Operator Exposure (OPEX) team in Germany. This allowed researchers from UMES and IAC Brazil to build upon the expertise of BASF OPEX team to address the issues with laboratory studies. The researchers also received training in extraction and analysis of garment from field studies. UMES was responsible for the development of documents and coordination with colleagues in Brazil, France, and Germany. As a result of the revised plans, we will be able to meet the goals and objectives for the decontamination study.

Objective 3: Interlaboratory tests for revision of spray method used for evaluation of whole body garments were conducted in 2019 to address interlaboratory variability. The decision was made in December 2019 to conduct the next interlaboratory with the revised methodology. The study was delayed due to the pandemic. As Convenor of ISO WG3 committee on protection against chemicals, and research with the colleagues from Brazil, I was actively involved in the planning of the interlaboratory study and analysis of the test data. Coordination of the interlaboratory study during the pandemic required additional planning and development of documents that enabled us to proceed with interlaboratory testing, discussions. The interlaboratory tests were completed in Fall 2021.

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

Methodology developed as an outcome of this project is being validated with several cotton/polyester fabrics with and without finish. The studies have the potential of serving as baseline studies for decontamination of workwear garments.

Standards development studies support revision of ISO test standards.

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

The decontamination study is ongoing with research to be completed prior to ending of the project in September 2022.

The international standards are used for testing and certification of PPE.

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.

Due to COVID research study plans for decontamination project had to be changed in order to complete the project by the end of the funding cycle. Study plans include working with BASF OPEX team on in Germany in October 2021.

PRECISION LIVESTOCK FARMING WITH ADVANCED PHENOTYPING TECHNOLOGY

Project Director

Sang Oh

Organization

University of Maryland Eastern Shore



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

In poultry production, the integrators decided to set their main goal on fast broiler growth and abundant production. The breeding toward that goal is thought to have contributed to a phenomenon known as woody (wooden) breast in broilers. Woody breast meat is tougher (harder) than normal breast meat, and creates a significant concern for producers and consumers with no practical solution yet. Because chicken with woody breast hold poor economic value and are not accepted by consumers, producers encounter significant economic loss since woody breast is only identified after harvest.

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 major activities in 2021 focused on the investigation of the physical characteristics of woody breast (WB) and normal breast (NB) in live chicken using a non-invasive, digital palpation device named "MyotonPRO®". This technology provides the measurements of superficial muscles regarding dynamic stiffness (DS), elasticity, mechanical stress relaxation time (MSRT) and ratio of deformation and relaxation time (RDRT). One hundred breast meat samples were used in this analysis (WB: 50; NB: 50), which were obtained from a local processing plant one day after harvest and sorted based on WB scoring with the naked eye (0, 1 for NB; 2, 3 for WB). The results showed the following variables were significantly different between WB and NB: DS (603.4 vs 565.8; N/m), and elasticity (1.40 vs 1.55). However, MSRT and RDRT were not significantly different. These results collectively show that the non-invasive measurements of WB differ from NB and therefore this device could be used to determine WB in live chicken. The degree of muscle hardness in WB can then be considered as a trait to be selected and utilized for the genetic/genomic selection program collecting the measurements before harvest.

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

This research will provide critical information about the processes behind efficiently phenotyping economically important traits in food animal production. Therefore, the resulting data will benefit food animal producers in their production management systems and help increase their profit margins through savings in maintenance and labor costs. The advanced phenotyping system developed through this study will improve the production efficiency of the producers, thereby reducing the production cost. Labor costs will be lowered in the harvest house from cutting down manpower to visually detect woody breast. On top of reduced labor costs, prices devoted to feeding chicken with woody breast and processing discarded meat from woody breast will drastically decrease by discovering the phenomenon at an earlier production stage.

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

This project correlates with significant environmental benefits. As producers can detect woody breast, they can reduce the amount of discarded meat in the future. Using animal movement tracking and weighing technology, producers can foresee animal health and take measures to care and reduce the waste from dead animals. Ultimately, these gains will culminate to an important step towards an environmentally friendly production system. Further, the above efforts will play an effort in projecting a positive impression that food animal industries are concerned about animal welfare to groups that believe the former does little to guarantee it. Finally, this will induce a more cordial atmosphere from society towards domestic agriculture by demonstrating the latter's vital role in the national economy. It will also implement social benefits by contributing overall balanced development.