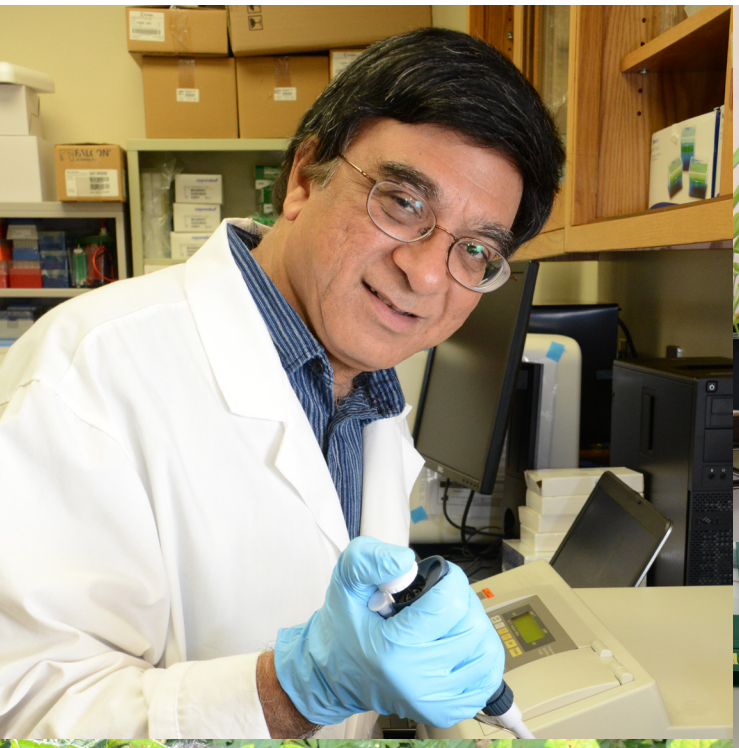
VIRGINIA STATE College of Agriculture

Agricultural Research Station

# IMPACT 2020-2021



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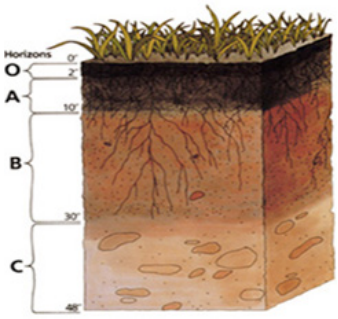
# Soil Health Assessment and Management

**Who cares and why?** Soil health is the "buzzword" currently being used to assess the status of soil productivi-ty and sustainability. It is a state of a soil meeting its range of ecosystem functions as appropriate to its environment combining the physical, chemical and biological attributes of the soil, which are critical to agriculture and human survival. Soil health testing is an assessment procedure that measures these attributes. Soil health depends on soil biodiversity (with a robust soil biota), and it can be im-proved via soil conditioning (by adding soil amendments). Maintaining healthy soil is critical for crop production, increasing yield, supplying organic matter to the soil and improving soil micro flora. In total, soil health benefits both farmer profitability and water quality and environ-mental sustainability.

**What has the project done so far?** To initiate a soil health program, Virginia State University, through the College of Agriculture and Agricultural Research Station, submitted a Capacity Building Grant proposal in 2020 to USDA-NI-FA. When funded, the project will set a foundation for future research in soil health that will bring VSU and the College of Agriculture in par with many land-grant uni-versities (LGUs) that have already initiated or established soil health programs. An approved Evans-Allen program that addresses fundamental soil health issues in selected Virginia soil series is already underway in the Soil and Water Program. The program focuses on the relation-ships between soil health and management by conduct-ing research that measures specific soil health indicator parameters (physical, chemical and biological) considered fundamental to soil health assessment. To make a more comprehensive assessment, we have included soil struc-ture, texture, strength, organic matter content, microbi-ology and fertility. These parameters are measured both on-site and in the laboratory.

When soil health encompasses these parameters, the application, management and utilization of a certain soil series become more specific, efficient and clearer than the current method used to identify soil quality, which is mostly geared towards a specific crop production. Using soil health assessment procedures, the manage-ment and utilization of soils become more systematic and the benefits are more sustainable. Both farmers and conservationists will gain more information than what soil quality may offer. It is with this idea in mind that the aforementioned proposal was submitted to NIFA.



A profile of natural soil indicating the master horizons.


A well-managed healthy soil, rich in organic matter.

**What research is needed?** Research on both assess-ment and management of soil health as well as farmers' innovation in soil health management approaches have been maturing over time. Multiple regional, national and global efforts are now leveraging the work to reach new stakeholder audiences, so that soil health manage-ment is expanding into mainstream agriculture. Public recognition of the critical importance of maintaining and rebuilding healthy soils for long-term sustainable agricultural production is growing. However, while much progress has been made, there is much more to be done to enhance crop production, maintain a healthy environ-ment and sustain a growing population.

**IMPACTS**

- Maintaining and improving soil health is critical to continued production of quality crops, farm profitability and environmental sustainability. It is a major component of all attributes necessary for human survival.

**This project was supported by USDA-NIFA Evans-Allen Funds.**
**Want to know more? Contact Dr. Asmare Atalay, (804) 524-6721, aatalay@vsu.edu**

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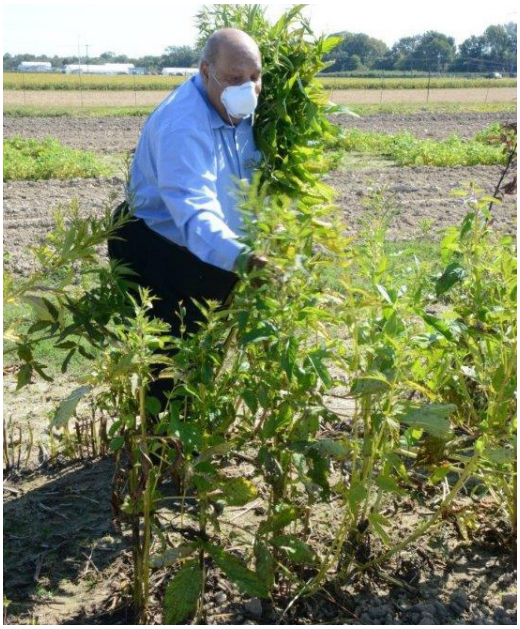
# Sesame Production in Virginia



**Who cares and why?** Considerable demand exists in Virginia and the Mid-Atlantic region for sesame (*Sesamum indicum* L., *Family: Pedaliaceae*) seed especially for use in the production of hummus. Currently, there is a complete lack of sesame production in Virginia due to unavailability of publicly-available shatter-resistant varieties. Traditional sesame varieties shatter and are not suitable for mechanical harvest. Extensive sesame research by Virginia State University's "New Crops Program" during 2011 and 2012 with proprietary dwarf and shatter-resistant sesame varieties indicated that sesame can be easily produced in Virginia. However, these varieties are not freely available to producers. A limited research effort with traditional tall, shatter-prone sesame material during 2017-2019 indicated that a possibility exists to develop sesame breeding material with reduced shattering.

**What has the project done so far?** A limited research effort with traditional shatter-prone/tall sesame material during recent years has indicated that a possibility exists to develop sesame breeding material with reduced shattering via agronomic manipulations, such as use of different planting dates, inhibition of apical dominance, spray of adjuvants to reduce capsule shattering, etc.

**What research is needed?** Extensive research is needed to develop shatter-resistant sesame varieties that are freely available to producers in Virginia and elsewhere. Continued efforts to identify agronomic practices to reduce shattering in sesame are also needed.

**IMPACTS**

- Sesame production can enhance Virginia's agricultural economy by providing a readily marketable crop that can create a significant and tangible source of income for farmers.
- Locally grown sesame can provide an alternative to imported sesame for production of hummus and other food products in the United States.
- Sesame varieties developed by this effort would be available publicly to all farmers without need for payment of royalties to current seed sellers.

**This project was supported by a USDA-NIFA Evans-Allen Grant and the Virginia Tobacco Indemnification & Community Revitalization Commission. Want to know more? Contact Dr. Harbans L. Bhardwaj, (804) 524-6723, hbhardwaj@vsu.edu**

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# Establishment and Initiation of Industrial Hemp Breeding and Research Program at VSU

**Who cares and why?** Virginia State University (VSU) has been involved in industrial hemp research since the implementation of a pilot research program in Virginia in 2015. VSU started its research program at Randolph Farm in 2016. Since then there is growing interest in hemp among growers/processors in the Commonwealth. The number of growers/processors and acreage of hemp rapidly increased within this short period. In spite of the demand and interest, there are several problems associated with hemp. Most important is seed/variety availability for growers because no public varieties are easily available. Almost all varieties are imported from Europe or Canada and are breeder-protected varieties so getting seed is difficult and expensive for small growers. As the United States imports major shares of hemp and hemp-based products from China and Canada, there is high demand and potential for this crop. A commercial processing plant was established in Virginia to help small growers process their products. With these developments and modifications in rules/regulations, hemp production is becoming very popular among Virginia growers. As a land-grant university, VSU is taking the lead to develop and disseminate hemp and hemp-based technologies through various research and Extension programs. The Agricultural Research Station (ARS) at VSU recognizes hemp as an important crop and conducts research under its Specialty Crops program. VSU aims to establish a long-term public hemp-breeding program for growers/researchers in Virginia and the United States.

**What has the project done so far?** We successfully introduced several hemp germplasms from a public gene bank in Germany. There are 44 valuable germplasms in this collection. Since there are no public resources for hemp germplasm in the U.S., these will be extremely valuable resources for the VSU Hemp Breeding program. These germplasms are grown for seed multiplication at

VSU's Randolph Farm to aid future research. In addition, we are also evaluating and selecting several lines/germplasm at the farm and are ready to harvest. They will be harvested in bulk as well as a single plant selection. Superior plants and families will be grown for further evaluation next year. Sixteen commercial hemp cultivars from Europe are being evaluated at VSU for yield and other yield traits. They are mature and ready to harvest. VSU is also a part of a nationwide variety trial for essential oil on Hemp (EOH) coordinated by Oregon State University. Their trial is at the flowering stage and data collection is going on for various traits.

**What research is needed?** Research is needed to identify suitable hemp varieties for seed and oil for immediate recommendation, as there is no recommended commercial variety. The planting date is very critical and research is needed to determine the optimum planting date along with fertilizer dose. Identification of suitable germplasm is needed for immediate and long-term breeding programs.

**IMPACTS**

- Successfully acquired several hemp germplasms from a public genebank (Germany).
- Germplasm evaluated and seed multiplied at Randolph Farm for further evaluation and utilization in the future.
- Several families selected from a single plant are also being evaluated at VSU's Randolph Farm.

**This project was supported by USDA-NIFA Evans-Allen Funds.**
**Want to know more? Contact Dr. Ramesh Dhakal, (804) 524-5615, rdhakal@vsu.edu**

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# Development of Edamame and Specialty Soybeans (*Glycine max*) A Profitable Option for Rural and Urban Agriculture in Virginia

**Who cares and why?** Small scale farming agribusinesses in southern Virginia are experiencing loss of income and croplands due to the end of a federal tobacco price support program. Growing alternative niche crops helps solve this challenge. Edamame or other food-grade specialty soybeans (*Glycine max*) is regarded as a profitable substitute for tobacco. Specialty soybeans are harvested for vegetable diets of fresh beans (*edamame*) and/or for soy-based food products of mature beans for organic foods.

Edamame can be grown similarly to general-purpose soybean, but has much higher market values. Along with more people being aware of the nutritional and health benefits of soy food, the demand for edamame and food-grade soybeans has significantly increased, which brings a promising opportunity to increase farmers' income. In addition, growing vegetable and specialty soybeans also helps the diversification of both rural and urban agriculture, as well as the food supply. The breeding program and scientists at Virginia State University's Agricultural Research Station have been dedicated to the development of new varieties of edamame and/or food-grade specialty soybeans suitable for production in Virginia and the entire United States. The project will benefit crop growers, small and/or part-time farmers, urban gardeners, soy-food processors, suppliers and consumers.

**What has the project done so far?** VSU has established an edamame research program and released three varieties. However, these lines have not been commercially grown because of some unsatisfactory traits like smaller seeds. Genetic improvement through further breeding and selection has been initiated. In addition to edamame, conventional food-grade specialty soybeans also have been integrated into the program. Reselection of individual plants, plant rows and breeding lines has been performed since 2015. About 400 breeding lines have been evaluated yearly for yield traits and nutritional quality (protein, oil, sugars, etc.) in fresh edamame and mature soybeans. Many promising lines have been selected, and seed purification and multiplication are in progress. Several new lines have also been introduced to another public breeding program and used by an edamame processing company and urban gardeners for evaluation. More than 400 soybean germplasm lines have been introduced and preliminarily screened for further use. New segregating/breeding materials have been developed for selection. Rapid evaluation of edamame quality was explored. Research results were published in many well-known journals and presented at professional meetings. It is expected that a few new superior lines will be released in coming years.

**What research is needed?** To meet the requirements of superior varieties, research will focus on the evaluation and selection of breeding lines for yield and quality of edamame and grain seeds; further purification and increasing of superior lines/varieties for release; and development of breeding populations integrated with high yield and high quality traits dual purposes. Post-harvest processing, storage and marketing of edamame/specialty soybeans are also needed.

**IMPACTS**

- Several new edamame lines developed by VSU are being used by another university in their soybean breeding program.
- Some growers exhibited interest in growing VSU Edamame lines after visiting the trials on Randolph Farm and several new edamame lines were introduced by an Edamame processing plant and urban gardeners for evaluation.
- Six research articles were published in referred journals of good reputation in the field/community.

**This project was supported by a USDA-NIFA Evans-Allen Grant and USDA-NIFA CBG Program.**
**Want to know more? Contact Dr. Guo-Liang Jiang, (804) 524-5953, gjiang@vsu.edu**

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# Production Potential of Flax (*Linum usitatissimum* L.) as an Alternative Grain and Fiber Crop for Producers in the Commonwealth of Virginia

**Who cares and why?** Flax (*Linum usitatissimum* L.), an ancient annual herbaceous crop from Europe introduced to North America by European colonial powers, does well under cool climates. It is produced mainly in the northern United States and Canada in rotation with warm season crops like corn and forage legumes. However, it has been planted as a winter crop in the southern states including South Carolina.

Recently, producer and industry interest in industrial hemp has led to its legalization and reclassification as a commodity crop. The legalization coupled with high producer interest and industry demand will stimulate proliferation, development and expansion of appropriate processing industries. Flax, like industrial hemp, is grown for its seed and fiber that are used in food and textile industries. Grains of both crops are rich in omega-3 fatty acids and are comparable in other food quality attributes. Flax fiber quality is better than that of cotton and industrial hemp and is a popular ingredient to improving the quality of low fiber material from other sources. Fiber and wool processing industries had to import flax fiber to meet their market demand. Availability of a locally produced fiber flax decreases the need for such imports and improve profit margins of fiber processing plants in the Commonwealth of Virginia, and nationally.

Flax oil is rich in alpha-linolenic acid (ALA), an omega-3 fatty acid important for brain development and human health. Linseed cake is a protein-rich and good animal supplemental feed used for beef, poultry, aquaculture and hog operations. Evaluating performances of flax in Virginia will give producers options to grow cotton, industrial hemp or flax to meet raw material demand for the appropriate processing industry. Similarly, introducing flax in the Commonwealth will contribute to strategic rotational cropping that will ensure a sustained supply of the raw material and lead to better soil nutrient utilizations, pathogen/pest cycle disruption and weed management.

**What has the project done so far:** The project, initiated in 2019, has evaluated several varieties for their growth and yield potential. All varieties evaluated showed good spring and fall growth with appreciable vegetative biomass and good reproductive growth (Figure 1). However, the extremely hot and dry weather in early summer 2019 significantly impacted the reproductive phase and grain fill. In spite of this, there were observed variety differences in vegetative growth and dry biomass yield. Also evaluated were winter survival potentials of selected varieties grown in the fall. Preliminary results show that flax can withstand cold temperature and continue growth in spring of the following year. Because of the mild snowfall in 2019, it is yet to be determined whether the crop can withstand severe and prolonged snowstorms.

Left: Flax at seedling phase; Top: late vegetative phase; Bottom: Reproductive phase

**What research is needed?** Over the last year, results showed that flax may be planted in spring and though seed fill for grain crops was problematic, flax for fiber may do just fine. More research is ongoing to determine the appropriate planting dates that may allow for proper development and fully filled seeds. Also, flax may be planted as a winter cover crop to be harvested the next spring. Preliminary results show that flax can withstand the mild winter weather of 2019-2020. However, because of the mild snowfall in 2019-2020, more work is needed to determine whether the crop can withstand severe and prolonged snowstorms.

**IMPACTS**

- Spring planted flax crop showed good vegetative growth, flowers and set seed. However, seed fill is negatively impacted by hot and dry summer weather.
- Preliminary results show winter-grown flax to withstand a mild winter and to set seed the following spring.

**This project was supported by USDA-NIFA Capacity Building Grant.**
**Want to know more? Contact Dr. Maru Kering, (804) 524-5955, mkering@vsu.edu**

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# What Does Not Kill Foodborne Pathogens Make Them Stronger!

**Who cares and why?** Accurate prediction of the thermal destruction rate of foodborne pathogens is important for food processors to ensure proper food safety. When bacteria are subjected to thermal stress during storage, sublethal stresses and/or thermal acclimation may lead to differences in their subsequent tolerance to thermal treatment.

**What has the project done so far?** This project has evaluated the thermal tolerance of the leading bacteria (*Escherichia coli O157:H7, Listeria monocytogenes*, *Salmonella enterica* and *Staphylococcus aureus*) accountable for the vast majority of foodborne illnesses, hospitalizations and deaths in the United States. In order to investigate thermal destruction variability in food- borne pathogens induced by thermal stresses during storage, each species of bacteria was incubated overnight at four different temperatures (15, 25, 35 and 45°C). Following incubation, the bacteria were subjected to thermal treatments at 55, 60 and 65°C. At the end of each treatment time, bacterial survival was determined for the thermal destruction time (D-value, min) and thermal destruction temperature (z-value, °C), respectively, for each bacterial species. Overall, *Salmonella* required the highest temperature increase to be destroyed at the same level as other bacterial species. Increasing patterns of D- and z-values in *Listeria* were obtained with the increment of incubation temperatures

| Incubation temperature (°C) | Thermal treatment (°C) | *D*-value | *z*-value |
|---|---|---|---|
| 15 | 55 | A 8.50±0.10 c | 5.29±0.21 b |
| | 60 | B 0.61±0.03 d | |
| | 65 | C 0.11±0.02 b | |
| 25 | 55 | A 10.94±0.61 b | 5.38±1.02 b |
| | 60 | B 1.18±0.08 b | |
| | 65 | C 0.17±0.11 b | |
| 35 | 55 | A 11.63± 0.23 ab | 7.10±0.20 a |
| | 60 | B 0.79±0.12 c | |
| | 65 | C 0.45±0.04 a | |
| 45 | 55 | A 12.39±0.54 a | 7.26±1.20 a |
| | 60 | B 1.84±0.10 a | |
| | 65 | C 0.67±0.26 a | |

from 15 to 45°C in sequential order (Table). *E. coli* generally demonstrated longer D-values and lower z-values indicating that the bacteria required longer time yet lower temperature increase to be destroyed.

Therefore, because its resilience to the increase in temperatures was the shortest, population reduction in *E. coli* associated with temperature increase alone may not be a representative indicator for the safety of food processing or their resistance during subsequent processing conditions. Findings from the present study confirm that the stress response of bacteria to temperature during bacterial enumeration affects the thermal tolerance of bacteria during subsequent thermal treatments. This affirms that bacterial adaptation to certain stresses may reduce the effectiveness of preservation hurdles applied during later stages of food processing and storage, not only enabling survival of bacteria under more severe conditions, but also enhancing their resistance during subsequent processing conditions.

**What research is needed?** Further research on the food matrix associated with a variety of food processing related stresses (i.e., acid, fat, protein, starch, sugar and water) as a bacterial growth and inactivation model in vitro and in situ is needed to validate current findings. Additional research on the influence of the growth temperature at the same physiological stage (i.e., lag, log and stationary phase) of cells on their sensitivity to sublethal stresses will also manifest the determination of adaptive responses in bacteria.

**IMPACTS**

- This study clearly demonstrated that storage and holding temperatures similar to those encountered in food service influence the ability of foodborne pathogens to survive subsequent thermal treatments.
- Our findings with further validation will assist the food industry with the establishment of critical limits for the safe thermal treatment of food products.

**This project was supported by USDA-NIFA Evans-Allen Funds.**
**Want to know more? Contact Dr. Chyer Kim, (804) 524-6715, ckim@vsu.edu**

VIRGINIA STATE College of Agriculture

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# The Toolbox Approach to Combat Foliar and Soil-borne Diseases on Chickpeas, Ginger and Other Specialty Crops

**Who cares and why?** Incidences of diseases, arthropod pests and weeds were challenging in 2020, due to erratic weather and the unprecedented Covid-19 global pandemic. In some instances, crops were stressed for lack of rain during the peak planting season in summer, which was followed by storms and uninterrupted rains that turned farms muddy. Diseases were on the rise on farms and gardens not only because of pathogens which thrive best in humid and wet weather, but also because of disorders from stress and inability to intervene or spray during these uninterrupted rains. The pandemic also exacerbated the situation, the same way it disrupted normalcy in many aspects of life. Amidst these challenges, VSU Specialty Crops Pathology put forth an extraordinary effort to continue three major research projects (a) integrated planting study and germplasm screening of chickpeas, (b) soil-borne disease management on ginger grown in a high tunnel and c) monitoring downy mildew on cucurbits from a Sentinel plot established at VSU's Randolph Farm. Faculty in the program also participated in a number of regional and national virtual educational events including field days, teaching managing garden diseases to Urban Ag certificate attendees, and working groups that focused on Integrated Pest Management (IPM) on hemp and pulse crops. Virtual workshop on "How to Keep Diseases at Bay" was part of the outreach in collaboration with the City of Hopewell.

**What has the project done so far?** On Chickpeas: Two preliminary outcomes included a continued better performance of early planting, early to intermediate maturity varieties and a denser spacing (1.5" between plants) of chickpeas. Chickpea pod borer was less frequent in 2020 but weeds, particularly broadleaf types, were the utmost challenge. On Cucurbits: a Sentinel plot was planted on July 1, cucurbit downy mildew disease was monitored on 5-7 days interval and growers were alerted after reporting the disease on the web-based map system (http:// cdm.ipmpipe.org/). On Ginger: Fusarium Yellows/Rhizome rot, Root Knot Nematodes and other yet to be identified pathogens continue to affect the seed rhizome and ginger plant at different stages.

Ascochyta blight on chickpea leaves and pod. Pod borer and saprophytic fungus also affects chickpea pods.

Seed rhizome and soil-borne diseases such as Fusarium Yellows, Rhizome rot (left) and Root Knot Nematode (right) detected on ginger in Virginia.

Cucumber downy mildew: symptoms on (left) and signs (right) on the lower side of the leaf.

**What research is needed?** In light of the research questions, monitoring, identification and quantification of existing and emerging specialty crops diseases will continue in 2021. More refined methodologies of the multi-factor field trials as well as greenhouse experiments will continue in 2021.

**IMPACTS**

- There was less prevalence of foliar and soil-borne diseases on chickpeas planted early in April and May. Ascochyta, Alternaria and Stemphylium continue to gravely impact chickpeas when planted late.
- Denser spacing of chickpea in 2020 resulted in better weed control and yield when compared to the wider spacing used in 2019. Weeds posed a surmounting challenge. A sound IPM package for a successful chickpea production should entail strategies to combat weeds and lepidopterous insect pests.

**These projects were supported by USDA-NIFA Evans-Allen Funds, 1890 Capacity Building Grant and USDA AMC Specialty Crops Multi-State Program. Want to know more? Contact Dr. Zelalem Mersha, (804) 524-2694, zmersha@vsu.edu**

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# Young Goat Kids Before and Around Weaning May Pose a Higher Risk of Harboring Pathogenic *Escherichia coli* than Mature Goats

**Who cares and why?** Losses attributed to sickness or death of young goat kids and lambs are among the challenges that affect the economic health of small ruminant production. Diarrhea in these young animals is a major contributor of ill-health, but the main microbes and factors that contribute to their vulnerability remain to be described. Goats are also kept as pets in many homes in the United States. They are also known as potential reservoirs of important public health pathogens, but the risk factors of transmitting these pathogens to humans

are not known. One of the most important bacteria that causes diarrhea in young small ruminants and may also cause diseases in humans is *E. coli.* Understanding the gut *E. coli* diversity in different age groups and growth periods may shed light on the factors that make young animals more susceptible to diarrhea by these bacteria. It may also reveal whether there are age groups that pose a higher risk in transmitting important strains to humans. This information is useful in designing management protocols and educational programs for small ruminant producers to reduce losses associated with infections and deaths in young animals. It also helps in educating the public on ways to protect themselves from pathogenic *E. coli* that may be associated with interacting with goats.

**What has the project done so far?** We have studied the gut *E. coli* diversity in goats beginning at three weeks of age until one year of age. We have characterized the genetic and virulence markers in these *E. coli* isolates. We have determined how frequent these markers are found in the different meat goat age groups and at different stages of growth. We have found that *E. coli* strains with genetic and pathogenic markers that indicate potential to cause diarrhea in animals are more common in apparently healthy young animals less than

three months. We also detected strains that are potentially pathogenic to humans exclusively in young goat kids around weaning.

The findings were presented to the scientific community in two conferences and one peer-reviewed paper was published. https://bmcvetres.biomedcentral.com/articles/10.1186/s12917-020-02479-0

**What research is needed?** Further molecular characterization and subtyping of the potentially pathogenic *E. coli* isolates are needed to determine other characteristics and virulence markers for causing disease in humans and animals. The research needs to be broaden to include sheep and goat flocks from diverse farms in Virginia.

**IMPACTS**

- Potentially pathogenic *E. coli* is common in the gut of apparently healthy young goat kids before weaning.
- Strains of *E. coli* that have markers indicative of pathogenic potential in humans were only detected in goat kids around weaning age.
- Ensuring young goat kids' immunity is optimal by ensuring colostrum intake. Avoiding stress may be one way of keeping check the pathogenic strains that are found in the gut of these animals.

**This project was supported by USDA-NIFA Evans-Allen Funds.**
**Want to know more? Contact Dr. Eunice Ndegwa, (804) 524-3264, endegwa@vsu.edu**

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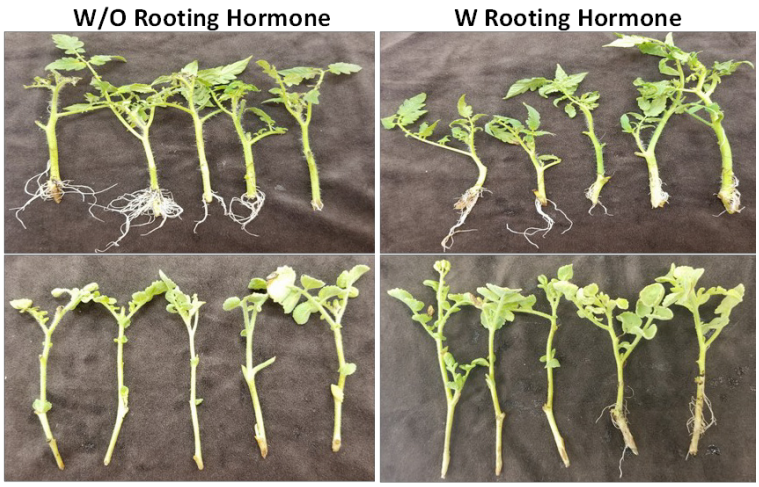
# Genetic and Genomic Approaches to Understanding Hormone-free Rooting Capacity of Stem Cuttings in Tomato

**Who cares and why?** Stem cuttings is one of the most commonly used plant propagation methods for woody and ornamental plants. For many ornamental shrubs, stem cuttings are, in general, easy to root; however for many tree species, rooting of stem cuttings is more challenging. Currently, rooting hormones are widely used to help root formation from stem cuttings in the horticultural industry, even though challenges still remain for many species. In addition, application of external plant hormones is not environmentally friendly and will pose health risks for those in direct contact with the hormone compounds and anyone else consuming the products contaminated through environmental pollution. Therefore, improving rooting ability from stem cuttings without external hormones will provide an economic and environmentally friendly strategy to mass propagate many woody and ornamental plants. Such technology could also be applied to hybrid vegetables for mass propagation to save both time and labor.



Top Row: Cherry Tomato. Bottom row: Wild Tomato

**What has the project done so far?** At Virginia State University, researchers found that the cherry tomato is very easy to form roots from stem cuttings, but wild tomato (*S. pennellii*) is unable to root at all, even with a 30-day water culture system. Researchers, therefore, systematically conducted experiments to characterize the genetic control of rooting from stem cuttings. Root formation of the cherry tomato is independent of plant hormone. Even without rooting hormones, all stem cuttings from cherry tomatoes formed roots within 7 days after cutting. However, the wild tomato is partially dependent on plant hormones for its root formation. Without external hormones, none of the stem cuttings formed roots, while about 30% of stem cuttings were able to initiate and develop root systems when rooting hormones were applied. During further studies using F1 and F2 generations from the cross of cherry tomato x *S. pennellii*, we found that an easy rooting phe-notype in cherry tomatoes is controlled by a dominant gene. Through next generation sequencing techniques, in combination with the pooled strategy in an F2 segregating population, we were able to pinpoint the corresponding gene onto ~4 MB region of Chromosome 3 or 2.5 MB region of chromosome 10. Further functional analysis within the regions leads us to identify only three interesting candidate genes that warrant further investigation.

**What research is needed?** With the results obtained, we are excited to examine the expression of all candidate genes and compare them between cherry tomatoes and *S. pennellii*. We will also clone all three genes from the cherry tomato and overexpress them in *S. pennellii* to check if the overexpression can override the *S. pennellii* phenotype and make it root more easily. Once the corresponding gene is confirmed, we will be able to apply it to other species to help facilitate the rooting process from stem cuttings.

**IMPACTS**

- Discover new knowledge on rooting capacity from stem cuttings and identify the gene corresponding to the rooting phenotype.
- Develop a new strategy for environmentally friendly mass propagation of many woody and ornamental species.

**This project was supported by USDA-NIFA Evans-Allen Funds.**
**Want to know more? Contact Dr. Shuxin Ren, (804) 524-3094, sren@vsu.edu**

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# Supporting Southside Virginia Horticulture

Picture from the handing over ceremony

**Who cares and why?** Parts of Southside Virginia that once relied on tobacco production as a cash crop before the quota buyout of 2004 are still struggling to identify an alternative crop. Small, limited-resource farmers who lack the acreage and resources to grow corn and soybean for the grain market face the biggest challenge.

**What has the project done so far?** Virginia State University with support from the Virginia Tobacco Region Revitalization Commission (TRRC) has been working to develop green bean agribusiness as an alternative to tobacco in affected counties. The project that has been active for more than six years came to a conclusion in 2020 with the handing over of equipment worth more than $250,000 to the Southside Virginia Fruit and Vegetable Producers Association (SVFVPA).

Among other units, the equipment included two ASA-Lift GB1000 harvesters with proven versatility in recovering different green beans, including lima beans, butter beans, string beans and edamame.


THE Southside Messeng
THE AREA'S ONLY LOCALLY OWNED & OPERATED NEWSPAPER
HOME CHARLOTTE COUNTY COLUMNISTS COMMUNITY EDUCATION/SCHOOLS FEATURES HEADLINE
LOCAL NEWS LUNENBURG COUNTY OBITUARIES OPINION OTHER NEWS POLICE & FIRE
PRINCE EDWARD COUNTY SPORTS THE WORD TOP STORY
Top News
Keysville Meth Dealer Faces Prison in Lunenburg and Charlotte
Charlotte County's Joe Reed Invited to NFL Combine
Lunenburg Man Dies in Madison County Car Crash
SVFVPA Receives Equipment From Virginia State University
Local News
Does Southern VA Need More Coworking and Makerspace?
Southside Virginia Herb Society Offers $700 Scholarship to Local High School Seniors

Media coverage of the event

**What research is needed?** More work is needed to support postharvest and marketing logistics to ensure that members of the association can deliver high quality and fresh products to the consumer. The organization also needs help with publicity to recruit more growers from Southside counties.

**IMPACTS**

- VSU facilitated the transfer of equipment worth more than $250,000 to a Southside, Virginia farmers' association.
- This represents significant investment in an association whose membership comprises mostly small, limited resource and socially disadvantaged farmers.

**This project was supported by the Virginia Tobacco Region Revitalization Commission (TRRC).**
**Want to know more? Contact Dr. Laban Rutto: (804) 524-6781, lrutto@vsu.edu**

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# Specialty Crops for Reducing Chronic Diseases in Virginia: Ginger, Turmeric, Berries and Papaya

**Who cares and why?** Chronic diseases, such as obesity, cancer, diabetes and cardiovascular disease, are prevalent in society. Obesity is one of the leading contributory factors in developing chronic diseases including cancer, cardiovascular diseases and diabetes. In Virginia, the obesity rate in adults is 30.1%, according to the 2018 State of Obesity: Better Policies for a Healthier America report. In Virginia, cancer is the leading cause of death, followed by cardiovascular disease. About 5.9% of Virginians are living with a variety of cardiovascular diseases, while 9.6% Virginians (nearly 1 in every 10) are living with diabetes, which is the 7th leading cause of death in the state. While those numbers are disconcerting, more awareness of how consuming foods that help prevent and treat chronic diseases, particularly obesity, is helping to educate consumers about the health benefits gained from ginger, turmeric, plums and papayas. Modern science has discovered that most food contains effective disease preventive biomolecules that can improve our health and reduce our risk for many diseases including obesity, diabetes, cardiovascular diseases, cancer, poor bone health and neurological diseases.

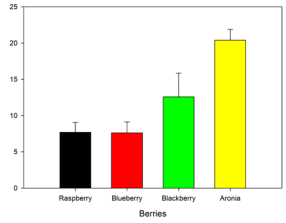
The Nutrition Science and Food Chemistry laboratory at Virginia State University is actively involved in investigating beneficial effects of fruits and vegetables for preventing and/or treating chronic diseases. The purpose of this program is to introduce new profitable crops in Virginia for promoting agriculture-based business development and human health and nutrition, providing incentives for farmers to grow these crops in Virginia.

**What has the project done so far?**

1. Berries are packed with antioxidation activity. Aronia berries grown at VSU's Randolph Farm are superior in phenolic contents and can potentially be a good anti-inflammatory fruit.

Blackberries, Blueberries. Aronia Berries, Raspberries

2. Baby ginger (*Zingiber officinale*) contains high levels of phenolic com-pounds and superior antioxidation activity than mature ginger and the extract from ginger effectively reduces lipid deposits in adipocytes (fat cells).
3. The phenolic compounds in turmeric (*Curcuma longa*) has strong anti-inflammatory activity and anticancer activity for breast cancer.
4. Papaya (*Carica papaya*) pulp increased glucose uptake in liver cells and can be beneficial to reduce blood glucose levels. In addition, papaya seeds possess wound healing activity and has a potential to be used for treating diabetic wounds, a complication that is common in diabetes patients.




Aronia berries are high in polyphenols

**What research is needed?**

Further research is needed to evaluate effects of berries in reducing chronic inflammation, such as atherosclerosis. Research is needed to test different varieties of ginger (white, yellow, pink and blue ginger) for their potential health benefits against obesity.

**IMPACTS**

- The Small Farm Outreach Program (SFOP) at VSU and the Virginia Cooperative Extension (VCE) at VSU conducted statewide workshops in 2019 on ginger, turmeric and berry production, which were attended nearly 100 interested growers/individuals.
- In 2019, Virginia consumers had access to locally grown ginger and turmeric substituted for imported ginger and turmeric from other countries. Virginia growers at local markets sold a total of 3,000 pounds of ginger and 2,000 pounds of turmeric with a total value of $55,000. Consuming baby ginger will impact reduction in the incidences of obesity.
- Efforts led by SFOP and VCE are expected to generate 10,000-15,000 pounds of blackberries and 5,000-7,000 pounds of blueberries per acre of land. The increase consumption of berries will help reduce pro-inflammatory conditions in affected populations to prevent chronic diseases.

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# Producing Clean Turmeric Plants

**Who cares and why?** Growers need access to clean plant material to produce healthy crops. Although producing clean plant material seems simple, it creates a lot of challenges for nurseries, especially for vegetatively propagated plants. Most fruits and many vegetables are propagated vegetatively. It means no true seeds are produced and a piece of plant (i.e. stem, root) is used to produce a new plant. This method of propagation transfers diseases from one generation to the next generation.

Conventional methods of plant propagation are not able to remove the pathogens from plants and the diseases keep piling up in the next generation, threatening the crop, the grower's income and food production and supply. Growers use extensive amounts of pesticides to control disease, which eventually may end up in our ecosystem and pollute the soil, water and air.

Nurseries use tissue culture techniques to remove the pathogen and clean the plant material. Tissue culture is also used in research to study the structure and function of cells. However, this method is very expensive and requires access to a laboratory, technical skills and infrastructures. Small, limited-resource producers do not have access to these infrastructures.

**What has the project done so far?** Researchers at Virginia State University have developed tissue culture techniques to study cell structure and function. These techniques have been used to also produce clean plant material of turmeric. The turmeric plant material can be used to create a nursery and produce ginger seed-rhizomes for growers to use as starting material for a new turmeric plantation. Virginia growers plant turmeric inside high tunnels and sell it as immature (baby) turmeric.

**What research is needed?** The tissue cultured turmeric needs to be sent to a plant pathology lab for testing to be certified as clean plant material. The tissue culture methods need to be optimized for maximum efficiency. The methods to adapt the tissue culture plants to outdoor environments need to be developed. Nurseries that have the infrastructure to adapt the plants to outdoor environments need to be identified.

Tissue culture turmeric plants produced at VSU. Tissue culture plants need to be acclimatized to outdoor environments.

Since the research is new and ongoing, it is difficult to quantify the impact at this point in time. So far, research has indicated the importance of the development of clean plant material for the establishment of a new plantation. The techniques to produce turmeric tissue culture plants have been developed. However, more research is needed to optimize the tissue culture and plant adaptation techniques.

**IMPACTS**

- Research findings indicate the importance of clean plant material to establish a new fruit or vegetable plantation.
- Tissue culture techniques can be used to produce clean plant material.
- Tissue cultured plants need to be tested and certified to be free of diseases and be adapted to outdoor environments.

**This project was supported by the USDA-Evans Allen Formula Fund-2018-2021.**
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# Flexible Grain Crop-Free-Range Poultry Production Systems

**Who cares and why?** Integrated crop livestock production systems ensure profitability of healthy farming and environmental sustainability. Increasingly, consumers within and beyond North America are demanding high-value agricultural products that are more naturally and/or humanely produced. Pasture-raised poultry meat and eggs match such consumer preferences and have aroused interest in sustainable range poultry production. Limited-resource farmers in Virginia consider free range/pastured poultry production a potentially exciting investment with many benefits. However, information on strategic fertility management and control of disease pathogens is not readily available. Having grain crop fields stocked with free-range chickens in alternate years may be less challenging.

Setting for shallow planting

**What has the project done so far?** At Virginia State University, the performance of free-range chicken, teff yield and quality, soil fertility and buildup of disease pathogens are being assessed in an integrated system. Data from teff fields with continuous presence of chickens for consecutive versus alternate years will be compared. The birds have free-choice fresh drinking water and commercial layers' feed with free foraging time from noon to dusk. As needed, laying nests are cleaned onto the field and soiled beddings replaced. To prevent manure buildup, coops are moved around weekly and their daily temperatures recorded.

Small scale threshing of sun-dried teff in the field

Birds foraging on teff crop residues in a teff field

**What research is needed?** Data collected will be analyzed for information on grain yield and quality. Birds performance will be assessed based on egg productivity, quality and any contamination with microbial pathogens. Information on factors influencing year-round foraging behavior and predator incidences is of interest. Likewise, effects of including strips of tall-growing plants in teff fields for shade and cover from aerial predators also need attention.

**IMPACTS**

- Research students witnessed foraging behavior of free-range chickens in a crop field.
- Stakeholders of integrated crop-livestock production witnessed affordable practices in place.
- A demonstration trial for alternative fertility management approaches to free-range poultry was established.

**This project was supported by the USDA-NIFA, 1890 Capacity Building Grants Program and the VA Agricultural Council.**
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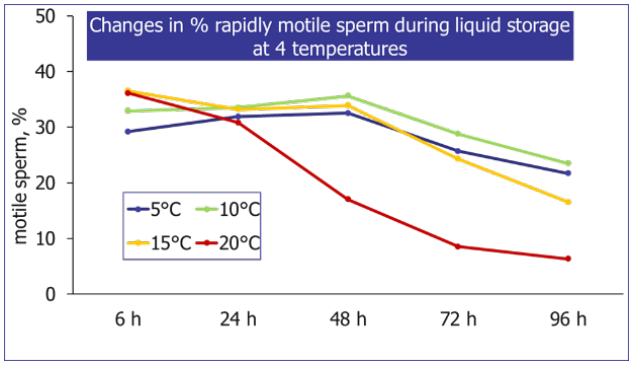
# Liquid Storage of Ram Semen: Re-evaluating Accepted Practices

**Who cares and why?** To achieve acceptable pregnancy rates using frozen-thawed semen in sheep, laparoscopic insemination is needed to deposit semen directly into the uterus. This procedure is costly and requires considerable technical expertise, resulting in artificial insemination not being as widespread in sheep as in other species. In recent years, emphasis has been placed on the use of short-term, liquid-stored semen in many sheep producing countries. Liquid-stored semen can be used in vaginal and intracervical artificial insemination with reasonable success rates, and has application in low-input, small farm settings. The parameters for processing and storing liquid semen need to be evaluated for different breeds and environments to develop standard protocols.

**What has the project done so far?** Two experiments were conducted evaluating (1) the effect of egg yolk inclusion levels in a simple skim milk extender and (2) the temperature best suited for liquid storage of ram semen. For both experiments semen was collected from six mature Barbados Blackbelly and St. Croix landrace hair sheep rams during the breeding season. Samples were pooled across all rams (Exp. 1) or by ram (Exp. 2). In Exp. 1 semen was extended to 250 million sperm/ml in UHT skim milk with egg yolk inclusion at 0, 5, 10, 15, 20 and 25% (v/v) and then stored at 5°C for 96 hours. Samples were removed from storage at 0, 6, 24, 48, 72 and 96 hours, and analyzed for motion characteristics with a computer assisted sperm analyzer. Total and progressive motility decreased at 0 and 25% egg yolk after 48 hours, while 15% egg yolk was the optimal inclusion level using motility as an indicator of semen quality. Exp. 2 followed a similar protocol, but compared storage temperatures of 5, 10, 15 and 20°C in skim milk/egg yolk extended semen. Retention of total and progressive motility was similar between 5 and 10°C storage, and higher then at 15 and 20°C storage, making them both viable options for liquid storage.




**What research is needed?** Future research will need to look at the effect of liquid semen cooling rate to storage temperature on semen quality characteristics. Furthermore, the indication that a storage temperature of 10°C is similar to that of refrigerated storage (5°C) suggests that commercially available shipping containers for industries with established liquid semen artificial insemination protocols (horse and swine) should be evaluated.

**IMPACTS**

- Egg yolk at 15% should be considered an optimal inclusion level for chilled storage of ram semen when using motility as an indicator of semen quality.
- Good retention of total and progressive motility was observed at both 5 and 10°C storage temperatures making 10°C a viable alternative to 5°C.

**These projects were supported by USDA-NIFA Evans-Allen Funds.**
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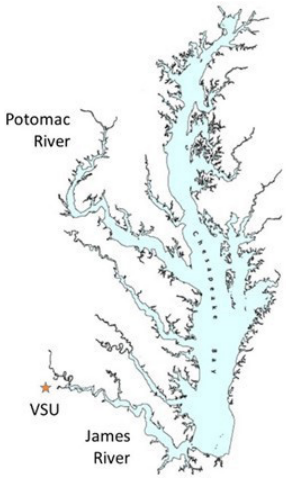
# Physicochemical Attributes and Muscle Protein Quality of Blue Catfish (*Ictalurus furcatus*) in Chesapeake Bay

**Who cares and why?** Blue catfish (*Ictalurus furcatus*), the largest catfish in the United States, was introduced into Virginia tributaries of the Chesapeake Bay in the 1970s and 1980s to establish a trophy sport fishery. Be-cause of high fecundity and few natural predators, their population dramatically increased and dominates several Chesapeake waterways. Blue catfish reportedly account for at least 75% of all fish biomass in the tidal James and Rappahannock Rivers. For these reasons, the species is now considered invasive. Substantial effort was made to study the blue catfish and understand its impacts in the Chesapeake Bay ultimately to develop a plan to manage them. Efforts were made to increase consumer awareness and consumption. The development of value-added uses for blue catfish meat beyond fillet might be a potential direction to increase their utilization and requires knowledge of the physicochemical and functional characteristics of the fish. Therefore, characterization is a necessary initial step for potential value-added food product development applications.





**What has the project done so far?** Researchers have conducted studies to investigate physicochemical attributes of the Chesapeake Bay's blue catfish and quality of muscle protein isolates as influenced by storage conditions and extraction methods. Fresh blue catfish (within 24 h post-capture) were obtained seasonally over a two-year period in June (summer), September (autumn), December or January (winter) and April (spring) of 2016 to 2018. Physical properties of whole fish and fillet (length, weight, fillet yield and firmness) and physicochemical properties of fillet (fillet pH, proximate composition and mineral composition) were characterized. Furthermore, protein was isolated from fresh and frozen fillets using either water or salt extraction. The isolated protein was characterized as extraction yield, color, water holding capacity and secondary structure. All fish were within the maximum consumable size limit. Those obtained during the autumn/winter and in Year 2 were larger with firmer fillet than their counterparts obtained during the spring/summer and in Year 1. Protein was the predominant nutrient component. Protein extraction yield ranged from 35.3 ± 1.4% to 47.0 ± 5.1 %, and β- sheet was the predominant secondary structure for all fish protein isolates. Salt-extracted protein isolates were whiter and had higher water holding capacity at neutral and alkali environments. The results of this study support the use of Chesapeake Bay blue catfish and muscle protein for potential value-added application.

**What research is needed?** More research is needed in the areas of blue catfish quality, including fatty acid and amino acid compositions and protein functional properties.

**IMPACTS**

- The study helped local fishery management understand quality and characteristic of blue catfish in the Chesapeake Bay.
- The study provided useful information on physicochemical attributes and muscle protein quality of Chesapeake Bay blue catfish for potential value-added opportunities, such as surimi and surimi-based products, protein concentrates and hydrolysates.

**This project was supported by USDA-NIFA Evans-Allen Funds.**
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# Potentials of Bio Recycling of Agricultural Waste to Value Added Products

**Who cares and why?** The rapidly growing global population and expansion in the agriculture sector and food industries have resulted in the generation of a large amount of agro-industrial waste annually. Almost 400 million metric tons (Tg) of dry crop residues biomass is produced annually in the United States by the 15 major crop plants. There is a need for a new biological recycling strategy with oyster mushrooms (edible fungus) to increase resource and efficiency while maintaining ecological sustainability. Biological treatment of this bio resource/substrate low in dietary protein and high in indigestible fiber can recycle agricultural waste into mushroom, a highly nutritious, functional food with medicinal uses, and the spent mushroom into feed and organic fertilizer.

**What has the project done so far?** At Virginia State University's Agricultural Research Station, researchers are

evaluating biological recycling of several crop residues with edible mushroom to value added end products. *Pleurotus ostreatus*, an edible white rot fungi (mushroom) has been cultivated on crop residues abundantly produced in the area such as corn stover and vegetable straw. Researchers are looking into the potential of the residues on the yield, biological efficiency and physiochemical properties of the mushroom, the effects of the mushroom growing on the residue used as substrate and the spent mushroom recovered.

**What research is needed?** Further studies are needed to explore important roles biological treatment of crop residues play in the potential of biological recycling of agricultural waste to value-added end products. The research needs to be expanded to include other abundantly produced agricultural wastes, including agro industrial by-products. Further investigation is also needed on the potential of using other beneficial microbes, fungi and bacteria on important parameters, such as:

- Biological efficiency of mushroom
- Physiochemical properties of the mushroom, substrate (crop residue) and the spent mushroom
- In vitro and in vivo assessment of nutritional quality
- Potential of mushroom as a nematicide against the economically important gastro intestinal nematode parasite, the Barber Pole Worm, in small ruminant health
- Potential of spent mushroom in soil health as organic fertilizer in the cultivation of leafy vegetables

**IMPACTS**

- Research findings will facilitate and enable the recycling of agricultural wastes into value-added products, such as high protein functional food (mushroom) and the spent mushroom substrate to feed for ruminant livestock and fertilizer in organic farming.

**This project was supported by USDA-NIFA Evans-Allen Funds.**

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