Virginia Polytechnic Institute and State University – Eastern Shore AREC, *Steve Rideout*

Protecting Virginia Broccoli and other Brassicas from Alternaria Diseases

Broccoli and other brassicas are important vegetable crops in Virginia. Virginia produces over $12 million US in broccoli, and the crop is steadily gaining popularity. One of the most impactful diseases plaguing broccoli production is Alternaria head rot, caused by the fungus, *Alternaria brassicicola*. This disease can cause significant losses, with one Virginia broccoli grower suffering nearly 50% losses as a result of the disease over the past two seasons. Damage in other cruciferous crops such as cauliflower, cabbage, and greens have been impacted in similar fashion. Researchers at Virginia Tech's Eastern Shore Agricultural Research and Extension Center (ESAREC) in Painter will conduct research objectives to better understand why Alternaria diseases are on the increase in brassicas. To accomplish these goals, we will network with growers to collect symptomatic samples from broccoli fields and other brassicas in the 2017 and 2018 growing seasons. Samples will be assessed for sensitivity to commonly used fungicides. Replicated field trials will also be conducted to assess fungicide efficacy in field settings. Results from this study will be used to develop practical and effective management strategies for this disease, improve grower productivity and profitability, improve IPM education and outreach techniques. In addition, researchers will examine the possibility of human pathogen survival on broccoli and other brassicas to determine risk potential and possible mitigation steps. This research will ensure the sustainability and growth of broccoli and other brassica crops in Virginia.

Virginia Polytechnic Institute and State University – Eastern Shore AREC, *Mark S. Reiter*

Sulfur Fertility Rates for Virginia Vegetables to Enhance Yields and Increase Fertilizer Use Efficiency

Vegetable crops are an important part of the Virginian farming economy. Fresh market tomato (2,367 acres), broccoli (843 acres), and sweet corn (3,000 acres) are grown across the Commonwealth and are valued in excess of $46 million per year (3-year averages, USDA-National Agricultural Statistics Service). The majority of fresh market vegetables are produced on coastal plain soils where sulfur deficiencies are known to occur. Coastal Plain soils are now commonly deficient in sulfur because they are low in organic matter, a major source of sulfur to plants, and sulfates leach readily in these soils. Environmental sulfur additions are also decreasing due to air emission standards implemented with the Clean Air Act, and the east coast USA typically has nearly 90% less sulfur depositions than 30-years ago. Therefore, farmers are now only receiving approximately 10% of their sulfur needs from rain and need to now add sulfur-containing fertilizers to their crops. Additionally, 90% of fresh market tomato roots, as with many vegetable crops, are found within 10-inches of the soil surface. A small root zone means that these vegetable crops' roots do not penetrate to the depths of "banked" subsoil sulfur and are commonly deficient if no additional sulfur fertilizer is applied. To make matters worse, the nitrogen:sulfur (N:S) ratio in a plant needs to be 15:1. Many farmers think their yellow plants are nitrogen deficient and add more nitrogen fertilizer. However, sulfur deficiencies closely mimic nitrogen yellowing and are actually making their problem worse since additional nitrogen fertilizer makes the N:S ratio even worse. Virginia Cooperative Extension needs data to support

sulfur fertilizer recommendations for fresh market tomato, broccoli, and sweet corn in Virginia. Based on preliminary research, we estimate that we can increase tomato, sweet corn, and broccoli yields by 14% using adequate sulfur fertility, which equates to a $773,600 yearly value increase for these three crops in Virginia.

Appalachian Sustainable Development – Abingdon, VA, *Kathlyn Terry*

Making Food Safety Certification and FSMA Compliance Attainable for Virginia Farmers
Appalachian Sustainable Development (ASD) and its partners VA Cooperative Extension and AgCon will enhance the competitiveness of fresh fruits and vegetables by providing training and one-on-one technical assistance to specialty crop farmers across Virginia in support of obtaining the food safety certification they require to access scale appropriate markets. 200 produce farmers will be prepared to obtain USDA GAP and Harmonized GAP with Global Addendum certification and will be prepared for Global GAP should the markets make such a change necessary. Additionally, ASD will work with its partners to enhance and incorporate FDA's Food Safety Modernization Act Produce Safety Rule requirements, including providing FSMA training by qualified Lead Trainers, establishing clear interpretations for which farmers will need to comply with these rules and when, and developing and delivering appropriate recordkeeping processes and tools. 80 farmers will receive USDA GAP, Harmonized, Harmonized with the Global Addendum, Primus or other food safety certification.

Virginia Polytechnic Institute and State University – Eastern Shore AREC, *Laura Strawn*

Risk of Pathogen Infiltration in Specialty Crops During Submersion in Water: Establishing FSMA Safe Harbors
Virginia Tech will reduce foodborne pathogen contamination in specialty crops by evaluating the risk of pathogen infiltration into susceptible commodities during submersion in water. These findings will directly support the Virginia specialty crop industries including apple, peach, cucumber, cantaloupe, and tomato in compliance with the Food Safety Modernization Act's Produce Safety Rule (PSR) and implementation of feasible science-based interventions to prevent contamination events during postharvest handling activities. Results will be communicated to stakeholders through Produce Safety Alliance Grower Trainings (which are held throughout Virginia; currently the only FDA-approved course for training requirements) and extension forums including Virginia's Annual Tree Fruit School, grower association meetings, and Virginia Cooperative Extension fact-sheets. Pathogens may infiltrate into the fruit core and inner tissues when warm fruit from the field are submerged into colder water. Therefore, the proposed project aims to evaluate the risk of *Salmonella* and *Listeria monocytogenes* infiltration into susceptible specialty crops with ambient (21°C) and refrigeration (4°C) core temperatures submerged into water at various temperature differentials, simulating common postharvest practices. Historically, to prevent pathogen infiltration into fruit during submersion in water, it was recommended that operations achieve a ≤10°C temperature differential between fruit pulp and postharvest water. However, recent data showed that decreasing submersion time in water was more effective at reducing pathogen infiltration than reducing temperature differential. Currently, several specialty crops are submerged in water

during postharvest handling (to increase quality and visual aesthetics), thus this proposed research has important food safety implications, as well as safe harbors for PSR compliance.

Institute for Advanced Learning and Research – Danville, VA, *Chuansheng Mei*

Disease Inhibition in Strawberry Using Biological Controls

The Institute for Advanced Learning and Research (IALR), in partnership with Virginia Cooperative Extension (VCE), industry leaders, and growers, will seek to improve Virginia strawberry production and sustainability by utilizing biological control methods to reduce disease pressure associated with strawberry production. In the past and prior to 2005, strawberry growers relied heavily on methyl bromide (MB) to control such soil borne diseases. As MB is now banned, and the use of 1,3-dichloropropene (1,3-D), a potential replacement, is limited in the Mid-Atlantic due to high water tables, proximities to sensitive areas, and human health concerns, viable alternatives to soil fumigants are needed to sustain future strawberry production and to keep this specialty crop strong statewide. To address this issue, this proposed 2-year research project will utilize various biological based approaches to reduce disease occurrence and impact in the field. Together, this team of experts will test promising treatments in greenhouse experiments first, to determine disease inhibition capabilities. Next, in partnership with commercial strawberry suppliers, strawberry plantlets will be introduced to promising treatments before transplanting to the field. The final stage will be to work with 4-5 farmers to observe plant growth performance and disease incidence under field studies. VCE will oversee field trials and field data interpretation. Outcomes are focused on increasing strawberry health and productivity naturally, compared to controls.

Virginia Polytechnic Institute and State University – Eastern Shore AREC, *Ramón A. Arancibia*

Improving Potato Quality with Calcium: Role in Bruising and Internal Disorders

Considering that potato is one of the three main vegetable crops in Virginia with over 4,700 acres and more than $18 million crop value (U.S. Department of Agriculture, 2017), improving tuber quality by reducing losses to IHN and bruising will enhance the competitiveness of the crop with a significant impact to the industry in Virginia. Internal heat necrosis (IHN) and bruising or skinning are among the limiting factors to quality potato (*Solanum tuberosum* L.) production and cause considerable economic losses to growers in Virginia. High temperature prior to harvest is conducive to IHN, which results in browning of the tuber tissue. Similarly, bruising is a key concern during harvest that results in unattractive scars and blackspot in table-stock potato, and the wounds are a venue to disease infections. Calcium content in the tuber tissue has been associated with a reduction in the incidence of IHN and bruising in potato. However, translocation of calcium into the tuber is difficult, so tuber calcium content is usually insufficient to ameliorate quality problems. Therefore, this project will investigate and develop a calcium application program (calcium sources, placement and timing of applications) to improve tuber content and reduce the incidence and severity of IHN and bruising. The generated information is expected to help farmers to reduce the losses to IHN and bruising in Virginia and improve the sustainability of the industry.

Old Dominion Research Foundation – Norfolk, VA, *Lisa Horth*

Assessing Pathogenic Disease in Bees and Flowers on Strawberry Farms in Virginia
ODU Research Foundation (through Dr. Horth's laboratory in the Biology Department at ODU) will test honeybees from strawberry farms in VA for three bee diseases (*Nosema apis*, *N. ceranae* and sac brood virus). Honeybee colonies have been collapsing in VA and disease is associated with collapse. Which diseases, and how, is poorly understood. We have added mason bees to berry farms to improve crop yield. Mason bees will also be tested for disease too. We can compare disease load for the bee species, which is important information for future using mason bees on farms if they transmit disease to honeybees. If mason bees have lower rates of disease or are disease free, this is important information with respect to continued use on farms since honeybees are dying in record numbers (44% of hives collapsed in 2016, increased from prior years). Here, we will test for three devastating bee diseases in two bee species to evaluate the health of bees on specialty crop farms in VA. The three diseases are all associated with debilitating impact on honeybees. They are: 1) *Nosema cerana*, 2) *Nosema apis* and 3) Sacbrood virus. Disease positive bees (100) will also be screened for genetic variants of *N. ceranae* since some variants are more likely to cause harm than others. Pollen from 100 berry flowers will also be tested for disease. Results will prove informative for honeybee health, the potential for transmission across crops, and for decisions regarding future use of mason bees on farms.

Virginia Polytechnic Institute & State University – Blacksburg, VA, *Mark A. Williams*

Alternative Fertilizer Recommendations that Support Helper Soil Microbial Communities in High-Density Apple Orchards
The Virginia Tech University will determine how soil applied organic fertilizers derived from multiple organic waste streams support the development of beneficial plant growth promoting microorganisms in three representative apple orchard ecosystems relevant to Virginia stakeholders. Profits and competitiveness of these orchards depend on high biomass accumulation, sustainable fruit quality, and fruit yield. In addition, the first 3-5 years of establishment are critical for the orchard for subsequent years. During this period high rates of high cost and environmentally mobile synthetic fertilizers are applied. There is thus a need to reduce monetary costs, increase plant yield, support longer-term orchard health, and support environmentally friendly management practices of orchards systems.

Based on the latest Agricultural and Research Extension Center survey, this research is supported by tree fruit farmers. Stakeholders understood that best agricultural practices related to orchard management and profitability were driven by robust research and science. The survey also indicated strong support for conservation practices that sustain the environment. The research is thus supported by the orchard industry because of its potential to sustainably increase efficiency, profitability, product competitiveness, orchard health, and environmental stewardship across the state**.**

The broad goal and outcomes of the research is to develop sustainable best management practices in support of grower economics, healthy soils, plant-microbial interactions, and lower environmental costs to society. The main task of the proposal will thus focus on describing the plant-microbial interactions in soil with different alternative organic and synthetic fertilizer practices, and to communicate these findings to stakeholders.

Virginia Polytechnic Institute & State University – Winchester, VA, *Christopher Bergh*

Releasing Trissolcus Japonicus to Promote Biological Control of Brown Marmorated Stink Bug in Virginia

Virginia Tech will raise and release a parasite of brown marmorated stink bug eggs to promote and enhance biological control of this invasive stink bug in Virginia. Initial outcomes expected are the broad establishment of this biological control agent in Virginia, followed longer term by measureable impacts on brown marmorated stink bug populations. This parasite, Trissolcus japonicus, was detected in northern Virginia 2015 and 2016, in several other Mid-Atlantic States between 2014 and 2016, and its redistribution in Virginia has been approved by the Virginia Department of Agriculture and Consumer Services. T. japonicus will be reared in the laboratory and released at multiple locations in Virginia known to have high brown marmorated stink bug populations, including tree fruit and soybean production regions. Post-release monitoring of its establishment at the release sites will be conducted.

The ApiSolutions Consortium – Gainesville, VA, *George H. Wilson III*

Enhancing Quality and Marketing of Honey & Products of the Hive

The ApiSolutions Consortium will provide training, education and other supportive resources to Virginia beekeeper honey farmers in order to improve their knowledge, skills and abilities in techniques for the production, processing, packaging, and marketing of honey as a high quality, profitable and valuable specialty crop safe from pathogens or adulteration. The project also seeks to increase the number of new beekeeper honey farmers going into specialty crop production in Virginia. The major tasks include 1) a series of hands on educational workshops held throughout the State; 2) a multi session specialty educational tract focused on Excellence in Honey and Hive Product preparation at the Eastern Apicultural Society's annual summer conference hosted in Hampton, Virginia in 2018; 3) the development of a website with educational and other resources, and 4) the production of an educational brochure on preparation and marketing of honey and other value added hive products available to honey farmers and other programs of the Virginia Department of Agriculture such as the Food Safety and Security. The project will be self-sustaining by utilizing a knowledge transfer/train-the-trainer approach.