PENNSYLVANIA VEGETABLE MARKETING & RESEARCH PROGRAM

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PA Vegetable Research Grant Pre-Proposals for 2024

A Joint Effort of the PA Vegetable Marketing and Research Program and the PA Vegetable Growers Association

As of November 1, 2023

Board and Committee members are asked to rate the following pre-proposals using the following system:

A – very interested in funding and in receiving a full proposal for final consideration
B – potentially interested in funding – would appreciate a full proposal for final consideration
C – very little or no interest in funding

__ 1. Do Micronutrient Fertilizers Help Reduce Herbicide Injury and Improve Weed Control?

Dwight Lingenfelter and John Wallace, Penn State Department of Plant Science

As herbicide-resistant weeds continue to develop and spread, farmers struggle to find effective herbicides that maintain a high level of crop safety. Often times farmers need to use herbicides at higher rates to achieve good weed control, while sacrificing crop safety. In recent years, companies have advertised nutritional or microbial products that can be added to postemergence herbicides that might improve crop safety and enhance weed control. These types of products can be used for both the agronomic and horticultural crops. Local extension personnel have been asked about them but there is no local data for these types of products. Unfortunately, there is limited university data evaluating these products and thus little we can say to help make informed decisions.

To evaluate the utility of these types of products, we propose to experiment with snap bean herbicide mixtures that represent a range of herbicides. These herbicides will be applied with and without nutritional additives. We propose to use Basagran (Group 6) + Reflex (Group 14) and Raptor (Group 2) with and without micronutrient products to determine their impact on weed control, crop injury, and yield. A few products are listed below, but we will include three to four products and the final selection will be based on further discussion with snap bean farmers and other consultants. The study will be conducted at the Penn State research farm in Centre County, Benefits to state and regional snap bean growers will include updated information in vegetable production guides and other educational resources on benefits of micronutrient additives to herbicides for weed control and crop safety.

A few examples include:
Phosfix (https://andersonsplantnutrient.com/agriculture/market-feed/303);
StomaBoost Supreme (https://www.schaeffercrops.com/stomaboost-supreme.html)
Anova (https://www.innvictis.com/wp-content/uploads/2023/06/2023_Anova5-0-0_SalesSheet-1.pdf)
$1,500

__ 2. Breeding fresh-market tomatoes for production in PA

Majid R. Foolad, Department of Plant Science, The Pennsylvania State University

Objective: To develop breeding lines and F_1 hybrid cultivars of fresh-market (FM) tomato with disease resistance and other desirable characteristics suitable for production in PA.

Summary: We have developed elite fresh-market (FM) tomato breeding lines, including large-size (slicer), plum, cherry, and grape tomatoes, with strong resistance to foliar diseases, including early blight (EB) and late blight (LB), and general resistance to other tomato diseases, including Septoria leaf spots

and bacterial canker (BCk: we have established a comprehensive project on BCk resistance; PhD thesis of Jonathan Bonfiglio). Our inbred lines also exhibit other desirable characteristics, including high yield, early maturity, superior fruit quality, and adaptation to PA conditions. Most of our inbred lines are elite and ready to be used as parents for developing F_1 hybrids for commercial evaluation. During the past several years we developed a large number of FM tomato F_1 hybrids, which were evaluated at Penn State Research Farms, and also trialed by several national/international seed companies, PA tomato growers, and PSU Extension Educators. For example, in 2023, we trialed 87 elite FM large-size F_1 hybrids with EB resistance, 105 elite FM large-size F_1 hybrids with EB + LB resistance, 27 FM plum F_1 hybrids with EB resistance, and 96 grape tomato F_1 hybrids with EB and/or EB + LB resistance. We also shared some of our F_1 hybrids with a few seed companies and a PSU Extension Educator for field trials. Further, in 2023, we developed 89 NEW F_1 hybrids of different types that were evaluated during the field season, and developed over 300 NEW large-size F_1 co-hybrids, in collaboration with seed company Johnny's Selected Seeds (JSS), which were trialed in 3 locations including Rock Springs, PA (will be reported in our 2023 research report). Moreover, in 2023, we grew and evaluated all of our elite inbred lines of different types (large-size, plum and grapes). In 2024, all of our elite FM tomato F_1 hybrids and co-hybrids will be trialed by us at Penn State, and select numbers will be trialed by a few seed companies (including JSS), growers and researchers, as outlined below.

The Main Objectives of our 2024 FM tomato breeding projects include:
1) Field evaluation of our Regular (EB resistant) FM tomato F_1 hybrids, including large-size, plum and grape tomatoes);
2) Field evaluation of our LBR (EB+LB resistant) FM tomato F_1 hybrids, including large-size, plum and grape tomatoes);
3) Field evaluation (in multiple locations) of our large-size F_1 co-hybrids, which were developed in collaboration with JSS;
4) Cooperative evaluation of select number of our FM tomato F_1 hybrids (large-size, plum and grape tomatoes) by a few seed companies, including JSS;
5) Trialing of our elite FM tomato inbred lines, including large-size, plum and grape tomatoes; and
6) Continuation of our projects on tomato bacterial canker, including germplasm screening to identify resistant resources and genetic mapping to identify resistance genes.
$8,000

__ 3. Breeding processing tomatoes for production in PA
Majid R. Foolad, Department of Plant Science, The Pennsylvania State University
Objective: To develop breeding lines and F_1 hybrid cultivars of processing (PROC) tomato with disease resistance and other desirable characteristics suitable for production in PA.

Summary: At Penn State, we have developed elite processing (PROC) tomato breeding lines with strong resistance to foliar diseases early blight (EB) and late blight (LB), and general resistance to other tomato diseases, including Septoria leaf spot and bacterial canker (we have established a comprehensive project on bacterial canker resistance; PhD thesis of Jonathan Bonfiglio). The PSU PROC tomato inbred lines have also been bred for other desirable characteristics, including high yield, early maturity, superior fruit quality (e.g. color, firmness, no physiological disorders), and adaptation to PA conditions. Most of our lines are elite and ready to be used as parents to develop F_1 hybrids for commercial trials. During the past several years, we developed a large number of PROC tomato F_1 hybrids and trialed them at Penn State Research Farms and also by a few processing/canning companies. For example, in 2023, we trialed 56 elite PROC tomato F_1 hybrids with EB resistance, and 61 PROC F_1 hybrids with EB + LB resistance; we also shared select number of our elite hybrids with three processing/canning companies, including

Furmano Foods Inc., Red Gold, and Hirzel Canning, which trialed the hybrids under their production conditions. Specifically, in 2023, we provided seeds of 47 PSU elite PROC tomato F_1 hybrids to Furmano for trials; these included 33 for small-scale trials (120 seed each hybrid) and 14 for large-scale trials (9 hybrids with ~40,000 seed each and 5 hybrids with ~100,000 seed each). While Furmano trialed all of the small-scale hybrids in 2023, they did not get a chance to trial the 14 large-scale hybrids as seeds were not available on time. They will trial these hybrids in 2024 (see below). Similarly, each of Red Gold and Hirzel Canning company trialed 32 PSU elite PROC tomato F_1 hybrids in small-scale in 2023. All three companies would want to re-trial these and more of our hybrids in 2024. For example, for Furmano trials in 2024, recently we selected (in cooperation with Furmano) 6 hybrids to be trialed at 150,000 plants each. Currently we are in the process of sending parental lines to Costa Rica for the production of commercial-scale hybrid seeds.

The Main Objectives of our 2024 PROC tomato breeding projects include:
1) Production of commercial-scale (~150,000) seed each of 6 elite F_1 hybrids in Costa Rica, to be trialed by Furmano in 2024;
2) Cooperation with Furmano to facilitate large-scale (commercial) seed trials during summer 2024, for a total of 14 large-scale and many small-scale (TBD);
3) Trialing of our PROC hybrids in cooperation with two other tomato processing/canning companies (Red Gold, Hirzel Canning);
4) Field evaluation of our Regular PROC tomato F_1 hybrids (EB resistant), for a total of 56 hybrids;
5) Field evaluation of our LBR PROC tomato F_1 hybrids (EB + LB resistance), for a total of 53 hybrids;
6) Trialing and development of elite PROC tomato inbred lines with EB and/or EB+LB resistance; and
7) Continuation of our projects on tomato bacterial canker, including germplasm screening to identify new sources of resistance and genetic mapping to identify resistance genes.
$8,000

__ 4. Evaluation of Fungicide Programs for Powdery Mildew Control in Pumpkins
Tim Elkner, Penn State Extension – Lancaster County and Beth Gugino – Department of Plant Pathology and Environmental Microbiology, Penn State University
Powdery mildew remains a concern for growers in Pennsylvania. Fungicide efficacy trials have identified new materials that are very effective for powdery mildew management on pumpkin. However, few studies have been conducted examining how these materials could be most effectively used in a season-long disease management program. In 2023 we examined several fungicide programs for powdery mildew control to evaluate a standard commercial program as well as alternative programs that were developed to reduce input costs as well as incorporate biorational materials where possible to see if we could maintain yields, fruit quality and needed fungicide resistance management protocols. We also included an OMRI program in the trial. Data from this study are currently being analyzed. We propose repeating the trial in 2024 with some modifications to determine if efficacy could be improved for the alternative programs. A breakdown of fungicide program costs for the season will also be developed.
$7,815

__ 5. Using Rely Herbicide Prior to No-till Pumpkin Establishment
Dwight Lingenfelter and John Wallace, Penn State Department of Plant Science
Establishing a consistent and weed-free stand of pumpkins can be challenging especially in a no-till setting. As more weed species develop resistance to different herbicide modes of action, finding effective burndown herbicides to control weeds such as marestail/horseweed, Palmer amaranth, waterhemp, common ragweed, and other species can be difficult. Typical burndown herbicides such as glyphosate or

paraquat are not "stand alone herbicides" due to resistance or inconsistent control. And other herbicides used for burndown such as, 2,4-D, dicamba, or Sharpen are not labeled due to sensitivity of pumpkins.

Rely herbicide has the potential to fill this need. Rely (glufosinate, similar to Liberty) can be used as a burndown herbicide in certain crops and can provide control of the species mentioned as well as others. However, the current Rely label does not allow this type of application before pumpkin planting. BASF, the manufacturer of Rely, is supportive of including pumpkin on a supplemental label if favorable crop tolerance data is confirmed. Furthermore, it is likely that the use of Rely as a hooded postemergence application for row middles (i.e., banded between crop rows) could be added as well. Having this additional utility would be a valuable option to control problem weeds mid-season as well.

Initially, we propose to evaluate the crop safety of Rely when applied as a burndown application prior to pumpkin establishment. Rely will be applied at 0X,1X (32 fl oz), 2X, and 4X use rates at 0 and 7 days before direct seeding a popular face-pumpkin variety. We will determine effect of the herbicide treatments on pumpkin injury and any subsequent impacts on yield. Weed control data will be collected if applicable. The studies will be conducted at the Penn State research farm in Centre County. Benefits to state and regional pumpkin growers will include data to support labeling Rely prior to pumpkin planting, updated information in vegetable production guides and other educational resources on how to control weeds more effectively with Rely.
$2,000

__ 6. Evaluation of specialty cucumber varieties for early production in high tunnel and silicon application for powdery mildew control.
Francesco Di Gioia, The Pennsylvania State University
Research priority: High tunnel crop rotation – cucurbit powdery mildew control
High tunnels are a great season extension tool for vegetable crops and are primarily used to produce high value crops such as fresh market tomatoes. While fresh-market tomato may be the most valuable crop, other alternative valuable crops are needed to ensure adequate crop rotation. The productivity and long-term sustainability of high tunnel vegetable production systems is strictly depended on our ability to preserve and maintain soil health and manage soilborne pests and pathogens, and crop rotation is a key management solution for this purpose. Cucumber is considered a potential valid alternative to fresh-market tomato production in high tunnel, however, there is limited information on the yield, quality, and market performance of different types of cucumber, variety selection for early production, their need in terms of pollination, and their tolerance or susceptibility to different issues that may reduce the profitability of this crop. To address this lack of information we propose to evaluate the performance of specialty cucumber varieties in terms of earliness, yield, quality, and susceptibility to key issues such as powdery mildew. In addition to comparing different varieties, we propose to evaluate the efficacy of silicon fertilization in managing powdery mildew. Previous studies conducted on different crops have shown that silicon fertilization can effectively prevent or substantially delay the attack of powdery mildew. Data collected on yield, cost of production and local market price will be recorded to conduct a partial budget analysis and provide clear information on the profitability of early specialty cucumbers grown in high tunnel under Pennsylvania conditions. The research results will be shared with vegetable growers through traditional extension methods.
$10,000 - Estimated funds required to cover land fee, plant material, field supplies (fertilizer, fertigation set-up, trellising supplies), and labor expenses.

__ 7. Evaluation of new Italian specialty vegetable crops for winter, early spring, and late-fall production in open field and high tunnel

Francesco Di Gioia, The Pennsylvania State University

Research priority: High tunnel crop rotation – new crops – winter, early spring, and late-fall crops

The U.S. Northeast region represents the largest consumer market in the U.S. and consumers are increasingly demanding high-quality locally produced fresh vegetables to satisfy their dietary needs. Following this trend, chefs are constantly searching for new specialty products to satisfy the needs of their costumers and often are reaching out to growers with specific requests of new vegetable crops, including some "ethnic" vegetables like Asian or Italian vegetables. A new trend emerging in the U.S. Northeast region is the high demand of high-quality Italian vegetables that are used by chefs in higher-hand restaurants to create new dishes that valorize recipes typical of the Italian cuisine and of the Mediterranean diet increasingly regarded as a healthy lifestyle and way of eating. While the market demand for several Italian vegetables is increasing and represents a good market opportunity, growers that decide to invest and serve such market are often challenged with lack of information on optimal crop cycle and growing conditions, limited variety selection, and best crop management practices. To address such need and potentially create new market opportunities and establish new profitable crop rotations we propose to investigate the yield and quality performance of specialty Italian vegetables suitable for early spring, late-fall or winter production in high tunnel and/or open field. The research will consider crops such as broccoli raab, chicory, and radicchio for example, examining heirloom varieties for their earliness, yield and quality performance testing different planting time, crop management, and crop protection strategies including the use of a new clear perforated plastic cover that may offer crop protection in the early stage of the crop without limiting the crop exposure to the radiation. The research will be conducted in both open field and high tunnel. The research results will be shared with vegetable growers through traditional extension methods.

$9,000 - Estimated funds required to cover land fee, plant material, field and laboratory supplies, and labor expenses.

__ 8. Evaluating the potential of supplementary LED lighting in improving the production of vegetable crop seedlings

Francesco Di Gioia, The Pennsylvania State University

Research priority: vegetable seedling production

The production of vegetable seedlings is a key task for vegetable growers and specialized nurseries and often the quality of the seedlings can determine either a good start of a valuable crop or limit its success. Producing high quality seedlings requires adequate planning and experience in the selection of a good growing medium, the management of the crop (irrigation and fertilization) and of the environmental conditions. Among the environmental factors, temperature and light are considered critical to produce high-quality seedlings. In Pennsylvania, the production of vegetable seedlings for the winter and early-spring planting is often limited by relatively low temperatures and solar radiation levels. While the temperature is controlled most of the times heating the greenhouse or high tunnel to set the plants in optimal growing conditions, efforts to improve the radiation levels are not common because require investment in adequate light fixtures and energy costs. With the advent of the Light-Emitting Diode (LED) lighting technology which is more efficient compared to other artificial lighting technologies and with the decreasing cost of LED light fixtures, there is great interest in examining the potential of supplementary LED light in improving the production and quality of vegetable seedlings. To this purpose there is a need to assess the effect of different supplementary LED light levels on the accumulation of sugars, minerals, dry matter content, leaf expansion, thickness, and root-to-shoot ratio of vegetable seedlings. Using fresh-market tomato as a test crop, we propose to evaluate the effect of increasing levels (100, 200, 300, and 400 $\mu mol/m^2/s$) of supplementary LED lights on the quality of tomato seedlings which

will be assessed examining seedling fresh and dry biomass, dry matter content, sugar content, and mineral content of seedlings grown without supplementary light (control) or with various levels (100, 200, 300, and 400 µmol/m^2/s) of supplementary LED light. The study will be conducted using greenhouse facilities of the Penn State College of Agricultural Sciences equipped with dimmable LED light. Cost of the LED fixtures and operating energy costs will be estimated to provide growers with additional information on the cost of this technology. The research results will be shared with vegetable growers through traditional extension methods.
$9,500 - Estimated funds required to cover greenhouse rental fee, seeds, growing trays and media, greenhouse and laboratory supplies, and labor expenses.

__ 9. The Economic & Operational Benefits of Using Biological Controls in Greenhouse Vegetable Production

Ashley Walsh, President and Founder, Pocono Organics, Blakeslee, PA
Pocono Organics is one of the largest Regenerative Organic Certified vegetable farms in North America located on over 380 acres in Long Pond, PA including 40,000 square feet of greenhouse space where diversified vegetable crops are grown throughout the year. In the 2023 growing season, Pocono Organics began experimenting with using beneficial insects to control pests and diseases in tomato, pepper and eggplant crops being grown in one of the eight greenhouses on site. The biological control program consisted of the repeated scheduled release of larval green lacewings, several parasitic wasps, Orius insidious (insidious flower bug) and predatory mites over the course of one month in the early spring to control aphids, thrips, spider mites, white flies and other pests that damage crops directly or act as disease vectors. The results were extremely positive in this initial trial. We would like to expand this biological control program to the majority of our greenhouses and compare the long-term yield and marketability of the vegetable crops (tomato, pepper, eggplant, lettuce, beets, and spinach) as well as the overall cost of the system (labor and inputs) to that of a "control" greenhouse using a schedule of sprayed pesticides as required to manage pests and diseases. Our hypothesis is that using beneficial insects and biological controls will result in decreased pest pressure in the greenhouse environment and is an overall better and more sustainable long-term investment with decreased time and materials needed for improved marketable yields of high value vegetable crops. We are requesting $16,420 for this research grant to fund the cost of purchasing the beneficial insects, seeds for trap crops and sticky cards for pest monitoring. This grant will also fund the cost of time/labor needed to disperse, manage, and monitor the biological controls system and compare findings to the more traditional management system.
$16,420

Total Requested by Pre-Proposals - $72,235