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December 17, 2021

Patti Keller
Secretary, Research Committee
State Horticultural Association of
Pennsylvania 26 Nursery Lane
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Email: patti@acnursery.com

Subject: **Proposal Title:** Disease Tolerance and Fruit Quality Assessments in Superior York Seedling Selections for the Mid-Atlantic Apple Fresh Market and Processing Industries
**UMD PI:** Dr. Christopher S. Walsh
**UMD Proposal Number:** 65233
**DUNS #:** 79-093-4285
**EIN:** 52-6002033

Please find enclosed the above referenced proposal submitted on behalf of the University of Maryland and signed by an Authorized Representative. We have assigned a University Proposal Number which you may use to reference this proposal in any future communication with our office. The budget request is in the amount of $33,256 for the period of 03/01/2022 through 04/01/2024.

We acknowledge that Dr. Walsh is identified by name as the PI at the University of Maryland and that he intends to carry out all responsibilities identified in the attached proposal. If this proposal is successful, the University of Maryland is prepared to enter into an agreement with the State Horticultural Association of Pennsylvania under mutually acceptable terms and conditions. Any resulting award should be should be sent to the Office of Research Administration for review and signature.

Questions regarding the technical aspects of this proposal should be directed to Dr. Walsh at (301)-405-4351 or via e-mail at cswalsh@umd.edu. Administrative questions should be directed to Stephanie Swartz at (301) 405-8280 or sswartz1@umd.edu. Thank you for your consideration of our proposal.

Sincerely,

Stephanie Swartz
Sr. Contract Administrator

**Title**: Disease Tolerance and Fruit Quality Assessments in Superior York Seedling Selections for the Mid-Atlantic Apple Fresh Market and Processing Industries

**Personnel**:
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**Duration of Project**: New Project - 2 years - Starting: March 1 2022, Ending: April 1 2024.

**Justification:**

Pre and Postharvest research is vitally important to industry and stakeholders for a multitude of reasons. Fungal plant pathogens not only cause losses in the field, but also during storage which decreases revenue, but also negatively impacts fruit quality, contributes to food waste, and can contaminate processed products with harmful mycotoxins (i.e. patulin). Unfortunately, everyone from the grower, packer, processor and consumer losses to postharvest decay. Sixty five percent of the U.S. apple crop is consumed as fresh fruit, whereas the remaining 35% is processed (U.S. Apple Association). Pennsylvania is the fourth largest apple producer in the US while Adams county grows nearly 75% of the apples for the entire state. Apples are a multi-billion-dollar business and consumers rely on a fresh supply of apple fruit year-round.

Apples are at risk for decay in storage as all commercial cultivars are susceptible to grey mold, blue mold and bitter rot (Spotts 1999; Jurick et al., 2011). These fungi are present in the air, soil, packinghouse equipment, on crates, and the surfaces of apple fruit. Decay occurs when favorable conditions for spore germination, which are present during storage, are coupled with bruised or wounded fruit during storage. The number of postharvest chemicals labeled for pome fruits is limited (4 total) and resistance management is critical to maintain the efficacy of these compounds.

In 2008, a block of York seedling apple trees was planted at the University of Maryland farm in Keedysville. These seedlings were an outgrowth of a funded SHAP grant to Drs Walsh and Harshman. We have identified seedlings that combined the firmness, storageability and moderate resistance to bitter rot of York (Biggs and Yoder, 2019), with fresh-market flavor and quality of Gala. Since then we have culled trees to avoid the susceptibility to fireblight that plagues Gala and York. After more than a decade of observation, evaluation and removal of susceptible trees, 11 elite York seedlings remain in the Keedysville planting. This represents about four percent of our original seedling population. The remaining seedling trees have the fruit size, productivity, and red color required for Pennsylvania orchards, without the bitter pit symptoms which also plague York.

**Potential Benefits and Products of the Study**: The results of this project address several research priorities under three different sections which are: Horticulture: maintaining fruit quality; Plant Pathology: Disease Resistant Management for Key Diseases; Post-Harvest Physiology: control of post-harvest pathogens. The information gained from this study will be of direct benefit to the fruit growers, packers, processors, and the agricultural research community. Data from this study will solve multiple problems listed in the RFA of industry importance.

These data will also answer the following question. Can any of the remaining York selections meet the needs of direct marketers and/or wholesale and process-apple growers?

**Objectives: Three objectives will be accomplished and replicated over 2 years**

1. Fruit quality and maturity assessments of select York seedlings and widely-planted commercial varieties before, during and after cold storage.
2. Preharvest disease assessment of York and commercial varieties before storage.
3. Postharvest disease evaluation of York and commercial varieties after storage.

**Procedures:**
Apple fruit used in this objective will be grown and harvested from the University of Maryland farm at Keedysville which is located in Washington County, Maryland. Fruit from Keedysville will be harvested and evaluated during September and October.

On each harvest date, elite York seedlings plus fruit from Honeycrisp, CrimsonCrisp, Aztec Fuji, or GoldRush will be picked. These commercial cultivars will serve as controls. Adequate fruit of the commercial cultivars and York seedlings will be harvested to meet our three objectives: Fruit maturity at the University of Maryland, Plant pathology at the USDA lab in Beltsville, and Storageability at 34° F at the University of Maryland farm in Keedysville.

On the day after harvest, apples will be evaluated at the University of Maryland for:

- Fruit size (fresh weight and diameter)
- Surface color (percent red color)
- Ground color (USDA color chips)
- Fruit firmness (Effegi penetrometer)
- Soluble solids (Leica benchtop refractometer)
- Starch Pattern index (Cornell iodine-potassium iodide solution and chart)

On the day after harvest, fruit will also be delivered to the USDA lab in Beltsville for plant pathology studies for preliminary observations of fungal pathogens prior to the pathology evaluations described below.

In addition to measuring fruit maturity and disease susceptibility at harvest, boxes of fruit will be stored in a commercial-size cold room. Fruit will be evaluated after 60, 120, and 180 days of storage. One day after cold storage, they will be evaluated for size, color, firmness, soluble solids and titratable acidity. Texture, flavor and eating quality will be evaluated as well. After an additional week at room temperature, storage problems, including bitter pit, scald, internal breakdown, and storage rots will be assessed.

**Postharvest pathology evaluations:** Apples will be harvested and stored at 1°C (34° F) until the experiment is conducted. Apples will be surface disinfested for 5 min in 0.6% sodium hypochlorite solution, rinsed three times with sterile water, and air-dried. Each fruit will be wounded with the point of a 3-mm-diameter finishing nail to a 3mm depth. Honeycrisp, Fuji and Cripps Pink apple fruit will be inoculated with conidial suspensions of *Botrytis cinerea, Penicillium expansum,* and *Colletotrichum fiorinae.* Conidial suspensions ($1\times10^5$ conidia/ml) will be obtained from 7-day-old fungal cultures grown at 20°C (68° F) and used for inoculations. Treatments will be conducted by inoculating apples with 50 µl of the conidial suspension with a micropipette into each wound. Fruit will be stored at room temperature for 7 days to ensure the maximum opportunity for decay and then number of fruit (decay incidence) and lesion size in mm (severity) will be recorded. Fruit will be air-dried for 15 min after dip treatment and then placed on fruit trays and stored in cardboard boxes at 1°C to mimic commercial storage conditions. Fruit will be assessed after 3 months of storage at 1°C, and each fungal treatment will have three replicate trays, each containing 20 fruit. Lesion diameters will be measured with a digital micrometer (% severity), and fruit with decay (% incidence) will be calculated and recorded (Jurick et al., 2011).

**Data Analysis:** All experiments will be conducted three times, each having three replications. Data from multiple experiments will be included in one analysis for differences between treatments by generalized mixed models in SAS (Proc Glimmix), and treatment means will be compared by Tukey's HSD at $P \leq 0.05$.

**Budget:**

| | **Initial Period** | **Year Two** | **Total Period** |
|---|---|---|---|
| | | | |
| Salary | 4,286 | 4,415 | 8,701 |
| Fringe | 1,192 | 1,227 | 2,419 |
| Supplies | 710 | 710 | 1,420 |
| Travel | 358 | 358 | 716 |
| Other (Consultant) | 1,500 | 1,500 | 3,000 |
| Subaward (USDA) | 8,500 | 8,500 | 17,000 |
| **Total Direct Costs** | 16,546 | 16,710 | 33,256 |
| **Indirect Costs (0% per sponsor policy)** | 0 | 0 | 0 |
| **Total Costs** | 16,546 | 16,710 | 33,256 |

**Other Support:** No other support exists for this specific project. Base funds for general operation of Jurick's program exist at USDA-ARS that cover his salary and daily operational costs to conduct core research associated with his in-house research project.

**Literature Cited**


1. Jurick II, W.M., Janisiewicz, W.J., Saftner, R.A., Vico, I., Gaskins, V.L., Park, E., Forsline, P.L., Fazio, G., Conway, W.S. 2011. Identification of wild apple germplasm (Malus spp) accessions with resistance to the postharvest decay pathogens Penicillium expansum and Colletotrichum acutatum. Plant Breeding. DOI: 10.1111/j.1439-0523.2011.01849.x
2. Spotts RA, Cervantes LA, Mielke EA (1999) Variability in postharvest decay among apple cultivars. Plant Disease 83:1051
3. Biggs, A. and K. Yoder (2019) Table of Apple Susceptibility to Bitter Rot. https://apples.extension.org/table-of-apple-cultivar-susceptibility-to-bitter-rot/