Research Grant Proposal Outline for 2022
State Horticultural Association of Pennsylvania

Title: Comparing the impact of ReTain® and Harvista™ on fruit quality, ethylene production and preharvest drop control of commercially important apple cultivars grown in the Mid-Atlantic Region.

Personnel:
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Duration of Project: One year

Justification:
Honeycrisp has become very popular among consumers in the fresh fruit market due to its crisp texture and distinct flavor profile. This makes Honeycrisp a high-value cultivar, resulting in premium prices for growers. However, Honeycrisp fruit grown under the mid-Atlantic hot and humid climactic conditions often experience marginal red color development in some growing seasons. To solve this issue, a common practice used by the industry in the region consists on delaying harvest until the minimum 50%-60% color requirement is met. However, this results in advanced fruit maturity, with reduction of flesh firmness at harvest and reduced storage potential. Furthermore, early- season cultivars such as Honeycrisp fruit are sensitive to preharvest fruit drop, which refers to the abscission of fruits from the tree before they are horticulturally mature. Thus, delaying harvest to enhance red color development also increases the severity of preharvest fruit drop, directly reducing yield and grower profitability.

Ethylene, one of the key ripening hormones, is considered a primary driver of advancing fruit maturity as well as of enhancing preharvest fruit drop. Therefore, in order to slow down fruit maturity, delay harvest and reduce preharvest fruit drop, Honeycrisp fruit trees can be treated with ethylene inhibitors during preharvest. Delaying harvest will potentially increase red skin coloration, increasing economical return. In addition, scheduling harvest maturity at the orchard is of crucial importance when there are large volumes of fruit to be harvested in a short period of time, as well as when there is insufficient labor and /or excessive rain during the harvest season.

The ethylene biosynthesis inhibitor aminoethoxyvinylglycine (AVG; ReTain®, Valent USA) as well as the ethylene reception/perception inhibitor 1-methylcyclopropane (1-MCP; Harvista™, Agrofresh, USA) have been applied commercially in Honeycrisp apple orchards. These two preharvest ethylene inhibitors which have different modes of action are thus recommended to be applied at different rates and application timings. For example, early applications of ReTain® will have a greater impact on the fruit than later applications. Also, fruit may start dropping before a late application of ReTain® can gain control of internal ethylene production. In the case of Harvista ™ better results are obtained when this product is applied closer to harvest. Furthermore, the application of Harvista™ requires an additional formulation tank and injector pump to be added onto a commercial sprayer. Although both materials aim to delay maturation (~7-10 days) without affecting final fruit quality, as well as to reduce preharvest drop, and even fruit cracking,

the direct comparison of their effects in Honeycrisp fruit has not been thoroughly evaluated under the mid-Atlantic growing conditions.

Considering this background, the goal of the proposed research is to compare the impact of ReTain® and Harvista™ on fruit quality, ethylene production and preharvest drop control of Honeycrisp fruit grown under the mid-Atlantic conditions.

The results of this study will be reported to the mid-Atlantic apple industry and will form the basis for development of a future larger research grant focused on understanding the impact of preharvest plant growth regulators on fruit physiology of different apple cultivars.

2022 SHAP Topical Priority List Categories:

Horticulture

- Strategic Management of Apple Variety Maturity Progression
- Maintaining Fruit Quality

Objectives:

1. Evaluate and compare the effect of ReTain® and Harvista™ ethylene inhibitors on fruit quality indices and ethylene production throughout ripening on the tree of Honeycrisp fruit grown in the mid-Atlantic.
2. Measure and compare the impact of ReTain® and Harvista™ ethylene inhibitors on preharvest fruit drop and cracking throughout ripening on the tree of Honeycrisp fruit grown in the mid-Atlantic.

Procedures:

1. Grower-cooperator recruitment.

Our team will partner with grower-cooperators to evaluate the impact of ReTain® and Harvista™ as well as of an untreated control, on fruit quality indices and ethylene production as well as preharvest fruit drop and cracking throughout ripening on the tree of Honeycrisp fruit. At the time of this writing, Joy Cline from Bear Mountain Orchards, Aspers, Pennsylvania has agreed to participate in this study. She has already previously acquired the additional formulation tank and injector pump needed for Harvista™ application.

2. ReTain® and Harvista™ ethylene inhibitors application

A commercial block of Honeycrisp will be selected for study. Three treatments will be established: ReTain® and Harvista™ and an untreated control. ReTain® will be applied at a rate of 166g/acre 21 days before anticipated harvest, while Harvista™ will be applied at a rate of 121 fl oz/acre (1 gallon/ acre) 3 days before anticipated harvest, while the control will be untreated. Ten to fifteen trees will be used by treatment in the same orchard block, with adequate separation among treatments to avoid product drift. The growers will spray the ethylene inhibitor products and will allow us access to the block for fruit sampling and for measurement of fruit drop and cracking. The grower will communicate and coordinate harvests with the investigators.

3. Evaluate and compare the effect of ReTain® and Harvista™ ethylene inhibitors on fruit quality indices and ethylene production throughout ripening on the tree of Honeycrisp fruit grown in the mid-Atlantic.

Fruit samples from each treatment will be collected four times throughout ripening on the tree: (i) at anticipated commercial harvest, (ii) 1 week after anticipated commercial harvest, (iii) 2 weeks after anticipated commercial harvest, and (iv) 3 weeks after anticipated commercial harvest.

Immediately following harvest, apples sampled from each treatment will be evaluated at the Fruit Quality Laboratory, University of Maryland (UMD), for:

- Ethylene production
- Fruit size
- Skin color:
    - Surface color (percent red color and by using a Minolta colorimeter)
    - Ground color (using a Delta A meter, a Minolta colorimeter)
- Flesh color (using a Minolta colorimeter)
- Fruit firmness (Texture analyzer or handheld penetrometer)
- Soluble solids (benchtop refractometer)
- Titratable acidity (malic acid equivalents, using an automatic titrator)
- Starch Pattern index (iodine-potassium iodide solution)

Pictures of the different cultivars at the different harvest maturities will also be taken.

4. Measure and compare the impact of ReTain® and Harvista™ ethylene inhibitors on preharvest fruit drop and cracking throughout ripening on the tree of Honeycrisp fruit grown in the mid-Atlantic.

For each treatment, four weeks before anticipated commercial harvest we propose to flag several limbs per plot and count the number of fruits per each limb as well as the number of cracked fruit per flagged limb. We will count the fruits on each limb and asses the presence of cracking every week starting 1 week before anticipated commercial harvest through 3 weeks after anticipated commercial harvest. The percentage of fruit drop and cracking at each stage will be calculated relative to the initial fruit count per limb.

Budget:

Budget Items	**Justification**	**Total May 2022-April 2023**	
Student Labor	$12.5/hour × 4 students x 20 hours/week × 12 weeks	$	12,000.00
Fringe Benefits	Hourly labor at University of Maryland at 7.7%	$	924.00
Travel	9 round trips to PA × 200 miles/trip × 0.56/mile	$	1,008.00
Supplies	Farcuh lab and field supplies	$	953.00
Total Direct Cost		$	14,885.00
Total Cost		**$**	**14,885.00**

Other Support:
This proposal has not been submitted to any other agency.

Results:
Research results will be published in the *Pennsylvania Fruit News* and a poster will be presented at the Mid-Atlantic Fruit and Vegetable Convention as well as in Pennsylvania and Maryland growers' meetings.