PennState
College of Agricultural Sciences

PROPOSAL TRANSMITTAL

Date: 12/19/2017 **PSU Ref. No: 199267**

Title: Third Generation Apple System Trials 2018

Submitted to: Patti Keller, Secretary, Research Committee

State Horticultural Association of Pennsylvania
26 Nursery Lane, PO Box 108
Aspers, PA 17304

Program: 2018 Research Grant Proposal

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Proposed Project Period: **05/01/2018 - 01/31/2019** **Total Project Request:** **$9,000**

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Please reference PSU Ref. Number in all correspondence.

Research Grant Proposal
To
State Horticultural Association of Pennsylvania, Inc.

TITLE: Third Generation Apple System Trials
PERSONNEL: Robert M. Crassweller and D. E. Smith
PHONE: 814-863-6163 **email:** rmc7@psu.edu
DURATION OF PROJECT: 2018 – 2022

OBJECTIVES: To evaluate apple tree training systems and techniques to increase production efficiency and reduce production costs.

JUSTIFICATION: Over the past several years we have evaluated different training systems for apples, at multiple sites. The most productive systems have been the various forms of a tall narrow canopy (Axe, Tall Spindle, Minimally Pruned, Tall Trellis). The primary reasons for their greater productivity is the ability to extend the cropping canopy to 10 to 12 feet and reduced pruning leading to earlier cropping. Yields tend to be higher in the MP due to less pruning and with less pruning production, costs were reduced. Robinson et al. (2007b) in discussing the development of apple orchard systems has shown how orchards evolved from large seedling rootstocks down to small pedestrian orchards to the current system where tree height is maintained at 10 to 13 feet with narrow but supported canopies. These systems under New York conditions seem to be profitable when planted at 809 to 1012 trees per acre (2007a). In our studies at Rock Springs there have been no differences in cumulative yield due to training systems for Jonagold. However, the Jonagold in TS have been the least efficient. In Fuji the systems having the highest cumulative yield have been those in the MP followed by the A with no cumulative efficiency differences due to any system.

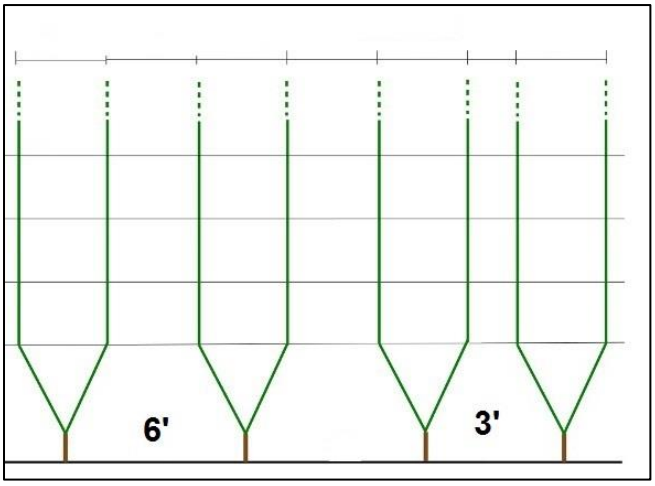
Future directions in orchard productivity strongly suggest that for large scale plantings some form of mechanization will be necessary. Work by Baugher (2009) with orchard platforms has shown that there is considerable savings to be realized with their use for pruning, thinning and potentially harvest. For any platform system to be successful, the tree architecture must have a thin mantle depth. The maximum depth of any canopy will be approximately 2.5 to 3 feet. An Axe/Tall Spindle type system and trellis system would seem to fit these requirements. The Axe system keeps a very narrow conical shape in the upper portions of the tree. While the trellis maintains a vertical even depth canopy the entire height of the tree. In our trellis the maximum width of the canopy at the end of the growing season is approximately 4.5 feet (2.25 ft. per side) which would provide for higher light penetration and improved fruit quality and color.

In the race to increase density to achieve instant orchards with the newest cultivar we have lost sight of the increasing costs and availability of finished trees. Robinson et al. (2013) showed that increasing tree costs restrict the profitability of an orchard system. Tustin (2014) suggested that we have overlooked canopy design in favor of increasing trees per acre when we should be thinking of ***stems*** or ***branches*** per acre. The approaches of Dorigoni et al. (2011) and Musacchi (2008) in producing more “trunks per tree” in bi-axial training systems can help reduce establishment costs and increase profitability. The objective of this type of system is to determine if we can divide the vigor over more stems to reduce the establishment costs while still maintaining equal production.

PROCEDURE: A new system trial has been established that includes a Bi-Axis System at two in-row spacing’s, 3’ (BiA3) and 6’ (BiA6), and a Tall Spindle (TS) at 3’ in row spacing. The trial was planted in 2017 and consists of Golden Delicious on M9 T337 with 8 replications. Between row spacing is a uniform 13 feet. In considering Tustin’s (2013) definition of stems per acre, the

BiA3 would have 2,234 stems/A (1,117 trees/A), the BiA6 would be 1,117 stems/A (558 trees/A) and the TS 1,117 stems/A (1,117 trees/A).

Yearly data to be collected will be tree size as measured by TCSA, yield, number of fruit/tree, fruit size, size distribution of the fruit and pruning time. Flowers will be counted in the first years of the planting and flower density will be calculated. Economic analysis will be developed to compare the differences between systems for yield and pruning time.



BiAxis 6' BiAxis 3'

Figure 1. Diagram representing the arrangement of 'stems' in the biaxis systems

References

Baugher, T, J. Schupp, K. Lesser, M. Harsh, C. Seavert, K. Lewis, and T. Auvil. 2009. Mobile platforms increase orchard management efficiency and profitability. Acta Horticulturae 824:361-364.

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Musacchi, S. 2008. Bibaum: a new training system for pear orchards. Acta Horticulturae 800:763-768.

Robinson, T., A. DeMaree & S. Hoying. 2007a. An economic comparison of five high density apple planting systems. Acta Horticulturae 732:481-489.

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Tustin, D. S. 2013. Future orchard planting systems: Do we need another revolution. Acta Horticulturae 1058:27 – 36.

Amount Requested

Wages with fringe	$8,400.00

Fringe benefits are computed using the fixed rates of 41.60% applicable to Category I Salaries, 15.40% applicable to Category II Graduate Assistants, 7.90% applicable to Category III Salaries and Wages, 0.10% applicable to Category IV Student Wages, and 26.30% for Category V, Postdoctoral Scholars and Fellows, for fiscal year 2018 (July 1, 2017, through June 30, 2018). If this proposal is funded, the rates quoted above shall, at the time of funding, be subject to adjustment for any period subsequent to June 30, 2018, if superseding Government approved rates have been established. Fringe benefit rates are negotiated and approved by the Office of Naval Research, Penn State's cognizant federal agency.

Production system supplies	$600.00
TOTAL	$9,000.00