PennState
College of Agricultural Sciences

PROPOSAL TRANSMITTAL

Date: 1/4/2021 **PSU Ref. No: 219941**

Title: Third Generation Apple System Trials

Submitted to: Patti Keller

State Horticultural Association of Pennsylvania

480 Mountain Road

Orrtanna, PA 17353

Submitted by: Robert Crassweller

(814) 863-6163

rmc7@psu.edu

Proposed Project **4/1/2021 - 3/31/2022** **Total Project Request: $10,533**

AUTHORIZED UNIVERSITY OFFICIAL

Christina Wagner DATE 1/4/2021

Christina Wagner
Research Administrator - Pre-award
College of Agricultural Sciences
107 Agricultural Administration Building
University Park, PA 16802-2602
Tel: 814-865-5419
Fax: 814-865-0323
Email: L-AG-contgrts@lists.psu.edu

John W. Hanold DATE 1/4/2021

John W. Hanold
Assoc. VP for Resrearch
Office of Sponsored Programs
The Pennsylvania State University
110 Technology Center Building
University Park, PA 16802-2602
Tel: 814-865-1372
Fax: 814-865-3377
Email: osp@psu.edu

EIN: 24-6000376
DUNS No: 00-340-3953

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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. 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. Overall monetary returns to the growers however were lower due to lower value of Jonagold (Crassweller et al. 2020). 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. The Fuji cultivar having a higher market value resulted in greater returns to the grower (Crassweller et al., 2020)

Future directions in orchard productivity strongly suggest that for large scale plantings some form of mechanization will be necessary. Work by Baugher et al. (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 Biaxial 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). Trees will be entering their 5th growing season and were pruned to reduce vigorous limbs and to shorten them through "click pruning". This technique keeps individual stems shorter allowing for denser spacing. This technique was adopted last year to the bi-axis to manage the 'leaders'.

Yearly data to be collected will be tree size as measured by TCSA, yield, number of fruit/tree, fruit size, of the fruit and pruning time. Economic analysis will be developed to compare the differences between systems for yield and pruning time.

3 ft Biaxis

Tall Spindle

6 ft Biaxis

2020 September

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.

Crassweller, R. M., L. Kime, & D. Smith. 2020. Orchard architecture effects on yield and economics of two apple cultivars. Acta Horticulturae 1281:207-211.

Dorigoni, A., P. Lezzer, N. Dallabetta, S. Serra, & S. Musacchi. 2011. Bi-axis: an alternative to slender spindle for apple orchards. Acta Horticulturae 903:581-588.

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

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

Budget

Salaries$7,414 Supplies$500
Hourly wages N/A Travel N/A
Fringe Benefits$2,586 Miscellaneous$33
Total $10,533

Budget Notes:

Don Smith(Technician) will contribute approximately 14% Effort

Fringe benefits are computed using the fixed rates of 34.88% applicable to Category I Salaries, 12.35% applicable to Category II Graduate Assistants, 7.94% applicable to Category III Salaries and Wages, 0.31% applicable to Category IV Student Wages, and 23.88% for Category V, Postdoctoral Scholars and Fellows, for fiscal year 2021 (July 1, 2020, through June 30, 2021). 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, 2021, 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.

Orchard Supplies and Land Fees

F&A rates are negotiated and approved by the Office of Naval Research, Penn State's cognizant federal agency. Penn State's current fixed on-campus rate for research is 60.50% of MTDC from July 1, 2020, through June 30, 2021. New awards and new competitive segments with an effective date of July 1, 2021, or later shall be subject to adjustment when superseding Government approved rates are established. Per 2 CFR 200 (Appendix III, Section C.7), the actual F&A rates used will be fixed at the time of the initial award for the duration of the competitive segment. ***Sponsor does not allow indirect costs***