

# ***SAES-422 Multistate Research Activity Accomplishments Report***

**Project No. NC 140 and Title: Improving Economic and Environmental Sustainability in Tree-Fruit Production Through Changes in Rootstock Use**

**Period Covered: Oct. 1, 2015 to Sept 30, 2016**

**Annual Meeting Dates: November 9-10, Penn State Univ., State College, PA**

## **2015-16 Published Written Works**

### **Books**

Crassweller, R.M., T.A. Baugher, R.P. Marini, and J.R. Schupp. 2016. P.1-89. In: G. Krawczyk (ed.) Penn State Tree Fruit production Guide for 2016-2017. Penn State Extension AGRS-045.

2016 Integrated Orchard Management Guide for Commercial apples in the Southeast. Edited by J. Walgenbach. NC Cooperative Extension Service, Raleigh. AG-572. 88 pp.

### **Refereed Journal Articles**

Chavez, D.J., T.G. Beckman, and J.X. Chaparro. 2016. Identifying the North American plum species phylogenetic signal using nuclear, mitochondrial, and chloroplast DNA markers. *Journal American Society Horticultural Science* 141: In press.

Fazio, G., T.L. Robinson, and H.S. Aldwinckle, 2015. The Geneva apple rootstock breeding program. *Plant Breeding Reviews* 39:379-424.

Geng, F., R. Moran, M. Day, W. Halteman and D. Zhang. 2016. Increasing shoot elongation and proliferation of ‘G.30’ and ‘G.41’ apple by chilling explants and plant growth regulators. *HortScience* 51:899-904.

Law, T.L. and G.A. Lang. 2016. Planting angle and meristem management influence sweet cherry canopy development in the “Upright Fruiting Offshoots” training system. *HortScience* 51:1010-1015. <http://hortsci.ashspublications.org/content/51/8/1010.full>

Lang, G.A. 2016. Cherry rootstock. pp. 631 in: Gasic, K. and J.E. Preece. Register of New Fruit and Nut Cultivars: List 48. *HortScience* 51:620-652. <http://hortsci.ashspublications.org/content/51/6/620.full>

Marini, R.P., W.R. Autio, B. Black, J. Cline, W.P. Cowgill, Jr., R.C. Crassweller, C. Hampson, M.M. Kushad, R. Moran, M. Parker, R.L. Perry, G.L. Reighard, T. Robinson, D. Wolfe. 2016. Time Required for Classifying Rootstock Vigor in Multi-location Rootstock Trials. *J. Amer. Pomol. Soc.* 70(2):82-91.

Shin, S., P. Zheng, G. Fazio, M. Mazzola, D. Main, and Y. Zhu, 2016. Transcriptome changes specifically associated with apple (*Malus domestica*) root defense response during *Pythium ultimum* infection. *Physiological and Molecular Plant Pathology* 94:16-26.

Tworkoski, T., G. Fazio, and D.M. Glenn, 2016. Apple rootstock resistance to drought. *Scientia Horticulturae* 204:70-78. 24

Tworkoski, T. and G. Fazio, 2016. Hormone and growth interactions of scions and sizecontrolling rootstocks of young apple trees. *Plant Growth Regulation*.

Ayala, M. and **G.A. Lang**. 2015. <sup>13</sup>C-Photoassimilate partitioning in sweet cherry (*Prunus avium* L.) during early spring. *Ciencia e Investigacion Agraria* 42:191-203.

<http://www.rcia.uc.cl/index.php/rcia/article/view/1508>

Marini, R.P., W.R. Autio, B. Black, J. Cline, W.P. Cowgill, Jr., R.C. Crassweller, C. Hampson, M.M. Kushad, R. Moran, M. Parker, R.L. Perry, G.L. Reighard, T. Robinson, D. Wolfe. 2016. Time Required for Classifying Rootstock Vigor in Multi-location Rootstock Trials. *Journal American Pomological Society*. 70(2):82-91.

### **Symposium Proceedings**

Fazio, G., Lordan, J., Francescato, P., Cheng, L., Wallis, A., Grusak, M.A., Robinson, T.L., 2016. Honeycrisp Apple Fruit Nutrient Concentration Affected By Apple Rootstocks, XI International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems. ISHS, Bologna, Italy.

Lang, GA, Blatt, S, Forge, T, Lordan, J, Neilsen, D, Reig, G and Robinson, T. 2016. Integrating sweet cherry canopy architectures and rootstocks in difference environments: the NC-140 trial results from Michigan, New York, British Columbia and Nova Scotia. ISHS Orchard Systems Symposium, Bologna, Italy. August 2016.

Reighard, G.L. 2016. Rootstock performance in the 2009 NC-140 peach trial across 11 States. ISHS 11th International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems. August 28 – Sept. 2, 2016. Bologna, Italy.

Fisk, C., C. Tu, D. Ritchie, M. Parker and G. Reighard. 2016. Rootstock effect on soil ecology in a young peach orchard. ISHS 11th International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems. August 28 – Sept. 2, 2016. Bologna, Italy.

Parker, M., D. Ritchie, G. Reighard, B.Clark and R. Marceau. 2016. Peach rootstock differences in tree survival from bacterial canker in the Southeastern United States. ISHS 11th International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems. August 28 – Sept. 2, 2016. Bologna, Italy.

Reighard, G., D.J. Chavez, et al. 2016. Rootstock performance in the 2009 NC-140 peach trial across 11 states. XI International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems.

Lang, G.A. 2016. Comparison of Intensive Sweet Cherry Tree Architectures to Optimize Fruit Quality and Labor Efficiencies. *2nd International Stone Fruit Conference*, Netherlands, May, 2016

Lang, G.A. et al. 2016. The NC140 Trial Results from Michigan, New York, British Columbia, and Nova Scotia. *ISHS Canopy Systems, Rootstocks, and Environmental Physiology Symposium*, Bologna, Italy, Aug. 28-Sept 2.

Lang, G.A. 2016. Integrating Canopy Architectures and Rootstock Traits to Optimize Fruit Production in Different Environments. *ISHS Canopy Systems, Rootstocks, and Environmental Physiology Symposium*, Bologna, Italy, Aug. 28-Sept 2.

Lang, G. A. 2016. Experiences with New Sweet Cherry Training Systems. *Tubitak Cherry Research Conference*, Samsun, Turkey, Sept.

Lordan, J., Fazio, G., Francescatto, P., Robinson, T.L., 2016. Effects of Apple (*Malus × domestica*) Rootstocks on Vigor and Yield Scion Response, XI International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems. ISHS, Bologna, Italy.

## Poster Presentations

## Popular Articles

Autio, W.R., J.S. Krupa, J.M. Clements, and W.P. Cowgill Jr. 2016. Evaluation of peach rootstocks: 2009 NC-140 Peach Rootstock Trial through seven growing seasons. *Fruit Notes* 81(3):1-3.  
<http://horticulturalnews.org/96-3/Cover813.html>

Autio, W.R., J.S. Krupa, J.M. Clements, and W.P. Cowgill Jr. 2016. Evaluation of peach rootstocks: 2009 NC-140 Peach Rootstock Trial through seven growing seasons. *Horticultural News* 96(3):1-3.  
<http://horticulturalnews.org/96-3/Cover96-3.html>

Autio, W.R. 2016. Rootstock Trial through seven growing seasons. *Fruit Notes* 81(3):1-3.  
<http://horticulturalnews.org/96-3/Cover813.html>

Crassweller, R. and D. Smith. 2016. Honeycrisp rootstock trial early results. *Pennsylvania Fruit News* 96(1):36-38.

Crassweller, R. and D. Smith 2016. 2015 Results of apple training system trials. *Pennsylvania Fruit News* 96(1):39-41.

Crassweller, R. and D. Smith. 2016 Nutritional analysis of new apple cultivars in high density plantings. *Pennsylvania Fruit News*. 96(2):21-22

Schupp, J. 2016. Prune mature trees to improve light distribution. *Fruit Growers News* 55(1):8-9

Baugher, Jarvinen, Dugan, and Schupp. 2016. Can a Rules-Based Apple Pruning System Improve Labor Efficiency without Affecting Orchard Productivity? *PA Fruit News* 96 (2):16-17.

Fazio, G., L. Cheng, M.A. Grusak, and T.L. Robinson, 2015. Apple rootstocks influence mineral nutrient concentration of leaves and fruit. *New York Fruit Quarterly* 25:11-15.

Hein, T. 2016. Smaller sweet cherry trees. *Fruit and Vegetable Magazine*, (in press).

Blatt, S. and D. Neilsen. 2016. Putting the cherry on top. *AgrInfo*, Issue 6, October 2016.  
<http://www.agr.gc.ca/eng/about-us/publications/agri-info-newsletter/?id=1419351635969>

Lang, G.A. 2016. Evaluating sweet cherry training systems for precision orchards. *American Fruit Grower* 136(1):26-27.

Lang, G. 2016. Una mirada a los sistemas de cobertura de cerezo en el mundo. Redagricola 80:34-38.

Tepe, E., E. Hoover, et al., 2016. extension.org/apples

Tepe, E., E. Hoover, et al., 2016. Commercial Fruit Extension (fruit.cfans.umn.edu)

Tepe E. and E. Hoover, 2016. Growing Fruit in the Northern Garden (available free on iBooks)

Warmund, M. 2016. The dangers of drought on fruit crops. M) Environment and Garden newsletter. June 2016. <http://ipm.missouri.edu/MEG/archive/2016/v22n6.pdf>.

Warmund, M. 2016. Split Pits in Peaches. Environment and Garden newsletter. July 2016. <http://ipm.missouri.edu/MEG/archive/2016/v22n7.pdf>.

Wolfe, D., D. Archbold, J. Johnston, and G. Travis. 2016. Rootstock Effects on Apple and Peach Tree Growth and Yield. Fruit and Vegetable Crops 2015 Research Report. University of Kentucky College of Agriculture, Agricultural Experiment Station publication. PR-688:9-12. <http://www2.ca.uky.edu/agcomm/pubs/PR/PR706/PR706.pdf>

Peck, G. and K. Yoder. 2016. 2015 Progress Report to the Virginia Apple Research Program: Continued Investigations into New Rootstocks, Cultivars, and Training Systems for Virginia. Virginia Fruit 97(1):7-11. (Apr 2016).

Thompson, A. and G. Peck. 2015. 2014 Progress Report to the Virginia Apple Research Program: Fine-tuning fertilizer recommendations for young apple trees in high-density plantings. Virginia Fruit 97(1):12-18 (Apr 2016).

### **Other Creative Works**

Basedow, M., R. Crassweller, J. Schupp and T. Baugher. 2016. Bench Grafting <https://youtu.be/ADIIcQGwAWA>

Basedow, M., J. Schupp, R. Crassweller, and T. Baugher. 2016. Bark Grafting. <https://youtu.be/MQFuJGngs.3M>

Lang, G.A. 2016. Cherry training systems – from traditional to transformative? American Fruit Grower 136(11):15-16. <http://www.growingproduce.com/fruits/stone-fruit/cherry-trainingsystems-from-traditional-to-transformative/>

Lang, G.A. 2016. Take a close look at the Tall Spindle Axe. American Fruit Grower 136(8):18-19. <http://www.growingproduce.com/fruits/stone-fruit/take-a-closer-look-at-the-tall-spindle-axetraining-system/>

Blatt, S. 2016. CBC News: Nova Scotia researchers growing dwarf cherry trees. <http://www.cbc.ca/news/canada/nova-scotia/dwarf-cherry-trees-growing-1.3687577>.

Crassweller, R., L. Kime, and J. Harper. 2016. Agricultural Alternatives: Apple Production. Publication UA428. (complete revision) also on internet at <http://extension.psu.edu/business/ag-alternatives/horticulture/fruits/apple-production>

North Carolina State University produced 2 videos on apple rootstocks and higher density training systems.

### **Scientific and Outreach Oral Presentations**

Adams, S. and B. Black 27 Jan 2016. "Apple and Peach Rootstock Update." A presentation at the Northern Utah Fruit Meeting. Brigham City, UT (50 attendees).

Adams, S. and B. Black. 18 February 2016. "Nursery Tree and Rootstock Considerations." A presentation in the Small Acreage Tree Fruit Basics session at the Utah Urban and Small Farms Conference, West Jordan, UT (45 attendees)

Black, B. and T. Roper. 28 June 2016. NC-140 plantings were featured at the Kaysville Fruit and Vegetable Field day. The tree fruit sessions had over 60 participants.

Autio, W.R. 2016. Update and tour of the current NC-140 trials at the UMass Cold Spring Orchard. Massachusetts Fruit Growers' Association Annual Summer Meeting, July 13, 2016.

Beckman, T. 2016. Post-release performance of MP-29, an interspecific plum-peach hybrid rootstock for peach. Annual Meeting of the American Society for Horticultural Science. Aug. 2016, Atlanta, GA.

Blatt, S. 2016. Odds and Ends: Rootstocks, bugs and sterility. Nova Scotia Fruit Growers Association Annual Convention, Greenwich, NS, 28 January 2016. Oral presentation to members of the Nova Scotia, New Brunswick and PEI tree fruit industry.

Blatt, S. 2016. Update on NC-140 Rootstock trials: Honeycrisp, Sweet Cherry and Modi. Oral presentation of my research results to members of the NS, NB and PEI tree fruit industry. Field Orchard Tour hosted by the Nova Scotia Fruit Growers Association, August 2016.

Casamali, B., M. Van Iersel, and D.J. Chavez. 2016. Irrigation and fertilization rates for young peach trees [*Prunus persica* L. (Batsch)]. Annual Meeting of the American Society for Horticultural Science. Aug. 2016, Atlanta, GA.

Cline, J. A. and D. Plotkowski. 2016. Industry Apple Tailgate Tour of the 2014 NC-140 Apple Rootstock Planting and 2015 European Cider Planting. August 15, 2016. University of Guelph, Simcoe.

Cochran, D.R. 2016. 'Honeycrisp' apple rootstock trial update. Iowa Fruit and Vegetable Annual Conference, Ankeny, IA, January 29, 2016.

Cochran, D.R. 2016. NC-140 'Honeycrisp' rootstock trial update 2016. Iowa State University Fruit and Vegetable Growers Field Day, Horticulture Research Farm, IA, August 15, 2016.

Cochran, D.R. 2016. Establishing an Orchard. Iowa Small Farms Conference, Scheman Continuing Education Building, Ames, IA, February 13, 2016.

Conlan, E., J. Liu, D.J. Chavez, O. Lindstrom, and M.A. Olmstead. 2016. Peach critical bud temperatures for different phenological bud stages. Annual Meeting of the Florida State Horticulture Society.

Crassweller, R. M. 2016. Cherry Rootstock Update. Presented at Mid-Atlantic Fruit & Vegetable Conference 2/4/16. Hershey, PA.

- Elkin, R. 2016. Rootstocks and orchard systems for European pears; 2014 Sacramento River District Pear Research Meeting (February 3, 2016) and 2016 North Coast Pear Research Meeting, Feb. 9, 2016. <http://www.calpear.com/research/>.
- Marini, R.P. 2016. Two Decades of NC140 Trial Results. 2016 IFTA Pre-Conference Intensive Workshop. Grand Rapids, MI. Feb. 6, 2016.
- Fallahi, E. 2015. NC-140 Fuji/Rootstock Report. Annual Conference of the Idaho State Horticultural Society, Nampa, Idaho. Nov. 12-13, 2015
- Fallahi, E. 2016. Training on Growing Apples on Different Rootstocks. Idaho apple growers March tour. March 8, 2016
- Fallahi, E. 2016. Performance of Apple Rootstocks under Intermountain West Conditions. University of Idaho Pomology Program Fruit Field Day. Sept. 16, 2016.
- Lang, G.A. 2016. Evolution of Precision Orchard Production Systems. *International Fruit Tree Association annual conference*, Grand Rapids, MI, Feb. 7-10.
- Lang, G.A. 2016. The Fruiting Wall Orchard: Tree Training Results for Sweet Cherries, Nectarines, Apricots, and Plums. *ASHS annual conference*, Atlanta, GA, Aug. 8-11.
- Lang, G.A. 2016. Sweet Cherry Orchard Designs: The Force Awakens, *NW Orchard and Vineyard Show*, Traverse City, MI; Jan. 12-13.
- Lang, G.A. 2016. Update on Apple Rootstock Research at MSU, *SW Hort Days*, Benton Harbor, MI; Feb 4.
- Lang, G. 2016. High Density Training Systems and Protected Production of Sweet Cherries, *MSU Clarksville Research Center Field Day*, Clarksville, MI, June 22.
- Lang, G.A. 2016. Sistemas Intensivos de Producción de Cerezas: Manejo Sostenible. 7th Region Extension (Curico, Chile), Oct. 18-19.
- Liu, J., A. Malladi, O. Lindstrom, E. Smith, M. Olmstead, and D.J. Chavez. 2016. Revisiting cold hardiness of peach [*Prunus persica* (L.) Batsch] in Georgia. Annual Meeting of the American Society for Horticultural Science. Aug. 2016, Atlanta, GA.
- Liu, J., A. Malladi, O. Lindstrom, E. Smith, M. Olmstead, and D.J. Chavez. 2016. Differential thermal analyses in peach [*Prunus persica* (L.) Batsch]. Annual Meeting of the American Society for Horticultural Science. Aug. 2016, Atlanta, GA. [poster]
- Lordan, J., Robinson, T.L., Blatt, S., Francescotto, P., Embree, C., 2016b. Performance of pear rootstocks in North America, ASHS Annual Conference. ASHS, Atlanta, Georgia, USA.
- Moran, R., B. Peterson, G. Fazio, and J. Cline. 2016. Seasonal and genotypic variation in cold temperature tolerance of apple rootstocks. Annual Meeting of the American Society for Horticultural Science Conference. Atlanta, GA. Aug. 2016.
- Moran, R. 2015. Pruning and Training Apple Trees. Summary of training systems including the use of size-controlling rootstocks for apple. Ehmej, Bcharre, and Jbeil, Lebanon, ME. Oct. 22 - Nov.3, 2015.

Moran, R. 2016. Highmoor Farm Tree Fruit Research Summary. Maine Ag. Trades Show, Augusta, ME, January 14, 2016.

Parker, M.L. January 2016. Peach Production Orchard Tour and Workshop with an emphasis on peach rootstocks and subsequent management. Attendance 50.

Parker, M.L. January 2016. North Carolina Peach Growers Society. Carthage, NC. Commercial grower audience. Attendance 85.

Parker, M.L. February 2016. Western District Apple School, Hendersonville, NC. Commercial grower audience. Attendance 110.

Parker, M.L. February 2016. Maximizing Orchard Productivity in the Brushy Mts., Wilkesboro, NC. Commercial grower audience. Attendance 40.

Reighard, G.L. 2016. Krymsk® and other stone fruit rootstocks. Ontario Fruit and Vegetable Convention, Niagara Falls, Ontario, February 16, 2016.

Reighard, G.L. 2016. Peach rootstocks for efficient orchard training and production systems. IFTA 59th Annual Conference. Grand Rapids, MI. February 8, 2016.

Reighard, G.L. 2016. Nitrogen nutrition and bacterial canker association on replant sites. SE Regional Fruit & Vegetable Conference. Savannah, GA. Jan. 9, 2016.

Thompson A. and G.M. Peck. Fine tuning fertilizer recommendations for young apple trees in high-density plantings. Cumberland Shenandoah Fruit Workers Meeting. 2015.

Peck, G.M. and A.A. Thompson. Soil microbial mediation of mineral uptake by apple rootstock. American Society for Horticulture Science General Meeting. 2016.

Wolfe, D. 2016. Apple and peach rootstock trials in Kentucky. UKREC Horticulture Field Day. June, 25, 2016.

Shengrui Yao. 2016. Fruit research update at NMSU Alcalde Center (with 2015 organic apple rootstock trial included). Presented at the New Mexico Fruit Growers Annual Workshop on March 4, 2016.

Yoder, K. 13 Aug 2016. Open House at the Alson H. Smith, Jr. AREC: Tour of the Horticulture and Pathology plantings. Winchester, VA. General public. Attendance: 65.

***Fund Leveraging, specifically, collaborative grants between stations and members.***

NC-140 members have written research proposals and attracted extramural funding associated or directly related to the five objectives of this project from local, regional, national and international funding sources. For fiscal year 2015/2016, funding and matching funds reported by members amounted to **\$1,590,140** plus **\$38,000** in-kind support from primarily commodity groups, state and competitive grant sources.

Autio, W, R Marini, J Cline, G Reighard, G Lang, and T Einhorn. 2016. NC-140 Rootstock Research Trial Coordinators. International Fruit Tree Association. \$10,000.

Cline, J. 2016. Canadian Horticultural Council. \$30,000

Cochran, D.R. 2016. Dwarfing Rootstocks. Iowa Dept. of Agri. and Land Stewardship Specialty Crop Block Grant. \$1,700 in-kind for land and equipment usage plus \$11,000.

Elkins, R. 2016. Rootstocks, Orchard Systems, and Cultivars for European Pears. California Pear Advisory Board. \$17,973.

Fallahi, E. 2016. Evaluation of leaf minerals and fruit quality attributes of mature 'Aztec' Fuji trees on different rootstocks, tree girdling, and canopy designs. Block Grant, Idaho State Department of Agriculture \$53,500.

Fallahi, E. 2016. Support in kind for agricultural chemicals from Wilbur Ellis Company, University of Idaho. \$6,000.

Fallahi, E. 2015. Labor and equipment (in-kind) from Idaho fruit industry for operation of various apple rootstock projects. Idaho Fruit Industry. \$6,800.00

Cheng et al., 2016. Accelerating the Development, Evaluation, and Adoption of New Apple Rootstock Technologies to Improve Apple Grower Profitability and Sustainability. USDA-SCRISREP. \$4,281,618.

Lang, G.A. 2016. Competitive Orchards 2020: Integrating Tree Fruit Cropping Physiology, Canopy Architectures, Climate Modification Technologies, and Pest Management Strategies. Project GREEN. \$38,800.

Lang, G.A. 2016. Preserving 'Honeycrisp' Apple Quality and Profitability. Project GREEN. \$36,500.

Lang, G.A. 2016. Apple Rootstock Evaluations. Michigan Apple Committee. \$15,251.

Lang, G.A. 2016. Bitter Pit in 'Honeycrisp'. Michigan Apple Committee. \$12,703.

Lang, G.A. 2016. Sweet Cherry Orchard Designs. Michigan Cherry Committee. \$10,000.

Lang, G.A. 2016. Trellised Protected Orchard Systems. International Fruit Tree Association. \$9,000.

Lang, G.A. 2016. Fruiting Wall Orchard Systems for Stone Fruits. International Fruit Tree Association. \$4,000.

Lang, G.A. 2016. Fruiting Wall and High Tunnel Stone Fruit Production. Michigan State Horticultural Society. \$8,124.

Lang, G.A. 2016. (in-kind). Michigan Tree Fruit Commission; \$24,500 nursery tree purchases, plot preparation and establishment, irrigation installation, deer fence for new cherry trials.

Lang, G.A. 2016. (in-kind). Michigan Tree Fruit Commission; \$124,000 mechanized orchard platforms for orchard research at Northwest Michigan and Clarksville Research Centers.

Lang, G.A. 2016. (in-kind). Al-Mar Orchards, Flushing, MI; Land use and maintenance for apple rootstock trial. \$2,500

Lang, G.A. 2016. (in-kind). Rasch Orchards, Sparta, MI; Land use and maintenance for apple rootstock trial. \$2,500

Parker, M.L. NC Legislature/Special Bill funding for apple research - \$9,000.

Wolfe, D. 2013-2017. New peach/nectarine cultivar planting. Cumberland Valley Nursery. \$1000.

Wolfe, D. 2014-2017. Technical Staffing from Kentucky Agricultural Development Board / Kentucky Horticulture Council grant. Infrastructure for Kentucky Horticulture. \$53,645

New York. 2016. - Evaluation of the Cornell-Geneva Apple Rootstocks and Other Promising Apple Rootstocks. - Sponsored by International Fruit Tree Association (\$10,000).

New York. 2016. High-Density Planting Systems and Rootstocks for Sweet Cherries in the East. - Sponsored by International Fruit Tree Association (\$9,000).

New York. 2106. Orchard management systems for improved yield and fruit quality – Sponsored by Apple Research and Development Program (\$68,000).

Reighard, G. 2016. Guardian® seed sales. South Carolina Foundation Seed. \$214,000.

Reighard, G. 2016. “Screening peach rootstocks for adaptability, productivity, and tolerance to *Armillaria* and bacterial canker”. South Carolina Peach Council research grant. \$4,000.

Saski, Gasic, Reighard, et al. 2016. Genomics of *Armillaria* resistant *Prunus* genotypes. Wells Fargo Grant \$150,000.

Robinson, T. and B. Black. 2015-2016. Scion – rootstock interactions and their effect on graft union break strength of apple. International Fruit Tree Association. \$10,000.

Black, B. 2014-2017. A Comparison of Water Relations and WUE Among Fruit Tree Rootstocks. Utah Dept. Ag. & Food, Specialty Crop Block Grant. \$31,029.

Shengrui Yao, Robert Heyduck and Steve Guldan. 2014-2017. Organic apple high density planting in New Mexico. Specialty Crop Block Grant through NM Department of Agriculture. \$27,242.

Song, J, Forge, T, Blatt, S, Neilsen D, Forney, C and Burgher-MacLellan, K. 2015-2018 (3 years). Costs of supporting the apple and cherry rootstock trials covered by AAFC’s A-base funding, project J-001036.001: ‘Developing more resilient tree fruit production systems from the ground up: Rootstocks with enhanced tolerance to emerging biotic threats to orchard health’.

Yoder, K.S. 2016-2017. New Rootstocks, Cultivars, and Training Systems for Virginia, project support for 2016. Virginia Apple Research Program. \$6,125.

Yoder, K.S. 2016-2017. Apple rootstock susceptibility to Tomato Ring Spot Virus (TmRSV) and latent viruses. Virginia Apple Research Program. \$9,500.

Peck, G.M. and M. Williams. 2014-2017. Towards ecologically-based fertilizer recommendations that improve soil quality in high-density apple orchards. USDA-NIFA, Southern Sustainable Agriculture Research and Extension Program (SSARE). \$140,000.

Peck, G.M. and K.S. Yoder. 2014-2016. Advancing Organic Apple Production in Virginia. Virginia Department of Agriculture and Consumer Services-Specialty Crop Block Grant. \$38,166.

Yoder, K.S. and G.M. Peck. 2014-2016. Susceptibility of new apple rootstocks to Tomato Ringspot Virus (TmRSV). Virginia Agricultural Council. \$2,000.

Peck, G.M. 2015-2016. Integrated Approaches for Reducing Synthetic Fertilizer Inputs in Apple Orchards. Virginia Agricultural Council. \$21,683.

Peck, G.M., A.T. Thompson, and D. Carbaugh. 2015-2016. Fine-tuning fertilizer recommendations for young apple trees in high-density plantings: Year Three, 2015. Virginia Apple Research Program. \$10,000.

Stefano Musacchi, Karen Lewis, Karina Gallardo, Tom Auvil. 2014-2017. WA 38 Rootstock and Systems Trial. Washington Tree Fruit Research Commission (WTFRC) Total Budget: 242,519 US\$ personal budget: \$133,495.

Kate Evans and Amit Dhingra. 2015-2018. Developing the foundation for U.S. pear rootstock breeding. PNW Pear Bureau. Budget: \$273,253.

Stefano Musacchi, Lee Kalcsits, Desmond Layne and Karina Gallardo. 2015-2018. Cosmic Crisp™: Training system and orchard management to optimize vigor control and quality. Specialty Crop Block Grant Program. Total budget \$249,191. Personal budget: \$104,865.

Stasiak, M. 2016. Door & Kewaunee Co. commercial fruit research and outreach support to cover apple rootstock planting maintenance. \$5,000.

Stasiak, M. and Atucha. 2016. Wisconsin Apple Growers Association funding for evaluation of NC140 apple rootstocks in Wisconsin. \$3,225.

Crassweller, R. J. Schupp, D. Smith. 2016. Apple Rootstock and Cultivar Evaluations. (continuing) 50%. SHAP Research Committee RMC = \$11,635, Total budget = \$18,932.

Crassweller, R. and D. Smith. 2016. SHAP Second Generation Apple System Trials. Endowment Committee. Year 9 of 10. RMC = 100%, Total budget = \$7,000

Crassweller, R.M. and D. E. Smith. 2016. New Apple Rootstocks' Influence on Mineral Composition of Leaves and Fruit. SARE On-farm Research/Partnership Project \$14,562