

SAES-422 Multistate Research Activity Accomplishments Report

Project No.: NC140

Project Title: IMPROVING ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY IN TREE-FRUIT PRODUCTION THROUGH CHANGES IN ROOTSTOCK USE

Period Covered: 10-2010 to 09-2011

Date of This Report: Nov. 15, 2011

Annual Meeting Dates: Nov. 2-4, 2011

Participants

ULR of the minutes

Although not in attendance, reports were submitted by Auburn - Alabama, AgCanada British Columbia and AgCanada Nova Scotia.

Brief Summary of Minutes of Annual Meeting

Greg Reighard was elected secretary for next year and agreed to host meetings in 2014 in South Carolina. Next years' meeting will be held in Portland, Maine with tentative dates being Nov. 8-9.

Virginia Tech membership was approved with a unanimous vote. Gregory Peck was the attending representative.

Accomplishments

Technical sub-committees for four fruit commodities (apple, cherry, peach, and pear) met to discuss management protocols of existing plantings and to discuss potential future plantings.

Apple Sub-Committee (T. Robinson, Chair). Plans for a new multi-location dwarfing rootstock study were finalized with three untested ones from the Vineland series, several from the Malling series, and possibly a few others from HortResearch. Trees will be propagated for planting in 2014. Sites that do not currently have a planting were given priority. Another multi-location trial for planting in 2015 with several from the Geneva series is also being planned.

Cherry Sub-Committee (G. Lang, Chair). The Cherry Subcommittee met to discuss current and future plantings. The current planting is a sweet cherry training systems trial with 3 precocious rootstocks, Gi3, Gi5, and Gi6, planted at 10 sites (originally 13). Growth was generally good in 2011, with better development within each of the training systems, setting up the first potentially significant fruiting in 2012. Critical data to be taken and 2012 pruning and training protocols were identified and discussed. Planning for a proposed coordinated trial to propagate, plant in 2015, and evaluate new rootstocks for both sweet and tart cherries was begun.

Peach Sub-Committee (G. Reighard, Chair). A 2016 peach rootstock planting was planned with rootstocks coming from the breeding programs at USDA-Byron, Georgia, U.C. Davis, California and Agromillora Catalan, Barcelona, Spain as well as any new releases from private nursery breeding programs in California. A cold hardiness study was again discussed with Utah and

Missouri planning on beginning the work in 2012-2013. Other states such as South Carolina may be involved.

Pear Sub-Committee (T. Einhorn, Chair). The 5 year report of the 2005 pear trial was presented at the ISHS Pear Symposium in Argentina in November 2010 and the Acta article is in press. There will be a systems trial planted in 2013 in 3 states: WA (Todd Einhorn), CA (Rachel Elkins), and NY (Terence Robinson). Todd Einhorn, with Joseph Postman, has been evaluating quince selections for cold hardiness and the best of these will be placed in a trial in 2015 or 2016. The group decided to do a separate trial of several Amelanchier rootstocks (exact year TBD). The pear group, along with the Pyrus Crop Germplasm Committee, will work with nurseries and rootstock importers to obtain new rootstock material for evaluation.

Objective 1. To evaluate the influence of rootstocks on temperate-zone fruit trees characteristics grown under different management systems and environmental conditions.

Existing plantings will be maintained and data collection will continue according to protocols developed by the respective technical committees. Planting coordinators will analyze and summarize data from the various sites for each coordinated planting, and will lead in writing 5-year progress reports and 10-year final reports for publication.

Concluded projects

- 1999 Dwarf and Semi-dwarf Fuji/McIntosh apple rootstock trial was completed last year, and results were published.
- 2002 Gala apple rootstock trial with 7 cooperating sites will be completed this fall.
- 2002 Cameo apple rootstock trial with 2 locations in the eastern USA is completed, and two papers are in preparation.
- 2002 Honeycrisp trial in 2 locations in New York was completed and data was published.
- 2002 Pear rootstock trial in 4 locations was completed and a paper is in preparation.
- 2003 Apple physiology study in 10 locations has been completed, and 3 papers are in preparation.
- 2003 Vineland apple rootstock study in 1 location (BC) was completed and a manuscript was submitted for review and publication in the Journal of the Amer. Pom. Society.
- 2006 Gala apple replant trial at 10 locations was completed, and data has been summarized (see objective 4).

Ongoing projects

Data was collected and summarized for each of the following studies:

- 2003 Golden Delicious apple rootstock trial at 9 locations.
- 2004 Pear rootstock trial at 3 locations.
- 2005 Pear rootstock trials at 6 locations.
- 2006 Cherry physiology trial 4 locations.
- 2007 Apple rootstocks trial in 2 locations (PA)
- 2008 Apple systems trial in 1 location (PA)
- 2008 Peach rootstock trial in 1 location (PA)
- 2009 Peach rootstock trial in 15 locations and the physiology trials in 13 locations.
- 2009 St. Jean apple rootstock trial in 1 location (BC).
- 2010 Apple rootstock trial in 22 locations.

- 2010 Cherry rootstock and training systems trial in 3 locations
- 2010 Apple rootstock trial in one location (MD).

Objective 2. To develop and improve rootstocks for temperate-zone fruit trees with breeding and genetic engineering, to improve propagation techniques for rootstocks, and to acquire new rootstocks from worldwide sources.

Cornell Univ., in cooperation with the USDA-ARS Geneva, continued to develop and test new rootstocks. Elite selections from the Geneva series are also being evaluated by the Univ. of Maryland.

Apple cultivars with the *Co* gene grown on their own roots are being evaluated for adaptation to conditions of the mid-Atlantic region. Tree architecture of these apple cultivars are being evaluated for horticultural traits, disease susceptibility and water use efficiency (MD and USDA-ARS Kearneysville).

An RNAi strategy for silencing sweet cherry viruses is being tested. 20 transgenic rootstock lines were generated, a portion of which was grafted and inoculated (MI).

Objective 3. To study the genetics and developmental physiology of rootstock/scion interactions in temperate-zone fruit trees.

A breeding program in Michigan has developed a new series of tart cherry rootstocks which will be evaluated in the next NC-140 cherry rootstock trial. Four rootstocks look promising. (MI)

A breeding program in California has a large number of stone fruit selections, and several have been grafted for further testing. Three are in the process of being patented for release and one is planned for a future release.

Objective 4. To better understand the response to and impacts of biotic and abiotic stresses on scion/rootstock combinations in temperate-zone fruit trees.

A peach alkalinity tolerance rootstock trial was continued in Utah.

A multi-site field trial of Gala on 12 rootstocks was conducted for tolerance to replant disease. This trial began in 2006 and data collection was complete in 2010. Trees on G.6210, M.9T337 and G.935 grew better on unfumigated soil than on fumigated soil.

Geneva rootstocks will be evaluated for fireblight tolerance in a hot, humid climate. Trees were planted in 2011 for ongoing evaluation of survival (MD and USDA-ARS Geneva).

Three locations are evaluating the cold temperature tolerance of apple rootstocks (MN, MO and ME). Apple rootstocks are being evaluated for performance in a cold climate (MN). An apple rootstock study was established in 2007 to determine the relationship between the amount of blackheart and tree performance (MO). Mid winter cold hardiness of B.9, G.11, P.2, and G.30 apple roots was similar to M.26, but greater than M.26 in G.935 (ME and USDA-ARS Geneva).

Impacts

1. Results from NC-140 research continue to direct the commercialization of tree fruit rootstocks. Changes in rootstock use by the industry are evident. Each year, at least 12 million apple trees are planted and 92% of these are now on dwarfing rootstocks. The value of increased production from using dwarfing rootstocks is estimated to be \$500 million (G. Fazio in Good Fruit Grower, April 15, 2011, p. 18-19).
2. The group website (www.nc140.org) is becoming an important source for information on new rootstocks. An eXtension website (www.extension.org/apples) for apple rootstocks was developed and launched in September 2011.
3. Collaborative research under this group led to 38 refereed research publications, and 22 technical reports and extension publications that reached fruit growers throughout North America. Seven articles in trade journals featured the NC-140 project.

Refereed Publications

- Autio, W., T. Robinson, B. Black, T. Bradshaw, J. Cline, R. Crassweller, C. Embree, E. Hoover, S. Hoying, K. Iungerman, R. Johnson, G. Lang, M. Parker, G. Reighard, J. Schupp, M. Stasiak, M. Warmund, and D. Wolfe. 2011. Performance of Fuji and McIntosh apple trees after 10 years as affected by several dwarf rootstocks in the 1999 NC-140 Apple Rootstock Trial. *J. Amer. Pomol. Soc.* 65(2):2-20.
- Autio, W., T. Robinson, B. Black, T. Bradshaw, J. Cline, R. Crassweller, C. Embree, E. Hoover, S. Hoying, K. Iungerman, R. Johnson, G. Lang, M. Parker, R. Perry, G. Reighard, M. Stasiak, M. Warmund, and D. Wolfe. Performance of Fuji and McIntosh apple trees after 10 years as affected by several semidwarf rootstocks in the 1999 NC-140 Apple Rootstock Trial. 2011. *J. Amer. Pomol. Soc.* 65(2):21-38.
- Autio, W., T. Robinson, J. Cline, R. Crassweller, C. Embree, E. Hoover, G. Lang, J. Masabni, M. Parker, G. Reighard, and M. Warmund. 2011. Performance of several semidwarfing rootstocks with 'Fuji' and 'McIntosh' as scion cultivars in the 1999 NC-140 Semidwarf Apple Rootstock Trials. *Acta Hort.* 903:327-334.
- Autio, W., T. Robinson, J. Cline, R. Crassweller, C. Embree, E. Hoover, G. Lang, J. Masabni, M. Parker, G. Reighard, and M. Warmund. 2011. Performance of several dwarfing rootstocks with 'Fuji' and 'McIntosh' as scion cultivars in the 1999 NC-140 Dwarf Apple Rootstock Trials. *Acta Hort.* 903:319-326.
- Autio, W., T. Robinson, W. Cowgill, C. Hampson, M. Kushad, G. Lang, J. Masabni, D. Miller, R. Parra Quezada, and C. Rom. 2011. Performance of 'Gala' apple trees on Supporter 4 and different strains of B.9, M.9, and M.26 rootstocks as part of the 2002 NC-140 Apple Rootstock Trial. *Acta Hort.* 903:311-318.
- Baugher, T.A., J. Schupp, K. Ellis, J. Remcheck, E. Winzeler, R. duncan, S. Johnson, K. Lewis, G. Reighard, G. Henderson, M. Norton, A. Dhaddey, and P. Heinemann. 2010. String blossom thinner designed for variable tree forms increase crop load management efficiency in trials in four United States peach-growing regions. *HortTechnology* 20(2):409-414.
- Black, B.L., D. Drost, T. Lindstrom, J. Reeve, J. Gunnell and G. L. Reighard. 2010. A comparison of root distribution patterns among *Prunus* rootstocks. *J. American Pomological Society* 64 (1): 52-62.
- Black, B.L., Drost, D., Lindstrom, T. and Reighard, G.L. 2011. Sampling to Compare Relative Root Distribution in Fruit Trees. *Acta Hort.* 903:949-953.
- Beckman, T. 2011. Progress in developing Armillaria resistant rootstocks for use with peach. *Acta Hort.* 903:215-220.

- Crassweller, R.M. and Smith, D.E. 2011. Influence of training system on production of three apple cultivars. *Acta Hort.* 903:619-626.
- Elkins, R.B. and T.M. DeJong. 2011. Performance of 'Golden Russet Bosc' on five training systems and nine rootstocks. *Acta Hort* 903.
- Fazio, G., H. Aldwinkle, T. Robinson, and Y. Wan. 2011. Implementation of molecular marker technologies in the apple rootstock breeding program in Geneva – challenges and successes. *Acta Hort.* 903:61-68.
- Fuller, K.D., Embree, C.G., Fillmore, S.A.E., St. George, E., Nichols, D.S. and Lutz, L. 2011. Performance of Geneva[®] 30 apple rootstock in Nova Scotia. *Acta Hort.* 903:273-279
- Harshman, J., C. Walsh, J. Daberkow, K. Sparkd, M. Newell and G. Welsh. 2011. Hybridizing 'McIntosh Wijick' and heat tolerant apple cultivars to develop precocious seedling trees with improved tree architecture. *Acta Hort.* 903:193-197.
- Hoover, E., S. McKay, A. Telias and D. Bedford. 2011. Degree of dwarfing and productivity of eight apple rootstocks with winter hardy scions. *Acta Hort.* 903:295-299.
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- Jiménez S, Z. Li, G.L. Reighard, and D.G. Bielenberg. 2010. Identification of genes associated with growth cessation and bud dormancy release using a dormancy-incapable tree mutant. *BMC Plant Biology* 10(25).
- Johnson, S, R. Andersen, W. Autio, T. Beckman, B. Black, P. Byers, J. Cline, C. Chavez-Gonzalez, W. Cowgill, R. Godin, G. Greene, M. Kaps, J. Kamas, H. Larsen, T. Lindstrom, D. Miller, M. Newell, D. Ophardt, D. Ouellette, R. Parra-Quezada, R. Pokharel, G. Reighard, T. Robinson, J. Schupp, L. Stein, K. Taylor, C. Walsh, D. Ward, M. Warmund, and M. Whiting. 2011. Performance of the 2002 NC-140 Cooperative Peach Rootstock Planting. *J. Amer. Pomol. Soc.* 65:17-25.
- Johnson, S., M. Newell, G. Reighard, T. Robinson, K. Taylor, and D. Ward. 2011. Weather conditions affect fruit weight, harvest date and soluble solids content of 'Cresthaven' peaches. *Acta Hort.* 903:1063-1068.
- Kviklys, D. and T. Robinson. 2011. Temperature before and after application of chemical thinners affects thinning response of 'Empire' apple trees. *Acta Hort.* 884:884-525.
- Lang, G., T. Robinson, J. Freer, H. Larsen, and R. Pokharel. 2011. Differences in mineral nutrient concentration of dormant cherry spurs as affected by rootstock, scion, and orchard site. *Acta Hort.* 903:963-971.
- Lang, G., Valentino, T., Demirsoy, H. and Demirsoy, L. 2011. High tunnel sweet cherry studies: Innovative integration of precision canopies, precocious rootstocks, and environmental physiology. *Acta Hort.* 903:717-723.
- McArtney, S. and J. Obermiller. 2011. Effect of dwarfing rootstocks on low temperature tolerance of 'Golden Delicious' apple trees during winter 2008-2009.
- Miller, D.D. and Racsko, J. 2011. Rootstock effects on fruit drop and quality of 'Gala Galaxy' and 'Golden Delicious Reinders' apples. *Acta Hort.* 903:397-404.
- Moran, R., D. Zhang and Y. Sun. 2010. Cold temperature tolerance of apple roots. *Acta Hort.* 903:289-293.

- Parker, M.L., Ritchie, D. and Reighard, G.L. 2011. Guardian[®] peach rootstock performance and preplant soil fumigation effects in a fallow site. *Acta Hort.* 903:469-473.
- Racsko, J. and Miller, D.D. 2011. Effect of different growth inducing rootstocks on alternate bearing of 'Royal Gala' and 'Vista Bella' apples. *Acta Hort.* 903:411-418
- Reginato, G. T. Robinson, and T. Yoon. 2011. Crop regulation and cytokinin sprays to improve 'Sweetheart' sweet cherry fruit size. *Acta Hort.* 903:849-856.
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- Robinson, T. and A. Lakso. 2011. Predicting chemical thinner response with a carbohydrate model. *Acta Hort.* 903:743-750.
- Robinson, T. S. Hoying and G. Fazio. 2011. Performance of Geneva[®] rootstocks in on-farm trials in New York State. *Acta Hort.* 903:249-255.
- Robinson, T. S. Hoying and G. Reginato. 2011. The Tall Spindle planting system: Principles and performance. *Acta Hort.* 903:571-579.
- Robinson, T., D. Wolfe, J. Masabni, R. Andersen, A. Azarenko, J. Freer, G. Reighard, P. Hirst, R. Hayden, and B. McCluskey. 2010. Performance of Plum Rootstocks with 'Stanley', 'Valor', 'Veeblue', and 'Santa Rosa' as the scions in the 1991 NC-140 Multi-State Plum Trial. *J. Amer. Pomol. Soc.* 64(3): 173-182.
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- Yoon, T., T. Robinson and G. Reginato. 2011. Effects of temperature and light level on efficiency of chemical thinner on 'Empire' apple trees. *Acta Hort.* 903:1085-1093.

Technical Reports and Extension Publications

- Agnello, A., A. Landers, D. Rosenberger, T. Robinson, J. Carroll, L. Cheng, P. Curtis, D. Breth, and S. Hoying. 2011. Pest Management Guidelines for Commercial Tree Fruit Production 2011. Cornell University, 252 pp.
- Autio, W., T. Robinson, B. Black, T. Bradshaw, J. Cline, R. Crassweller, C. Embree, E. Hoover, S. Hoying, K. Iungerman, R. Johnson, G. Lang, M. Parker, R. Perry, G. Reighard, J. Schupp, M. Stasiak, M. Warmund, and D. Wolfe. 2011. Performance of Fuji and McIntosh apple trees after 10 years as affected by several dwarf rootstocks – Final report of the 1999 NC-140 Dwarf Apple Rootstock Trial. *Compact Fruit Tree* 44(2):18-21.
- Autio, W., J. Krupa, J. Clements, W. Cowgill, and R. Magron. 2011. Comparing strains of B.9, M.26, M.9, P.14, and three Pillnitz rootstocks: 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey. *Fruit Notes* 76(3):6-10.

- Autio, W., J. Krupa, J. Clements, W. Cowgill, and R. Magron. 2011. Comparing strains of B.9, M.26, M.9, P.14, and three Pillnitz rootstocks: 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey. *Horticultural News* 91(3):6-10.
- Carroll, J., T. Robinson, T. Burr, and S. Hoying. 2010. Effect of spring-pruning method, copper sprays and training systems on bacterial canker of sweet cherry. NYS IPM Program Project Report.
- Clements, J., W. Cowgill and W. Autio. 2010. To-date performance of three dwarf rootstocks in the 2002 NC-140 apple/Cameo rootstock trial in Massachusetts and New Jersey. *Fruit Notes* Vol. 75.
- Crassweller, R. and D. Smith. 2011. Influence of training systems on cropping and labor requirements on Jonagold and Fuji in their third growing season. *PA Fruit News* 91:56-60.
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- Domoto, P. and L. Schroeder. 2011. Performance of an established dwarf apple rootstock trial (2003 NC-140) *Ann. Prog. Rept. 2010 for Hort. Res. Stn. ISRF10-36:27-28.*
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- Elkins, R. 2011. Evaluation of potential new size controlling rootstocks for European pear. 2010 California Pear Research Report, p. 108-116, www.calpear.com/_pdf/research-reports/2010_NC-140_Report.pdf (accessed October 28, 2011).
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- Miranda-Sazo, M. and T. Robinson. 2011. The use of plant growth regulators for branching of nursery trees in NY State. *NY Fruit Quarterly* 19(2):5-9.
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- Robinson, T. 2010. Performance of high-density planting systems and rootstocks for sweet cherries in the Northeast. *Compact Fruit Tree* 43(3):2-9.
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- Schupp, J., T. Baugher, R. Crassweller, K. Ellis, E. Winzeler, J. Remcheck and T. Kon. 2010. Labor efficient production systems. *PA Fruit News* 90(2):31-34.
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- Lehnert, R. 2011. Resistant rootstocks key to surviving fireblight. Good Fruit Grower, February 15, 2011, p. 21-23.
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- Warner, G. 2011. Geneva rootstocks in production. Good Fruit Grower, April 15, 2011, p. 22-23.
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