SAES-422 Multistate Research Activity Accomplishments Report

Project No. and Title: NC140 Improving Economic and Environmental Sustainability in Tree-Fruit Production Through Changes in Rootstock Use

Period Covered: 10-2011 to 09-2012
Date of Report: 21-Nov-2012
Annual Meeting Dates: 08-Nov-2012 to 09-Nov-2012

Participants
ULR for the Minutes: www.nc140.org

Brief Summary of Minutes of Annual Meeting

A report on each trial was given by planting coordinators. Current status of seven existing or recently terminated plantings and four future plantings were shared with the group. Sites for future meetings were confirmed. Next year's meeting will be coordinated by Essie Fallahi and will be located in Boise, ID. The following year's meeting will be in South Carolina, organized by Greg Reighard, and in 2015 in California by Rachel Elkins. Washington State's membership was confirmed with Kate Evans as the voting member.

Accomplishments
Objective 1. To evaluate the influence of rootstocks on temperate-zone fruit tree characteristics grown under varying environments using sustainable management systems.

Apple Sub-Committee (T. Robinson, Chair). John Cline reviewed plans for a trial to be planted in 2014 and a list of cooperators committed to planting it. Terence proposed a new planting for 2016 with new genotypes from the UK, New Zealand and including some Geneva selections. Plans for an organic rootstock trial were also discussed. Manuscripts have been prepared for the 2002 trial and 2003 physiology trials.

Cherry Sub-Committee (G. Lang, Chair). 2010 sweet cherry systems trial is still in progress with 9 sites. A tart cherry trial is planned for 2015 to be coordinated by Matt Stasiak with MSU selections in 6 locations. A sweet cherry trial is planned for establishment in 2015 to be coordinated by Greg Lang with 7 other cooperators. A new trial to test training systems designed for platforms and mechanization was proposed.

Peach Sub-Committee (G. Reighard, Chair). Greg is preparing a paper on the 2009 trial. An apricot rootstock trial was proposed with four cooperators.

Pear Sub-Committee (T. Einhorn, Chair). 2013 is the anticipated date for the next planting with collaborators in NY, CA and OR. Propagation was delayed by cold temperature injury. There are plans for a future quince trial with 22 genotypes selected for hardiness. A manuscript for the 2002 trial is completed and ready for review.

Concluded projects:
2002 Pear rootstock trial has concluded and a paper ready for review.
2003 Apple Physiology study was completed with one paper published, one in press and two potential papers to be prepared.
2003 Apple rootstock trial data collection is in its final year. Data will be summarized for a paper.

Ongoing projects:
2004 Pear rootstock trial compares 3 rootstocks at 3 locations in North America.
2004 Apple dwarf and semidwarf rootstock trials in MI.
2005 Pear rootstock trial at 6 locations in North America.
2005 Cherry high tunnel systems in MI.
2006 Cherry physiology trial compares the yield and fruit size of a dwarfing cherry rootstock at 4 locations in North America.
2009 Peach rootstock and physiology trials at 13 sites.
2009 St. Jean apple rootstock trial to compare 6 rootstocks in 1 site.
2010 Apple rootstock trial.
2010 Cherry rootstock and training systems.
2011 Apple rootstock trial in VA with 10 rootstocks and 3 cultivars.

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.

Rootstocks from the California peach breeding program have been patented and released with an additional rootstock to be released at a future date. Quince selections in OR are being screened as potential size-controlling pear rootstocks. Pyrus germplasm was established in a collection in WA to evaluate for size control, disease resistance and biotic tolerance of pear trees. Germplasm will also be used for future pear breeding.

Efforts to transform Gisela cherry rootstocks with genetic resistance to Prunus necrotic ringspot virus were successful. Field testing of elite cherry genotypes continued in WA and MI.

Tissue culture propagation has enhanced rooting of Geneva apple rootstocks and increased the number of stock plants. Efficient methods for existing pear, cherry and apple rootstock micropropagation have been developed in WA for rapid multiplication of new rootstocks.

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

In WA, genomics and transcriptomics approaches are being tested to understand rootstock/scion interactions to ensure the compatibility of new rootstocks.

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

Biotic stresses. Apple rootstock tolerance to replant disease continues in NY to categorize 36 genotypes as resistant, intermediate or susceptible. The 2006 apple replant trial continued in some sites. A 2006 apple fumigation trial in NJ and MA continued. A 2009 peach replant study continued in NC. Russian and Geneva apple rootstocks were evaluated for fireblight tolerance in NY. In VA, 10 rootstocks showed differing susceptibility when inoculated with fireblight bacteria.

Abiotic stresses. Evaluation of peach rootstock tolerance to soil alkalinity continued in Utah. Apple rootstock tolerance to soil pH is also being evaluated in NY. Cold hardiness evaluation of new apple rootstocks continues in ME with 3 Vineland and 12 Geneva genotypes. Cold hardiness of quince selections for pear continued in OR. In MO, a study to determine the relationship of blackheart and tree performance continued. Few rootstocks differences in peach bud survival occurred in the 2009 rootstock trial in SC, MO and UT despite warm winter temperatures.

Impacts

The NC-140 plantings are regularly used as demonstration plots of new rootstock for growers, nurserymen, visiting scientists, and graduate students. The NC-140 comparative plantings have helped speed the testing and commercialization of the disease resistant stocks CG rootstocks. Rootstock trials on grower's farms have yielded invaluable information on adaptability that was not known from experiment station trials. Apple and peach rootstocks with tolerance to replant disease are being identified to improve survival and productivity without the use of fumigants. Apple and pear (quince) rootstocks with superior cold temperature tolerance are being identified to improve survival and productivity. Results from NC-140 research continue to direct the commercialization of tree fruit rootstocks. High density apple, pear and sweet cherry orchards that employ several dwarfing rootstocks have stimulated growers to expand commercial acreage.

Over the last 15 years, there has been a large change in rootstock use in the United States and Canada. Changes in rootstock use were documented in Indiana. Previously, approximately 80% of apple orchards in the state were planted on more vigorous rootstocks. In plantings made in the last 15 years, use of the preferred dwarfing rootstock has increased 660%. The use of this rootstock can increase crop value by more than $12,000 per acre. On a state-wide basis, this is an increase of $8.8 m per year.

Publications

Collaborative research under this group led to 17 refereed research publications, 38 nonrefereed publications, and numerous Extension presentations that reached fruit growers throughout North America. Seven articles in trade journals highlighted the impact of rootstock research on tree fruit production.

Autio, W., T.L. Robinson, J. Cline, R.M. Crassweller, C.G. Embree, E. Hoover, G. Lang, J. Masabni, M.L. Parker, R. Perry, G.L. 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.L. Robinson, T. Bradshaw, J. Cline, R.M. Crassweller, C.G. Embree, E. Hoover, G. Lang, J. Masabni, M.L. Parker, R. Perry, G.L. Reighard, J. Schupp, 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.L. Robinson, W. Cowgill, C. Hampson, M. Kushad, G. Lang, J. Masabni, D.D. Miller, R.A. Parra Quezada, R. Perry, 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.

Autio, W.R., T.L. Robinson, B. Black, T. Bradshaw, J.A. Cline, R.M. Crassweller, C.G. Embree, E.E. Hoover, S.A. Hoying, K.A. Iungerman, R.S. Johnson, G. Lang, M.L. Parker, R.L. Perry, G.L. Reighard, J.R. 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. Pom. Soc. 5(2):2-20.

Autio, W.R., T.L. Robinson, B. Black, T. Bradshaw, J.A. Cline, R.M. Crassweller, C.G. Embree, E.E. Hoover, S.A. Hoying, K.A. Iungerman, R.S. Johnson, G. Lang, M.L. Parker, R.L. Perry, G.L. Reighard, M. Stasiak, M. Warmund, and D. Wolfe. 2011. Performance of 'Fuji' and 'McIntosh' apple trees after 10 years as affected by several semidwarf rootstocks in the 1999 NC-140 apple rootstock trial. J. Amer. Pom. Soc. 5(2):21-38.

Elkins, R., R. Bell, and T. Einhorn. 2012. Needs assessment for future US pear rootstock research directives based on the current state of pear production and rootstock research. Journal of the American Pomological Society 66(3):153-163.

Elkins, R.B., S. Castagnoli, C. Embree, R. Parra-Quezada, T.L. Robinson, T.J. Smith and C.A. Ingels. 2011. Evaluation of potential rootstocks to improve pear tree precocity and productivity. Acta Hort. 909 (1): 183-194.

Hampson, C. R. 2012. The performance of four Vineland apple rootstocks in British Columbia, Canada. J. Amer. Pomol. Soc. 66(1):23-27.

Hampson, C.R., P. Randall and P. Sholberg. 2012. Tolerance of Vineland apple rootstocks to waterlogging and Phytophthora infestation. Can. J. Plant Sci. 92(2):267-269.

Hoover, E.E., R.P. Marini, E. Tepe, W.R. Autio, A.R. Biggs, J.M. Clements, R.M. Crassweller, D.Foster, M.Foster, D. Doud Miller, M.L. Parker, G.M. Peck, J. Racsko, T.L. Robinson, M.R. Warmund. 2012. eApples: A case study in using eXtension to increase access to research-based information. HortTechnology 22:576-579.

Lang, G., T. Valentino, H. Demirsoy, and L. Demirsoy. 2011. High tunnel sweet cherry studies: innovative integration of precision canopies, precocious rootstocks, and environmental physiology. Acta Hort. 903:717-723.

Lang, G., T. Valentino, 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. 903:93-971.

Marini, R.P., Autio, W.R., Black, B., Cline, J.A., Crassweller, R., Domoto, P., Hampson, C., Moran, R., Quezada, R.A., Robinson, T., Stasiak, M. and Wolfe, D. 2012. The

influence of crop density on annual trunk growth of 'Golden Delicious' apple trees on three rootstocks at 11 locations. J. Amer. Pomol. Soc. 66(4):183-195.
Marini, R.P., W.R. Autio, B. Black, J.A. Cline, W. Cowgill Jr., R. Crassweller, P. Domoto, C. Hampson, R. Moran, R.A Parra-Quezada, T. Robinson, M. Stasiak, D.L. Ward, D. Wolfe. 2012. Summary of the NC-140 apple physiology trial: The relationship between 'Golden Delicious' fruit weight and crop density at 12 locations as influenced by tree dwarfing rootstocks. Journal of the American Pomological Society 66:78-90.
Olmstead, J.S., M.D. Whiting, D. Ophardt, N.C. Oraguzie, and G.A. Lang. 2011. 'PC7064-3' (Selah™) sweet cherry. HortSci. 46:123-124.
Ouzounis, T. and G.A. Lang. 2011. Foliar applications of urea affect nitrogen reserves and cold acclimation of sweet cherries (Prunus avium L.) on dwarfing rootstocks. HortScience 46:1015-1021.
Robinson, T.L., Lakso, A.N. and Hoying, S.A. 2012. Advances in predicting chemical thinner response of apple using a Malusim carbon balance model. Acta Hort. 932:223-229.

Other Publications (Abstracts, Fact Sheets, newsletters, reports)

Bell, R. L., R. B. Elkins, and T. Einhorn. 2012. Current state of pear rootstock research progress and priorities (abstract). HortScience 47(9) Supplement: S100.
Domoto, P. and L. Schroeder. 2012. Performance of Gibson Golden Delicious on dwarfing rootstocks. Ann. Prog. Rept. – 2011 for Hort. Res. Sta., ISRF11-36:46-47. http://www.ag.iastate.edu/farms/11reports/Horticulture/PerformanceGibsonGolden.pdf
Domoto, P. and L. Schroeder. 2012. Second year performance of Honeycrisp on 31 dwarfing rootstocks in the Iowa planting of the NC-140 2010 regional rootstock trial. Ann. Prog. Rept. – 2011 for Hort. Res. Sta., ISRF11-36:44-45. http://www.ag.iastate.edu/farms/11reports/Horticulture/SecondYearHoneycrisp.pdf
Elkins, R. 2011. Evaluation of potential new size controlling rootstocks for European pear. 2011 California Pear Research Report, California Pear Advisory Board, Sacramento, California, p. 104-113.
Fazio, G., D. Kviklys, M. Grusak and T.L. Robinson. 2012. Elucidating the Genetics of Absorption and Translocation of Macro- and Micronutrients by Apple Rootstocks in the Context of Breeding Populations. HortScience 47(9):S101 (Abstr.)
Fazio, G., D. Kviklys, M.A. Grusak and T. Robinson. 2012. Soil pH, soil type and replant disease affect growth and nutrient absorption of apple rootstocks. NY Fruit Quarterly 20(1):22-28.
Huffman, L., M. Miranda-Saso, and T.L. Robinson. 2012. Is fall planting for apples a good idea? Lake Ontario Fruit Newsletter 2012(20):2-3.
Lang, G. 2012. Integrating new technologies, germplasm, and physiology into innovative strategies for producing high quality sweet cherries. OPGMA Today (Summer issue).
Lang, G., E. Hanson, and B. Gluck. 2012. Organic production of cherries and raspberries in high tunnels. Organic Broadcaster 20(5):7, 14.

Lang, G.A. 2011. Producing first-class sweet cherries: integrating new technologies, germplasm, and physiology into innovative orchard management strategies. Proc. 3rd Serbian Conference "Innovations in Fruit Growing: Modern Production of Sweet and Sour Cherry" pp. 59-74.
Lang, G.A. 2011. Strategie di conduzione per l'alta qualità. Rivista di Frutticoltura October (10) Suppl.:16-17.
Lang, G.A. 2012. Strategie e techniche innovative per produzioni di alta qualità. Rivista di Frutticoltura April (4):24-28.
Lang. 2011. Proizvodne prakse za stone trešnje sadašnjost I budućnost proizvodnje za izvoz. USAID Serbia Agrobiznis Projekat, 31 pp.
Miranda-Sazo, M. and T. Robinson. 2012. Strategies to control vegetative growth. Lake Ontario Fruit Newsletter 2012(4):1-2.
Miranda-Sazo, M. and T.L. Robinson. 2012. 2012 Studies using Retain and NAA for pre-harvest drop control of Linda Mac and Honeycrisp in New York State. Proceedings Great Lakes Fruit Workers Annual Meeting 2012:20-21 (Abstr.)
Miranda-Sazo, M. and T.L. Robinson. 2012. Working Efficiently in Apple Orchards. Proceedings Great Lakes Fruit Workers Annual Meeting 2012:44 (Abstr.)
Miranda-Sazo, M. and T.L. Robinson. 2012. Assessment of Bud Damage and Bloom Prediction Lake Ontario Fruit Newsletter 2012(6):1-2.
Miranda-Sazo, M. and T.L. Robinson. 2012. Branch management is critical for moderate and highly vigorous apple trees. Lake Ontario Fruit Newsletter 2012(15):2-3.
Miranda-Sazo, M. and T.L. Robinson. 2012. Current Apple Bloom Prediction (April 9, 2012). Lake Ontario Fruit Newsletter 2012(7):1-2.
Miranda-Sazo, M. and T.L. Robinson. 2012. Strong leader growth is critical when growing a weak apple cultivar in years 1-3. Lake Ontario Fruit Newsletter 2012(14):6-7.
Miranda-Sazo, M. and T.L. Robinson. 2012. The Horticultural Benefits of an Early Start. Lake Ontario Fruit Newsletter 2012(4):6-7.
Miranda-Sazo, M. and T.L. Robinson. 2012. The Orchard Planted Today Will Be Your Orchard in 2027. Lake Ontario Fruit Newsletter 2012(5):5-6.
Robinson, T, B. Bujdoso and B. Reginato. 2012. Using Pruning to Improve the Fruit Size of 'Sweetheart', 'Lapins' and 'Hedelfingen' Sweet Cherry Grown on Gisela Rootstocks. NY Fruit Quarterly 20(3):12-16.
Robinson, T. and K. Iungerman. 2012. Thinning Heavy Blooming Honeycrisp in 2012. Northern NY Fruit Newsletter 2012(1): 1.
Robinson, T., M. Miranda-Sazo, and C. Kahlke. 2012. The Use of Retain and NAA for Commercial Drop Control of Apples. Lake Ontario Fruit Newsletter 2012(17):2-3.
Robinson, T.L. 2012. Congrés IFTA – Chili/Argneine/Brésil. Zoom Abre Fruitier. Edition 2012:26-29.
Robinson, T.L. 2012. IFTA Conference – Chile/Argentina/Brazil. AGYours- Tree Fruit. 2012 Edition :24-27.
Robinson, T.L. 2012. The Physiology of Trees during Dormancy. Lake Ontario Fruit Newsletter 2012(3):2-3.
Robinson, T.L. and A.N. Lakso. 2012. Precision Thinning and Precision Irrigation. Proceedings Great Lakes Fruit Workers Annual Meeting 2012:40 (Abstr.)

Robinson, T.L. and M. Miranda-Sazo. 2012. Forecasting Apple Bloom in the Spring of 2012 Lake Ontario Fruit Newsletter 2012(5):1-2.
Robinson, T.L. and M. Miranda-Sazo. 2012. Irrigation: An Increasingly Essential Practice for New Tall Spindle Plantings. Lake Ontario Fruit Newsletter 2012(8):1-2.
Robinson, T.L. and M. Miranda-Sazo. 2012. Western NY Crop Situation as of May 15th, 2012. Lake Ontario Fruit Newsletter 2012(12):5-8.
Robinson, T.L. M. Fargione and M. Miranda-Sazo. 2012. The Benefits of Boron and Zinc to Overcome the Effects of Early Spring Frosts. Lake Ontario Fruit Newsletter 2012(7):5.
Robinson, T.L., S.A. Hoying, M. Miranda and K. Iungerman. 2012. AVG Combined with NAA Control Preharvest Drop of 'McIntosh' Apples Better than Either Chemical Alone. HortScience 47(9):S164 (Abstr.)
Rothwell, N. and G. Lang. 2012. Fall foliar nitrogen applications should be applied now. MSUE News (also NW FruitNet), September.
Ward, W.P. Cowgill Jr., J.L. Frecon, G.C. Hamilton, J.R. Heckman, L.S. Katz, N. Lalancette, B.A. Majek, D. Polk. 2012. "New Jersey Commercial Tree Fruit Production Guide." Rutgers Cooperative Extension Bulletin E002 total pages (229). New Jersey Plant and Pest Fruit Newsletter, 309 articles written. http://njaes.rutgers.edu/pubs/plantandpestadvisory/
Wolfe, D., D. Archbold, J. Johnston, and G. Travis. 2011. Rootstock effects on apple and peach growth and yield. 2011 Fruit and Vegetable Crops Research Report. University of Kentucky College of Agriculture, Agricultural Experiment Station publication. PR-626:11-14. http://www.ca.uky.edu/agc/pubs/pr/pr626/pr626.pdf
Wolfe, Dwight. 2012. Apple Tree Training. Kentucky Fruit Facts (3/2012):3. http://www.ca.uky.edu/fruitfacts/ffMar12.pdf

Articles in Trade Journals

Lehnert, R. 2011. Resistant Rootstocks Key to Surviving Fireblight. Good Fruit Grower Feb. 11, 2011.
Lehnert, R. 2012. Choosing a Peach Rootstock. Good Fruit Grower, July 2012.
Moser, M. 2012. Geneva Rootstocks are Exciting, Frustrating. Fruit Grower News, November 2012, p. 54.
Rothwell, N. 2011. MSU Studying High-Density Tart Cherries. Fruit Grower News, Nov. 2011.
Sigler, D. Achieve the Right Ratio of Wood and Buds in Cherry. Fruit Grower News, May 2012.
Sigler, D. Apples: How to Know What to Plant. Fruit Grower News, April 2012.
Warner, G. 2012. Cherry Tours Highlight Innovations. Good Fruit Grower website, 2012. http://www.goodfruit.com/Good-Fruit-Grower/Web-2012/Cherry-tours-highlight-innovations/.

PRESENTATIONS / FIELD DAYS

Domoto. Jan. 27, Iowa Fruit and Vegetable Growers Conference, Ankeny, IA, 150 attendees

Domoto. 2011 Performance of 'Gibson Golden Delicious' on 23 rootstocks in the Iowa planting of NC-140 2003 apple rootstock trial, Second year performance of 'Honeycrisp' on 31 dwarfing rootstocks in the Iowa planting of the NC-140 2010 regional apple rootstock trial. July 23, Fruit and Vegetable Field Day, ISU Horticulture Research Station, Ames, IA, 90 attendees

Coneva. Peach Rootstock Cultivar Evaluations, Regional Bulletin. 2012. http://www.aaes.auburn.edu/comm/pubs/pubsbytype/rebull2125.php

Coneva. Peach Rootstock Trial in Alabama. Poster presentation at the Annual Meeting of the Alabama Fruit and Vegetable Growers Association, Auburn, AL, February 10-11, 2012.

Coneva. Peach Rootstock Trial Demonstration. 2012 Home and Wildlife Expo, Chilton REC, AL, August 4, 2012. (Attendance 750+).

Bell, R. and R. Elkins. Current state of pear rootstock research: progress and priorities. American Society for Horticultural Science Pomology Working Group Workshop, Rootstocks: Challenges and Progress, August 2, 2012, Miami, Florida.

Elkins, R. Evaluation of potential new size controlling rootstocks for European pear (two presentations). 2012 Sacramento River District Pear Research Meeting, February 2, 2012, Walnut Grove, California and 2012 North Coast Pear Research Meeting, February 16, 2012, Lakeport, California.

Elkins, R. Spring Irrigation and Field Meeting. May 20, 2012, Talmage, Mendocino County, California.

Fallahi. Idaho State Horticultural Society Summer Tour, July 18, 2012 (110 attended)

Fallahi. Idaho and Washington Fruit Growers March Field Day , March 14, 2012 (65 attended)

Fallahi. University of Idaho Pomology Program Fruit Field Day, September 14, 2012 (900 attended)

Cowgill. North Jersey Fruit Meeting, March 2012; Broadway, NJ, 62 attendees, growers

Cowgill. North Jersey Twilight Fruit Meeting, April, 11; Rutgers Snyder Farm, Pittstown, NJ 44 attendees, growers

Cowgill. North Jersey Twilight Fruit Meeting, May 3; Phillips Farm, Milford, NJ 66 attendees, growers

Cowgill. North Jersey Twilight Horticultural Research Meeting, Rutgers Snyder Farm, September, 2012; sponsored by RCE and NJ NOFA – 48 growers participating

Coneva. NC-140 2009 Peach Rootstock Trial. Chilton County Regional Peach Production Meeting, February 2, 2012, Clanton, AL. (Attendance 89).

Coneva. Peach rootstock evaluations in Alabama. Poster presentation at the SR ASHS Annual Meeting, Birmingham, AL, February 3-5, 2012.

Strang. Jan. 5, 2012, Apple Rootstocks. Kentucky Fruit and Vegetable Growers Conference, Lexington, KY, attendance 50.