

Multistate Research Activity Accomplishments Report

Project Number: NC-140
Project Title: Rootstock and Interstem Effects on Pome- and Stone-fruit Trees
Period Covered: October 1, 2002- September 30, 2003
Date of This Report: December 1, 2003
Annual Meeting Dates: November 10-11, 2003

Participants: Please see annual meeting minutes, available on the NC-140 web-site: <http://www.nc140.org/annualmeeting.html>. The address of the listserve for participants is nc140@virtualorchard.net.

Summary of Minutes: Please see annual meeting minutes, available on the NC-140 web-site: <http://www.nc140.org/annualmeeting.html>.

Accomplishments and Impacts:

Objective 1: Evaluate the performance of pome-and stone-fruit rootstocks in various environments under different management regimes.

To evaluate the performance of rootstock material in different climatic and edaphic environments, replicated, uniform trials were planned, conducted, and coordinated by NC-140 see <http://www.nc140.org/> for more details on planting design, rootstocks included and locations). In 2003, three trials were completed and manuscripts are in preparation, nine trials are underway and three trials are in various stages of planning. Several local and regional (AR, CA, IA, ME, MA, MI, MN, NB, NJ, NY, NS, OR, PA, WA, and WI) trials also were underway, but only uniform NC-140 trials will be the focus of this report.

1992-1993 Liberty/CG Rootstock (coordinated by Terence Robinson, NY). The 1992 planting was terminated in 2000 and the 1993 planting the following 2001 season. A final version of the manuscript for the 5-year summary was shared with the cooperators and will be submitted for publication in 2004.

1994 Gala Dwarf Apple (coordinated by R. Marini, VA). Through the 9th growing season and across all sites trees on m.0 Pajam 1, M.9 Pajam 2, B.9, and V.1 have greater than 90% survival; whereas, those on Mark, M.9 EMLA, P.16, and O.3 have less than 85% survival. M.26 EMLA, V.1, M.9 RN29, and M.9 Pajam2 resulted in the largest trees, and M.27 EMLA, B.491, P.16, and P.22 resulted in the smallest trees. M.9 clones were ranked from least dwarfing to most dwarfing: Pajam 2 > RN29 > Pajam 1 > EMLA > NAKBT337 > Fleuren 56. Trees with the greatest yield efficiency were on B.491, P.16, and O.3, while M.26 EMLA, M.27 EMLA, V.1, and Mark had the lowest yield efficiencies. M.9 strains resulted in the largest fruit size overall. At the 11 sites that have Fleuren 5, it tends to be the smallest clone. NAKBT 337 is also small.

1994 Semi-dwarf Apple (coordinated by R. Marini, VA). At the end of 9 growing seasons data suggest poor survival of 'Gala' trees on Geneva™ 30 based on breakage at the graft union. But generally survival has been good throughout the trial. Trees on Geneva™ 30 were the most yield efficient while trees on P.1 were the least. Alternate bearing has been reported to be a problem at some sites.

1998 Sweet Cherry Rootstock (coordinated by F. Kappel, BC). After 5 growing seasons, trees on Gisela 6 and Giessen 318-17 are largest. Bing as the scion has performed poorly in sites of Western cooperators.

1998 Tart Cherry Rootstock (coordinated by F. Kappel, BC). After 5 growing seasons Gisela 6 and Mahaleb had higher yield efficiencies than Weiroot 10 and 13. They also suckered 6-fold less than the Weiroot rootstocks. Mahaleb has been lost to *Phytophthora* in some trials.

1998 Gala/Jonagold Apple G.16 Rootstock (coordinated by T. Robinson, NY). Mid-trial results of this trial suggest that CG.3401 has higher yield efficiencies than other rootstocks planted under Jonagold fruit the best fruit size is achieved when using M.9, while CG.3041 and G.16 produced the smallest fruit. With Gala G.16T was significantly larger than M.9 and B.9 but not larger than M.9EMLA. Yield efficiency was greatest for M.9 followed by G.16T, M.9EMLA, B.9 and M.26.

1999 Dwarf and Semidwarf Fuji/McIntosh Apple (coordinated by W. Autio, MA). Currently, the full dwarfing rootstocks that are performing the best are G.16 N, G.16 T, Supporter 1-3, and M.9 NAKBT337. They are similarly yield efficient. With Fuji, they resulted in similar fruit weight, but the two clones of G.16 produced a somewhat larger tree than the Supporter series or M.9. With MacIntosh, tree size was similar, but M.9 NAKBT337 resulted in larger fruit than the others.

2001 Redtop/Redhaven Peach Rootstock (coordinated by G. Reighard, SC). SC-17, Lovell, and Cadaman were more vigorous than Lovell at a few sites. The largest trees were those in California, Georgia, Maryland, and South Carolina. Jaspri, K146-43, K146-44, and VVA-1 were generally the least vigorous, with trunk circumferences about 35% less than those of Lovell. Overall, survival was lowest with Pumiselect and VVA-1. No rootstock had a significantly higher survival rate than Lovell at any location except Georgia and Colorado. Only Cadaman has a 100% survival rate after 2 years. Suckering was minimal among all rootstocks at most locations. No rootstock yielded significantly more than Lovell as of the 2002 harvest season. BH-4 and Hiawatha had the highest yields. BH-4, SLAP, and P30-135 produced the largest fruit.

2002 Cresthaven/Redhaven Peach Rootstock (coordinated by G. Reighard, SC). Orchards are in the first years of establishment and a group report is due in 2004.

2002 Cresthaven Peach Physiology (coordinated by S. Johnson, CA). Orchards are in the first years of establishment and a group report is due in 2004.

2002 Cresthaven Peach Physiology (coordinated by S. Johnson, CA). Orchards are in the first years of establishment and a group report is due in 2004.

2002 Apple (coordinated by W. Autio, MA). Orchards are in the first years of establishment and a group report is due in 2004.

2003 Golden Delicious Physiology (coordinated by R. Marini, VA). Orchards are in the first years of establishment and a group report is due in 2005.

2003 Dwarf Apple Rootstock (coordinated by R. Marini, VA). Orchards are in the first years of establishment and a group report is due in 2005.

Objective 2: To assess and improve asexual techniques of pome and stone fruit rootstocks.

1999 Dwarf and Semidwarf Fuji/McIntosh Apple (coordinated by W. Autio, MA). Two states are working on techniques for the improved propagation of apple (NY) and pear (OR) rootstocks.

Objective 3: To improve the ability to identify pome and stone fruit rootstocks through morphological, biochemical and genetic differences.

1999 Dwarf and Semidwarf Fuji/McIntosh Apple (coordinated by W. Autio, MA). Efforts are continuing to confirm the identity of Cornell-Geneva series rootstocks around the world through molecular methods (NY).

Objective 4: To develop new and better pome and stone fruit rootstocks through breeding and genetic engineering.

Programs are underway in AR, CA, NY, OH and Ontario.

-An ongoing breeding program in Arkansas is testing twelve new apple and 44 new peach rootstock selections.

-At Cornell, four new CG apple rootstocks are being released over the next two years, with the collection of new rootstocks from programs worldwide. In 1999, 16 rootstocks from three European breeding programs were established for testing.

-Testing of five Moiooka series rootstock clones is underway in Ohio.

-The Vineland series of apple rootstocks together with several standard rootstocks are under evaluation for fire blight resistance in Ontario, Canada. The results indicate that wide differences in rootstock susceptibility exist.

Objective 4: To determine biotic and abiotic stress tolerance of pome and stone fruit trees in relation to new and existing rootstocks.

Programs are underway in New Brunswick, NY, Ontario and UT.

-The CG apple rootstocks are being screened for cold hardiness in New Brunswick, Canada.

-The CG rootstocks, as well as many other rootstocks collected worldwide, are being screened for tolerance to biotic and abiotic factors such as replant disease, late winter cold temperatures, Phytophthora root rots and fire blight. Three-year-old Gala trees on various rootstocks were inoculated with fireblight in 1999. The CG rootstocks have outsurvived the standards.

-The Ontario studies are continuing the evaluation of fireblight sensitivity and cold hardiness of the Vineland series of apple rootstocks compared to several known standard rootstocks.

-In Utah, field studies were conducted to evaluate fireblight sensitivity and bud union breakage under high winds of Gala apples on different rootstocks. Experiments on cherry bud cold hardiness in the fall have shown that Colt rootstock are 2 to 4°C less hardy than buds on trees growing on GM.61.1, MXM.2, Mahaleb, Mazzard and Gi.148.1.

USEFULNESS OF FINDING AND IMPACT OF COOPERATIVE RESEARCH PROJECTS

The conduct of uniform trials across all regions in North America continue to suggest crescent rootstocks without bias. Nearly all states indicate the importance of the results from these trials as the primary source of information for recommendations made by research and extension personnel. Fireblight, a major limiting factor for apple rootstock selection, is being assessed in several locations for sensitivity and to reduce tree losses to the disease. State surveys of trees planted in recent years show a shift to tree on dwarfing and semi-dwarfing rootstocks. The pome and stone fruit industries recognize the importance of unbiased information from broad uniform trials and more than \$1,000,000 is given to support these trials and related rootstocks projects.

WORK PLANNED FOR NEXT YEAR

Existing trials will be maintained following the protocols developed by the respective technical committees. Current (and supplemental) data will continue to be collected and summarized by the planting coordinators, who will prepare the five- and ten- year reports for publication. Individual state project leaders will, wherever possible, expand the data collection on a particular planting beyond the uniform data set so as to gain further information on rootstock performance, or how the rootstocks respond to training and local conditions. As new rootstocks become available for testing, plantings will be planned for (3 to 5 years prior to establishment) and established. The following trials are in the planning stage.

2005 Cherry (coordinated by F. Kappel, BC). Planned for planting in 2005.

PUBLICATIONS

Website

<http://www.NC140.org>

E-mail distribution list

Maintained by W. Cowgill (NJ) and J. Clements (UMASS). nc140@virtualorchard.net

Journal Articles

Al-Hinai, Y.K. and T.R. Roper. 2004. Rootstock effects on growth, cell number, and cell size of 'Gala' apples. *J. Amer. Soc. Hort. Sci.* 129:(in press).

Al-Hinai, Y.K., and T.R. Roper. 2004. Rootstock effects on growth and quality of 'Gala' apple fruit. *Hortscience* (in review).

Autio, W.R., J.R. Schupp, C.G. Embree, and R.E. Moran. 2003. Early performance of 'Cortland', 'Macoun', 'McIntosh', and 'Pioneer Mac' apple trees on various rootstocks in Maine, Massachusetts, and Nova Scotia. *J. Amer. Pomological Soc.* 57:7-14.

Ayala, M. and G. Lang. 2003. Examining the influence of different leaf populations on sweet cherry fruit quality. *Acta Horticulturae* (in press).

Beckman T.G. and G.A. Lang. 2003. Rootstock breeding for stone fruits. *Acta Horticulturae* (in press).

Ferree D.C., J.G. Streeter, and Y. Yuncong. 2003. Response of container grown apple trees to soil compaction. *Hortscience* (in press).

Hampson, C., H.A. Quamme, F. Kappel, and R.T. Brownlee. 2003. Varying density with constant rectangularity. 1. Effects on apple tree growth and light interception in three training systems over ten years. *Hortscience* (in press).

Hampson, C., H.A. Quamme, F. Kappel, and R.T. Brownlee. 2003. Varying density with constant rectangularity. 1. Effects on apple tree yield, fruit size, and fruit color development in three training systems over ten years. *Hortscience* (in press).

Marini R.P., J.A. Barden, J.A. Cline, R.L. Perry, and T. Robinson. 2002. Effect of apple rootstocks on average 'Gala' fruit weight at four locations after adjusting for crop load. *J. Amer. Soc. Hort. Sci.* 127:749-753.

Marini R.P., M.L. Parker, J.A. Barden, and C.R. Unrath. 2003. The effect of eight dwarf rootstocks on burrknot development on 'Gala' apple trees at two locations. *J. Amer. Pomol. Soc.* 57:93-96.

Mielke, E.A. and L. Smith. 2003. Pear cultivars as interstems – the initial five years. Do they have anything to offer? *J. Amer. Pomol. Soc.* 57:76-88.

Olmstead, M.A., N.S. Lang, G. Lang, F. Ewers, and S. Owens. 2003. characterization of graft union development in sweet cherries (*Prunus avium* L.) on dwarfing rootstocks. *Acta Horticulturae* (in press).

Robinson, T.L. 2003. Rootstocks and production systems for success. 2002. Nova Scotia Fruit Growers' Assoc., 2002 Annual Rpt. P.31-45.

Robinson, T.L., H.S. Andersen, and S.A. Hoying. 2003. Performance of Gisela cherry rootstocks in the Northeastern United States. *Acta Horticulturae* 662:513-520.

Robinson, T., L. Anderson, A. Azarenko, B. Barritt, T. Baugher, G. Brown, G. Couvillon, W. Cowgill, Jr., R. Crassweller, P. Domoto, C. Embree, A. Fennell, E. Garcia, A. Gaus, R. Granger, G. Greene, P. Hirst, E. Hoover, S. Johnson, M. Kushad, R. Moran, C. Mullins, S. Myers, R. Perry, C. Rom, J. Schupp, K. Taylor, M. Warmund, J. Warner, and D. Wolfe. 2003. Performance of Cornell-Geneva apple rootstocks with 'Liberty' as the scion in NC-140 trials across North America. *Acta Horticulturae* 662:521-530.

Robinson, T., L. Anderson, A. Azarenko, B. Barritt, G. Brown, J. Cline, R. Crassweller, P. Domoto, C. Embree, A. Fennell, D. Ferree, E. Garcia, A. Gaus, G. Greene, C. Hampson, P. Hirst, E. Hoover, S. Johnson, M. Kushad, R. Marini, R. Moran, C. Mullins, M. Parker, R. Perry, J.P. Privé, G. Reighard, C. Rom, T. Roper, J. Schupp, and M. Warmund. 2003. Performance of Cornell-Geneva rootstocks in the multi-location NC-140 rootstock trials across North America. *Acta Horticulturae* (in press).

Schupp J., W.P. Cowgill, Jr., T.R. Robinson, J. Compton. 2003. Water conditioners and surfactants increase growth control and fruit cracking of 'Empire' apple caused by prohexadione-calcium. *Hortscience*. 38(6):1205-1209

Walsh, C.S., S. A. Altman, L.A. Doyle, J. Hu, K.W. Hunt, and D. Lai. 2003. Fruit maturation, tree ripening, and cracking susceptibility in 'Gala' apples. (submitted to *Hort Technology*).

Trade Publications

Cowgill, W.P. Jr., J. Compton, M. Maletta, R. Belding, J. Goffreda, D. Polk, W. Tietjen. 2002. NE183 apple cultivar trials-New Jersey 2001 Report. *Horticultural News* 82(4).

Greene II, G.M. 2003. Influence of rootstocks on the growth, productivity, and longevity of apple trees. *Penn Fruit News* 83(2): 24-25, 28-30.

Proceedings

Azarenko, A., R. Anderson, G. Brown, C. Embree, D. Ferree, A. Gaus, D. Hunter, F. Kapel, D. Ketchie, E. Mielke, R. Renquist, and D. Sugar. 2002. Final evaluation of the NC-140 pear rootstock trial. In: L. Corelli-Grabadelli, J. Janick, S. Sansavini, M. Tagliavini, D. Sugar, and A. D. Webster (eds.). *Proc. 8th Intl. Sym. on Pear*, *Acta Hort.* 596:319-323.

Kushad, M.M. 2003. Rootstock selection for Illinois apple orchards. *Transactions of the Illinois Horticultural Society*. pp. 87-88.

Kushad, M.M. 2003. Performance of 'Red Gala' in the 1994 NC-140 dwarf and semi-dwarf apple rootstocks trial in Champaign, Illinois. Transactions of the Illinois Horticultural Society. pp. 89-95.

Kushad, M.M. 2003. Postharvest handling of small fruits for the fresh market. Proceedings of the Illinois Small Fruit and Strawberry School. pp. 57-62.

Mielke, E.A. and J. Turner. 2003. Evaluation of pear interstems. In: L. Corelli-Grabadelli, J. Janick, S. Sansavini, M. Tagliavini, D. Sugar, and A.D. Webster (eds.). Proc. 8th Intl. Sym. on Pear, Acta Hort. 596:401-404.

Privé, J-P. 2003. Apple rootstock research. Proceedings from the NB apple grower meetings. Fredricton, N.B.

Robinson, T.L. 2003. Achieving a balance between vegetative growth and cropping. P. 6.1-6.32. Proc. of Orchard Systems Workshop. Int. Dwarf Fruit Tree Assoc. Geneva, NY.

Poster

Autio W., R. Crassweller, and J-P. Privé. 2003. Rootstock affects performance of 'Ginger Gold' apple trees. 100th Annual meeting of the American Society for Horticultural Science. Providence, R.I.

Book Chapters

Ferree, D.C. 2003. Light interception and photosynthesis. pp.157-165. In: Encyclopedia of Temperate Tree Fruit. Food Products Press.

Ferree D.C. and J.R. Schupp. 2003. Pruning and training physiology. pp.319-344. In: Apples: Botany, Production, and Uses. D.C. Ferree and I.J. Warrington (eds.) CABI, UK.

Abstracts

Autio, W.R., J. Krupa, and J. Clements. 2003. Does rootstock differentially affect performance of 'Cortland', 'Macoun', 'McIntosh', and 'Pioneer Mac' apple trees? Hortscience 38:665.

Autio, W.R., R. Crasweller, and J.P. Privé. 2003. Rootstock affects performance of 'Ginger Gold' apple trees. Hortscience 38:667.

Crassweller, R.M. and D.E. Smith. 2003. Performance of 'Ginger Gold' apple on five semidwarf rootstocks. Hortscience 38:666.

Presentations

Autio, W.R. 2003. Current rootstock recommendations from research in Massachusetts and elsewhere. Richmond, MA. 25 attendees.

Autio, W.R. 2003. Current rootstock recommendations from research in Massachusetts and elsewhere. Stow, MA. 46 attendees.

Autio, W.R. 2003. Current rootstock recommendations from research in Massachusetts and elsewhere. Westport, MA. 33 attendees.

Cowgill, W.P., Jr. 2003. International Dwarf Fruit Tree Association Conference, Syracuse, NY. Invited speaker. "What's up down there, perspectives on tree fruit production in South America.

Domoto, P. 2003. Evaluation of new apple rootstocks in Iowa. Minnesota Apple Growers Association Annual Conference, La Crosse, WI. 150 attendees.

Domoto, P. 2003. Apple rootstock research at ISU. Iowa Fruit and Vegetable Growers Annual Conference, Marshalltown, IA. 90 attendees.

Kushad, M.M. Factors controlling fruit size and color. Southern Illinois Fruit School Centralia, Cobden and Hardin, Illinois. February 4-6, 2003. 175 attendees

Kushad, M.M. Fruit quality parameters. Illinois Specialty Growers Conference. Springfield, IL. January 22, 2003. 85 attendees

Kushad, M.M. Pre- and postharvest factors that have the greatest impact on fruit quality. Mid-America Fruit Growers Conference. Olathe, KS. January 28-30, 2003. 55 attendees.

Kushad, M.M. An apple a day can keep the doctor away, but can it increase the ringing of the register. Mid-America Fruit Growers Conference. Olathe, KS. January 28-30, 2003. 50 attendees.

Mielke, E., D. Sugar, L. Smith. 2003. Cultivars used as interstems still show promise after eight years on two Oregon locations. Wash. State Hort. Soc., Yakima, WA, Dec 2002. 1400 registrants.

Mielke, E., D. Sugar, L. Smith. 2003. Cultivars used as interstems still show promise after eight years on two Oregon locations. Northwest Pear Research Review, Hood River, OR, Feb. 2003. 85 attendees.

Extension Publications

Belding, R.D., W.P. Cowgill, Jr., J.L. Frecon, G.C. Hamilton, J.R. Heckman, L.S. Katz, N. Lalancette, B.A. Majek, D. Polk, P.W. Shearer, W.H. Tietjen. 2003. New Jersey commercial tree fruit production guide. Rutgers Cooperative Extension Bulletin E0020, 160 total pages.

Domoto, P. 2003. Iowa planting of the 1993 NC-140 Cornell-Geneva apple rootstock trial. Annual Fruit/Vegetable Progress Report 2002. ISU Ext., FR-601:45-46.

Domoto, P. 2003. Iowa planting of the 1994 NC-140 dwarf apple rootstock trial. Annual Fruit/Vegetable Progress Report 2002. ISU Ext., FR-601:47-49.

Domoto, P. 2003. Iowa planting of the 1994 NC-140 semi-dwarf apple rootstock trial. Annual Fruit/Vegetable Progress Report 2002. ISU Ext., FR-601:50-51.

Domoto, P. and W. Roush. 2003. Assessment of winter trunk injury in the western Iowa 1992 cultivar by rootstock trial. Annual Fruit/Vegetable Progress Report 2003. ISU Ext., FG-601:62-64.

Domoto P. and W. Roush. 2003. Apple cultivar by rootstock trial. ISU Western Iowa R & D Farm, ISRF01-10:23-34.

Hampson C. 2003. Subclones of M.9 rootstock: are they any different? The Orchardist 1(1):20-24.

Hampson C. 2002. Subclones of M.9 rootstock: are they different? Fresh from the Cedar Press 15(4):20-22.

Masabni J.G, G.R. Brown, and D.E. Wolfe. 2003. Rootstock and interstem effects on pome fruit trees. 2002 Fruit and Vegetable Crops Research Report. University of Kentucky publication (PR-470:28-30).

Masabni J.G., G.R. Brown, and D.E. Wolfe. 2004. Rootstock and interstem effects on pome fruit trees. 2003 Fruit and Vegetable Crops Research Report. University of Kentucky publication (in press).

Meetings

Cowgill, W.P., Jr. North Jersey Fruit Meeting, March, 2003; Broadway, NJ, 85 attendees, growers.

Cowgill, W.P., Jr. North Jersey Twilight Fruit Meeting, April, 2003; Rutgers Snyder Farm, Pittstown, NJ, 45 attendees, growers.

Cowgill, W.P., Jr. North Jersey Horticultural Research Twilight Meeting, September, 2003; Snyder Farm, Pittstown, NJ, 75 attendees, organic and conventional growers.

Cowgill, W.P., Jr. South Jersey Field Day and Tour, August 2003; RAREC, Upper-Deerfield, NJ, 204 attendees, growers, industry, and extension personnel.

Other

Al-Hinai, Y.K. 2003. Rootstock effects on fruit growth, quality, cell number, and cell size of 'Gala' apple fruit. Ph.D. Dissertation. Univ. of Wisconsin, Madison. 82 pp.