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, 2001 – September 30, 2002
Date of This Report:	December 31, 2002
Annual Meeting Dates:	November 8-9, 2002

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 2002, two trials were complete and manuscripts are in preparation, ten trials are underway, and five trials are in various stages of planning. Several local or regional (AR, CA, IA, ME, MA, MI, MN, NB, NJ, NY, NS, OR, PA, WA, and WI) trials also were underway, but this report will focus on the uniform, NC-140 trials.

1990 Apple (coordinated by R. Marini, VA). Four locations (MI, ONT, NY, and VA) from this trial were used to conduct an analysis of covariance (with crop load as the covariate) to better understand the effects of rootstock on fruit size. After adjusting for crop load, trees on M.9 consistently produced the largest fruit. Two locations (NC and VA) also were used to study the effects of rootstock on burr knot development on the scion. It was found that P.1 and O.3 resulted in more burr knot formation than Mark or M.27.

1992/93 Apple (coordinated by T. Robinson, NY). The final results from this trial were assembled and presented at the International Horticultural Congress in 2002. They will be published in *Acta Horticulturae*, and a manuscript detailing these results has been prepared for potential publication in the *Journal of the American Pomological Society*. Cornell-Geneva (CG and Geneva™) rootstock comprised the bulk of the test material. Trees on Geneva™ 11 and CG.3029 were similar in size to those on M.9 with greater yield. Trees on Geneva™ 30 were similar in size to those on M.7, but they were much more productive. These rootstocks from the Cornell-Geneva program are resistant to two major diseases: fireblight and crown rot. The economic benefit to apple growers of these resistances is tremendous.

1994 Dwarf Apple (coordinated by R. Marini, VA). Through the eighth growing season and across all sites trees on M.9 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 Pajam 2 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, and those with the lowest were on M.26 EMLA, M.27 EMLA, V.1, and Mark. M.9 strains generally resulted in the largest fruit size.

1994 Semidwarf Apple (coordinated by R. Marini, VA). Data collected through the eighth growing season suggest poor survival of trees on Geneva™ 30 based on breakage at the graft union. Trees on Geneva™ 30 also were the most yield efficient.

1998 Cherry (coordinated by F. Kappel, BC). After the fourth growing season, trees on G6, W13, W10, and Gi 318/17 were similar in size to mazzard and mahaleb. Those on Gi 195/20, W158, G7, and G5 were 70-80% of those on mazzard and mahaleb. Trees on W154, edabriz, Gi 473/10, W72, Gi 209/1, and W53 were 45-65% of those on mazzard and mahaleb. Greatest yields were harvested from trees on G7, G6, Gi 195/20, W72, G5, Gi 473/10, and W53, and Gi 318/17, G5, G6, and Gi 195/20 resulted in the largest fruit.

1998 Apple (coordinated by T. Robinson, NY). Interim results from this trial were combined with the results from comparable trials and presented at the International Dwarf Fruit Tree Association's annual meeting in Kellowna, BC, Canada and published in *Compact Fruit Tree*. Also, they were presented at the International Society for Horticultural Science Fruit-tree Rootstock Symposium in Zaragosa, Spain and will be published in *Acta Horticulturae*. After four growing seasons, this trial has given further evidence that trees on Geneva™ 16 are similar or slightly larger than trees on M.9 and are very productive.

1999 Dwarf Apple (coordinated by W. Autio, MA). Interim results from this trial were combined with those from the 1998 Apple trial and presented and published as noted above. After three growing seasons, the largest Fuji trees were on CG.4013, and the smallest were on M.9 NAKBT337, Supporter 1, Supporter 2, and Supporter 3. The most yield efficient trees were on Supporter 3 and Supporter 1. The largest McIntosh trees were on CG.5202 and CG.4013, and the smallest were on Supporter 1 and M.9 NAKBT337. Supporter 2 and Supporter 3 resulted in the greatest yield efficiencies.

1999 Semidwarf Apple (coordinated by W. Autio, MA). Interim results from this trial were combined with those from the 1998 Apple trial and presented and published as noted above. After three growing seasons, the largest Fuji trees were on CG.4814, CG.7707, Geneva™ 30N, and M.7 EMLA, and the smallest were on M.26 EMLA. The most yield efficient trees were on CG.7707, Geneva™ 30N, and M.26 EMLA. The largest McIntosh trees were on Geneva™ 30N, Supporter 4, and M.7 EMLA, and smallest were on CG.4814 and CG.7707. Trees on CG.4814 were the most yield efficient.

2001 Peach (coordinated by G. Reighard, SC). After the first growing season, across all locations and cultivars, survival was greatest for trees on P30-135 and Bailey and least for trees on Pumiselect. Trees on BH-4, SC-17, Hiawatha, and Cadaman were the largest, and those on KI146-43 were the smallest.

2002 Apple (coordinated by W. Autio, MA). A trial including 11 states and provinces (AR, BC, Chihuahua, IL, IN, KY, MA, MI, NJ, NY, and OH) and 20 rootstocks (B.9 Europe, B.9 Treco, CG.3007, CG.3041, CG.5935, Geneva™ 11, JM.1, JM.2, JM.7, M.9 Burgmer 756, M.9 Nic 29, M.9 NAKBT337, M.26 EMLA, M.26 NAKB, PiAu 36-2, PiAu 51-4, PiAu 51-11, PiAu 56-83, P.14, and Supporter 4) was established in 2002.

2002 Pear (coordinated by G. Mielke, OR). A trial including five locations (OR, WAx3, and WV) with Bartlett and Bosc on eight rootstocks was established in 2002.

2002 Peach (coordinated by S. Johnson, CA). A trial including Redhaven at nine locations (CA, KY, MA, MD, MO, OH, PA, SC, and ONT) and Cresthaven at nine locations (Co, IL, MO, NJ, NY, TX, UT, WA, and Mexico) on eight rootstocks (Adesoto 101, MRS 2/5, Penta, VSV-1, VVA-1, Pumiselect, Cadaman, and Lovell) was established in 2002.

Future Trials. Acquisition of rootstock material, propagation, and planning occurred in 2002 regarding five upcoming trials: 2003 Apple (to be coordinated by R. Marini, VA), 2004 Pear (to be coordinated by G. Mielke, OR), 2005 Cherry (to be coordinated by F. Kappel, BC), 2005 Pear (to be coordinated by G. Mielke, OR), and 2007 Apple (to be coordinated by T. Robinson, NY).

Objective 2: Assess and improve asexual propagation techniques of pome- and stone-fruit rootstocks.

Work is underway in NY studying approaches to improve stoolbed propagation of the CG-series (CG and Geneva™) rootstocks. OR is in the midst of a long-term trial examining the effects of budding height on pear tree performance. To date, the most vigorous and yield efficient trees have resulted from a budding height of 22 cm, vs. 8 or 38 cm.

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

NY established a molecular genetics laboratory in association with its rootstock breeding program. The lab has begun the process of developing DNA fingerprints of all commercially available rootstocks and CG selections..

Objective 4: Develop new and better pome- and stone-fruit rootstocks through breeding and genetic engineering.

Rootstock breeding and selection was conducted in AR, CA, NY, and OR. Selections of the AAR (Arkansas Apple Rootstock) and the APR (Arkansas Peach Rootstock) series are presently under evaluation in AR. In CA, more than 20 superior peach rootstock selections have been identified for extensive replicated trials. In OR, 545 selections of the Horner series of pear rootstocks are under evaluation. Some dwarfing has been noted, and trees on H-10 were 50% more yield efficient than those on the control rootstock (OHxF 97). The USDA hired a new breeder to head the Cornell-Geneva apple rootstock program. New crosses were made in 2002, and extensive testing of elite selections is underway. Commercial stoolbeds of Geneva™ 11 were established. Geneva™ 202 was released in New Zealand, and CG.3041 and CG.5935 will be released soon.

Apple rootstock acquisition from other parts of the world, under the leadership of NY and OH, resulted in approximately 16 rootstocks for future NC-140 trials. Efforts to acquire new pear, peach, and cherry rootstocks are underway and led by OR, SC, and BC, respectively.

Objective 5: Determine biotic and abiotic stress tolerance of pome- and stone-fruit trees in relation to new and existing rootstocks.

Several locations have observed differing sensitivity of fireblight (caused by *Erwinia amylovora*) among apple trees on various rootstocks under evaluation in Objective 1 (KY, MN, NY, OH, UT). NY is studying the differential sensitivity of apple rootstocks to different strains of the fireblight-causing bacteria. Among CG selections, CG.3041, CG.5179, CG.7707, and Geneva™ 16 were resistant to all strains; whereas, CG.3007 and CG.6253 were resistant to two strains and susceptible to two strains. Studies are underway to attempt to understand the molecular genetics of the differential sensitivity so as to breed rootstocks with stable resistance.

Work in NY with new Russian cherry rootstocks found them to be hypersensitive to Prunus Necrotic Ringspot Virus, moderating the commercial nursery interest in their introduction.

Cold hardiness of apple rootstocks was studied in IA, MN, and NB. NB specifically studied the effects of the timing of N application, crop load, and long-term productivity on cold hardiness. NB also continued to screen the CG rootstocks for cold hardiness.

Outreach

During 2002-03, NC-140 cooperators gave approximately 50 oral and poster presentations on NC-140-related topics with more than 2,500 individuals (primarily orchardists) in attendance. Several articles were written for orchardists on NC-140 research (see appendix). The NC-140 website (http://www.nc140.org/) received over 12,000 unique 'visitors' from 61 countries during the year. Popular pages included the 'home' page, rootstock planting descriptions, and project leader contact information. Search words use to find the NC-140 website included 'rootstock(s),' 'cherry,' and 'apple.'

Grants

NC-140 funds were used to leverage approximately $100,000 in additional grant moneys in 2002-03, primarily from orchardist groups.

Work Planned for Next Year

A new NC-140 apple rootstock trial will be established in 2003. Journal articles will be in print detailing final results from the 1992/93 NC-140 Apple Rootstock Trial and the 1994 NC-140 Peach Rootstock Trial. Journal articles will be prepared and submitted as 5-year reports from the 1998 NC-140 Cherry Rootstock Trial and the 1998 NC-140 Apple Rootstock Trial. Data will be collected and analyzed for the final report of the 1994 NC-140 Dwarf Apple Rootstock Trial and the 1994 NC-140 Semidwarf Apple Rootstock Trial and for the 5-year report of the 1999 NC-140 Dwarf Apple Rootstock Trial and the 1999 NC-140 Semidwarf Apple Rootstock Trial. All trials established after 1994 will be maintained. New work to begin in 2003 under objective 1 will focus on optimization of experimental design for fruit-tree rootstock trials.

Existing work under new objectives 2, 3, and 4 (revised project 2002-07) will continue, but now efforts will be initiated to understand the relationships among crop load, rootstock, and tree physiology under objective 4.

Refereed Publications

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